Implementing Heijunka Improves Production Time Efficiency at PT Toyota

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Abstract
When businesses batch for products that have varying levels of demand, the work will typically be distributed unevenly, creating a high likelihood for overtime or idle time on the production line. These peaks and valleys in production result in an overload for workers. On the one hand when demand skyrockets, and lower productivity on the other hand when demand slumps to its lowest point. There is an unevenness in the production process, so it is necessary to apply the equality that we know as Heijunka. So heijunka means conversion to level production. The definition shows that production that is carried out on the workstation or shopfloor is production levelling or production smoothing. Consumer demand is broken down into smaller lot or batch sizes. The production schedule applied spreads production needs more evenly (demand leveling) alternately between all product items, so that production is relatively stationary (production leveling). This avoids the accumulation of products that continue to be produced for a long time, and long waiting times for other products that are not produced. Waste due to stock buildup and waiting times is prevented with heijunka. Based on the data of the results of the study using a qualitative method with interviews, significant analysis results were obtained, namely before using the heijunka method, there was a buildup in the first hour of 37 units, while in the second hour there were only 13 units. However, when using the Heijunka method, it was successfully flattened to 25 units per hour for 8 working hours, so that the total production time reached 480 minutes. With this method, equal distribution of production time is achieved so that there is no unit model that is produced by itself at the end of production, this also minimizes delays in customer demand if there are product order variables.

Keywords: Heijunka, Time Efficiency, Production Scheduling, Product Leveling, Production Efficiency

Introduction

Heijunka implements mixed scheduling with small production lot sizes. Heijunka requires a short setup time (changeover time. Reduction of setup time is very important to avoid losses due to reduced production time and setup time. Heijunka is carried out by leveling by volume (controlling the size of production lots) and leveling by product (handling alternating scheduling) of PT. Toyota as a manufacturing company has various types of products with different amounts of demand for each type of product. Therefore, in scheduling production, it requires a method that can minimize consumer waiting time, as well as maximize labor facilities, and equipment.

In other words, the Heijunka method is a production scheduling method that is suitable for companies with various product variations and production volume variations. The purpose of production scheduling is to find the shortest completion time or minimize makespan, minimize delays from predetermined deadlines (due dates), and minimize idle machines. An illustration of the principle of leveling in which the workload is leveled for continuity (tortoise consistency) without looking at the variation in the order (rabbit velocity) (Liker, 2004, Chap.10). The Toyota Production System (TPS) can only be realized if everyone becomes a sluggish and steady turtle rather than running fast and jerking like a rabbit (as in the traditional production system). Heijunka is to level production both in terms of volume and product mix. It does not create products based on the actual order of customer orders, which can go up and down sharply, but takes the total number of orders in a period and flattens them so that they are made in the same quantity and mix every day. The TPS approach from the beginning has been to maintain a small batch size and make what the customer wants.

In the actual one-piece flow, it is possible to make products A and B, according to the actual order of the customer's order (e.g. A, A, B, A, A, B, B, B, A, B.). The problem is, if we make according to the actual product order, it will make the components irregularly. So if the order on Monday is twice the order on Tuesday, what happens is to pay overtime pay on Monday and then there is unemployment on Tuesday. To level it out, take actual customer demand, determine the volume and mix patterns of its products, and create a flat schedule every day. For example, if you make five products A for every five products B, you can now create a production sequence that is flattened into ABABAB. This is called the mixed-even production model, because there is a mixing of production but also flattening customer demand into predictable sequences, which spread different types of products and different volume levels.

