# THE WORKER ALLOCATION PLANNING OF A MEDICAL DEVICE DISTRIBUTION CENTER USING SIMULATION MODELLING

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**KEYWORDS**
Worker allocation, Simulation, Worker workload
Medical device distribution center, Inbound logistics process

## ABSTRACT

Medical Devices are essential for medical services. It is very necessary to manage them to be ready for quick responding on the demand of the patients that can be urgent. The case study is a Medical Device Distribution Center in Thailand and its major task is to manage medical devices for its clients starting from receiving to shipping. For the inbound logistics process, there are two types of receiving products. The first type is Goods Receive, which is to receive new products. The second type is Goods Return, which is to receive the returned products from customers. The received products will be sent to five different departments. Each department has a different amount of incoming products for each day. The inequality workload clearly affects the inefficiency of the inbound logistics process. This research is then conducted to reduce the lead time of the inbound logistics process. Discrete event simulation modeling using ARENA was utilized to allocate workers in the inbound process. The new worker allocation plan can reduce the average total inbound logistics process time for all product groups. Moreover, the average utilization of each worker is about 30%-40%.

## INTRODUCTION

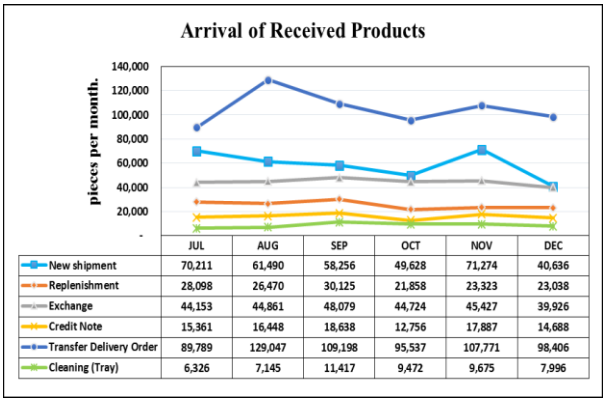
A Medical Device Distribution Center is operated 24 hours a day in order to respond with urgent needs that may exist. Its clients are the owners or agents of medical devices. The medical devices consist of four products that are Cardiovascular, Orthopedic, Ophthalmic and Dental. The case study's major tasks are inbound logistics, warehouse management and outbound logistics. The case study receives medical devices from its clients and conducts warehouse management for those devices received. Once there is a need from hospitals or clinics, the case study will conduct the outbound logistics process in order to send the devices to customers effectively. As the medical devices can be urgent according to the patients' need, lead time reduction is a major issue for the case study. For the inbound logistics process of the case study, there are two product types to receive. The first type is called 'Goods Receive' and it means to receive new products. It can be divided into two groups.

1. Newshipment is a new product from customers.
2. Replenishment is to receive and store products from the main Distribution Center.

The second type is called 'Goods Return' and it means the returned products by the customers. It is divided into four groups.

1. Exchange is the product that the customers want to exchange to other product specifications. Ophthalmic products are mostly found for exchanging.
2. Credit note is the returned product for debt reduction.
3. Transfer Delivery Order is the returned product after the operation (Implant) and it is often orthopedic products.
4. Cleaning is the instruments for the operation. The instruments are returned for cleaning.

The arrival of received products are highly fluctuated for each month as shown in figure 1. It can be seen that Transfer Delivery Order is fluctuated between 80,000 and 130,000 pieces per month. While Credit note is spreading around 12,000-19,000 pieces per month.




| | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|
| New shipment | 70,211 | 61,490 | 58,256 | 49,628 | 71,274 | 40,636 |
| Replenishment | 28,098 | 26,470 | 30,125 | 21,858 | 23,323 | 23,038 |
| Exchange | 44,153 | 44,861 | 48,079 | 44,724 | 45,427 | 39,926 |
| Credit Note | 15,361 | 16,448 | 18,638 | 12,756 | 17,887 | 14,688 |
| Transfer Delivery Order | 89,789 | 129,047 | 109,198 | 95,537 | 107,771 | 98,406 |
| Cleaning (Tray) | 6,326 | 7,145 | 11,417 | 9,472 | 9,675 | 7,996 |

Figure 1: Arrival of received products (JUL - DEC 2015)

Proceedings 31st European Conference on Modelling and Simulation ©ECMS Zita Zoltay Paprika, Péter Horák, Kata Váradi, Péter Tamás Zwierczyk, Ágnes Vidovics-Dancs, János Péter Rádics (Editors)
ISBN: 978-0-9932440-4-9/ ISBN: 978-0-9932440-5-6 (CD)

The received products will be sent to five different departments. Each department has a different number of assigned workers. Long lead-time is found in the inbound logistics process due to both fluctuated orders and process times. The exchange group consumes the highest lead time at 562.22 minutes per document. While the lead time of Newshipment and Cleaning group are 413.67 and 345.96 minutes per document respectively. Moreover, the lowest utilization is 8% founded in putaway department. The receive department has the highest utilization at 58%. The purposes of this research are then to balance the number of workers in each department and reduce the average total time of inbound logistics process.