The superiority of Japanese philosophy is likened to a race between rabbits and turtles. Ohno makes up the story: a slow but consistent turtle results in less waste and is far more desirable than a rabbit that is fast and excels in the race and then stops because it is sometimes sleepy [2]. This is an illustration of the principle of leveling where the workload is leveled for continuity (turtle consistency) without looking at the order variation (rabbit speed). Ohno then went on to say that the Toyota Production System (TPS) can only be realized if everyone becomes a sluggish and steady turtle rather than running fast and jerking like a rabbit, as in the traditional production system. The goal of TPS is to build a lean system, it can be tried by producing goods right when the customer wants, just-in-time (JIT). However, demand is in reality very unpredictable and actual orders generally vary over time. For example, if we make products because there are orders and the number of orders is large, maybe we make products in large quantities for a period of time which causes workers and equipment to have to work hard and result in high risks. Then in the next period, the number of orders is small, then the work becomes less and the equipment becomes less. In English, heijunka has two different meanings, but they are interrelated. The first is: leveling of production by volume which means the leveling of volume or production schedule, then in this discussion it will be called production leveling. And second, leveling production by product type or mix which means the alignment of the type or mix of products in the production schedule, then in this discussion it will be called product leveling. The relationship between the two can be illustrated in their respective technical explanations.
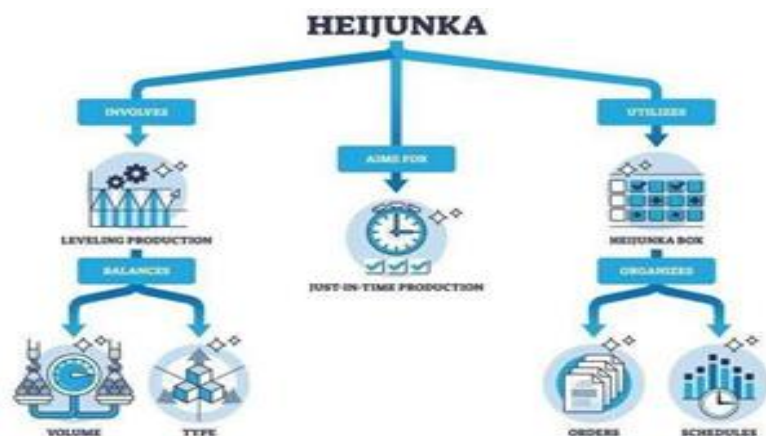
Figure 1. Heijunka

The main goal of Heijunka is to achieve more stable and efficient production. Heijunka involves:
- Production Leveling: The process of leveling production, both in terms of the number (volume) and type (type) of products produced.
- Heijunka Box: A visual aid used to organize production sequences.
- Just-In-Time Production: Production is carried out according to demand, thereby minimizing inventory.

Heijunka balances:
- Volume: The number of products produced.
- Type: The types of products produced. Heijunka organizes:
- Orders: Production orders.
- Schedules: Production schedules.

Production Levelling

The ideal just in time is very difficult because fluctuations in customer demand can result in overtime (overtime) when demand rises or idle time when demand drops thus creating inconsistent production schedules, Production leveling tries to overcome this problem

The characteristics of JIT include:
1. Meet customer requests right when there is a customer request (just-in-time)
2. Inconsistent work schedules, overtime when demand rises or idle time when demand drops
3. Suppliers must have high variability to meet the variability of customer demand
4. Reduce the inventory of finished goods.

The characteristics of production levelling include:
1. Meet total customer demand based on a predetermined production levelling period, such as weekly or monthly
2. Maintain the availability of finished goods and semi-finished goods (Work In Progress) for a short period of time against high demand

3. Work schedules are more consistent because they are planned
4. Production stability with regular scheduling

Table 1. Production Daily Planning

		Just in time prod		
Push	Type	Plant	TakeTime	Cod e
1	Vios	129	1,6 min	V
	Yaris	58	2,0 min	Y
	Sienta	11	2,5 min	S

In Table 1, it is explained that daily production planning means meeting customer needs right when there is a demand.

Table 2. Weekly Production Planning

	Production Levelling					
Type	Plant Week				Take Time	Code
	1	2	3	4		
Vios	516	516	516	516	1,6 min	V
Yaris	232	232	232	232	2,0 min	Y
Sienta	44	44	44	44	2,5 min	S

Table 3. Monthly Production Planning

Production Levelling						
Type	Plant Month				Take Time	Code
	1	2	3	4		
Vios	2064	2064	2064	2064	1,6 min	V
Yaris	928	928	928	928	2,0 min	Y
Sienta	176	176	176	176	2,5 min	S

In Tables 2 and 3, it is explained that production levelling means meeting customers with consistent planning.

Method

The design of this study is to make calculations from the data that has been taken, this research was carried out at PT. Toyota from January 2016 to May 2016. In simple terms, Heijunka is a way to make production more regular and efficient by equalizing the number and type of products produced. This helps to reduce waste, improve product quality, and better meet customer demands. This research was carried out by collecting historical data on the request of PT. Toyota from the 4th week to the 10th week in 2016 and conducted interviews related to working hours at PT. Toyota with the head of the PPIC Division. After the two data are obtained, data processing is carried out for the calculation of demand prediction and production scheduling. This research was carried out by making a bar chart at the request of PT. Toyota to determine the method of predicting the demand that will be carried out. This research uses qualitative methods and interviews with interviewees.

Result and Discussion

Based on the results of the research using heijunka at PT. Toyota time V, Y, S to be more efficient. The total working hours are 8 hours/day which means 480 minutes. If the production only uses the method of the old process first with the following instructions. 1 hour is 60 minutes, the first 1 hour of production produces 37 units and the second hour produces 13 units, this makes the production process less efficient because there will be accumulation in the first hour and employees have a lot of free time in the 2nd hour compared to after using the Heijunka method, namely:

$$\frac{60}{2,4} = 25 \ Unit/Jam$$

Take time 2.4 minutes or 25 units per hour by alternating between models If we use the method of working based on the most variables first, then the vios unit will be worked on first.

17 x 1.6) + (7 x 2.0) + (1 x 2.4) =27.5 +14 + 2.4 = 43.6 minutes / 25 units from 3 models.

The calculation above concludes that the equalization minimizes the amount of waiting time and time gap when interlacing the model. Sequence data before Heijunka application in 1 hour:

V,V,V,V,V,V,V,V,V,V,V,V,V,V,V,V
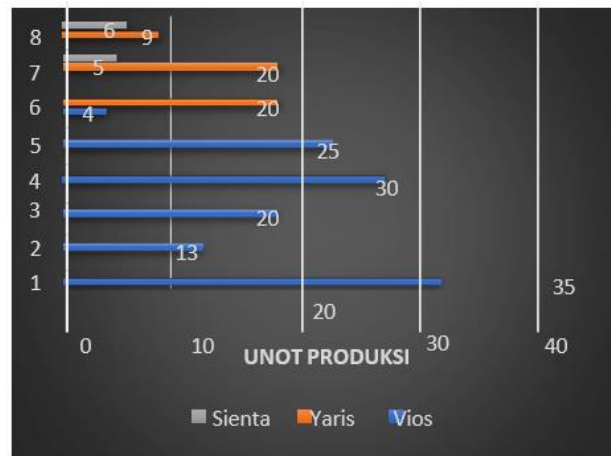

Figure 1. Heijunka Sequence

Figure 2. Daily production bar diagram every hour before the application of Heijunka.

Sequence data after the application of heijunka:
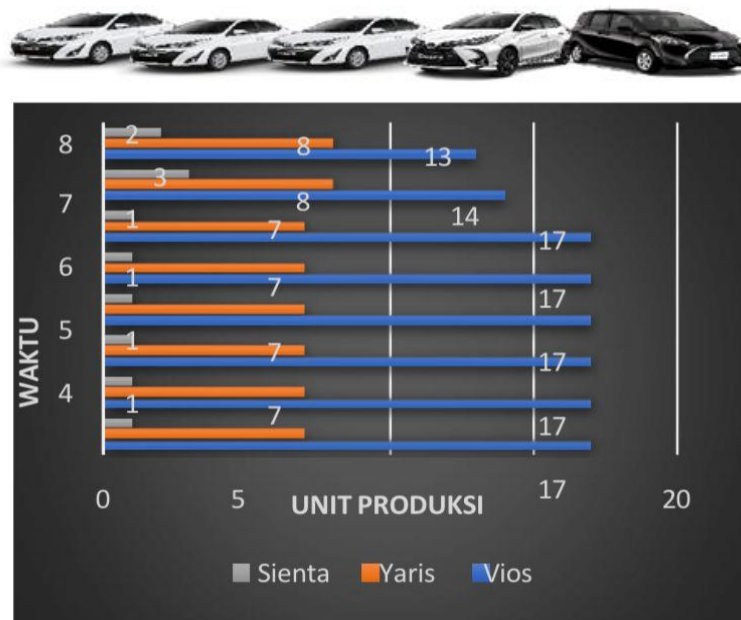V, V, V, V, V, Y, Y, V, V, V, V, V, Y, Y, V, V, V, V, V, Y, Y, V, V, Y,

Figure 3. Daily production bar diagram every hour after the application of Heijunka.

In the 1st figure, the production of each hour is irregular which results in accumulation in the first hour and leisure time that is too much waiting time in the first hour.
2 and in the 2nd figure the production of each hour is divided equally, this reduces the waiting time for each unit to be produced.

Conclusion

The production scheduling system with the heijunka method is a production scheduling process that is quite suitable for being applied to the automotive manufacturing production process. This is due to the amount of production that will be produced will be distributed evenly in 1 production period. The advantage in this case is that there are no units that are produced waiting too long. If you wait too long, a lot of time will be wasted and make the unit late to enter the next process. With a good division of production time in one period, there is no one product model that is produced in its own end. The results obtained using the heijunka method in the production process are to minimize the accumulation of goods in the first hour from 37 units to an average of 25 units per hour, and the long time in the second hour which was previously only 13 units becomes more efficient, because there is no interlude between other models and minimizes delays in customer orders when there are variables in the products ordered. Rescheduling can occur due to various things such as damage to the engine, running out of raw materials, lack of manpower, and others

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