## LITERATURE REVIEW

Worker allocation is one of the strategies that can improve workers' performance of the case study. There are several studies focused on worker allocation to improve operational efficiency in many businesses. For example, Spry and Lawley (2005) presented a simulation model for efficiency improvement of a pharmacy department. The objective is to reduce turnaround time so that patients get medication quickly. The results show that adding four technicians in the evening can improve performance and reduce turnaround time. Rong and Grunow (2009) studied workers' planning to manage air freight transportation by using simulation. The steps of managing and sorting products from containers (UID) were studied. The worker allocation plans were suggested to reduce the cost of workers and increase the utilization of workers. Zeng *et al.* (2012) studied to improve the emergency department at a community hospital at Lexington, Kentucky by using simulation. They found that adding one CT scanner and two nurses to take care of the patients for six rooms can reduce waiting times for the patients and utilization of the nurses. Bank and Emery (2013) studied the improvement of the operation in warehouses by simulation modelling. The simulation focused on the improvement of the storage location of goods, the picking of goods, and the allocation of resources in warehouse. The objective is to reduce average queue time of incoming lorries waiting for unloading. The results show that separation of the workers to unload the goods from more than one lorry at a time is the best method to reduce the average queue time of the lorries and also improve the resource utilization. Süer *et al.* (2013) used mathematical modelling to study workforce planning in manufacturing. The authors suggested the flexibility strategy by sharing workers between operations in Cellular Manufacturing in order to maximize output rates and minimize total tardiness.

It can be seen that many authors are interested in exploring simulation tools and techniques to improve worker allocation. The method of each research is adding the workers, resources and sharing the workers together towards some key performance measures such as time, workload and cost. This research is then constructed from a current situation and concerns both time and workload or utilization. The techniques investigated are sharing or allocating the workers in each product group and balancing workload of workers. The next part is research methodology that is used to conduct this research.

## RESEARCH METHODOLOGY

Discrete event simulation, ARENA, is applied as a tool to study for this research. Inbound logistics process is selected to study because of the different amount of incoming products for each day. Two types of receiving products are studied that are Goods Receive and Goods Return.

1) Goods Receive

1.1 Newshipment

The inbound logistics process for Newshipment group will start from creating queue, checking products (batch, code, the amount of product, expired date and physical conditions), placing sticker, placing barcode UID, placing both sticker and barcode or not placing anything, creating PO or non-creating PO, creating inbound document (using serial or non-using) and dispatching. It can be written as a flow chart shown in figure 2.

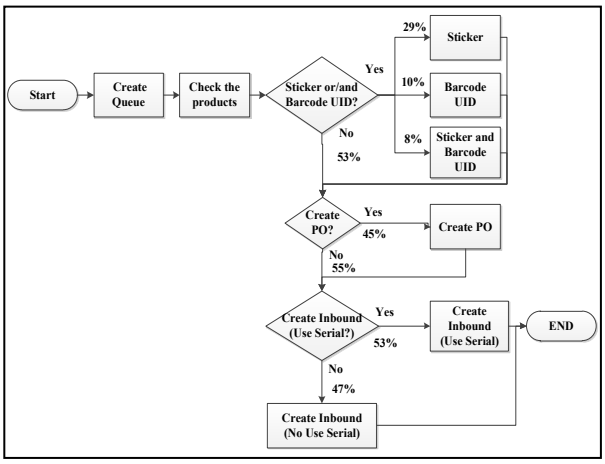



Figure 2: Newshipment process

1.2 Replenishment

The inbound logistics process of the Replenishment product group will start from creating queue, checking products (batch, code, the amount of product, expired date and physical conditions), and dispatching. The replenishment process is shown in figure 3.

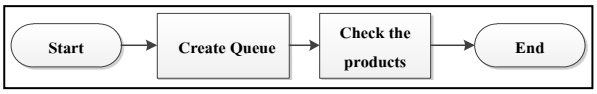



Figure 3: Replenishment process

2) Goods Return

2.1 Credit note

The inbound logistics process of Credit note group will start from creating request documents, receiving products from the customers and returning them to the Distribution Center. When the product is back to Distribution Center, it will start from checking product process (batch, code, amount of product (actual), expired date and physical conditions), keying in received document into the computer system and dispatching. Figure 4 shows the credit note steps.

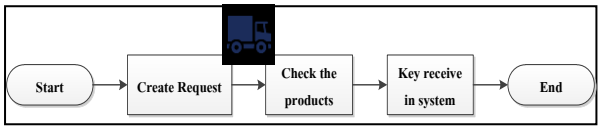



Figure 4: Credit note process

2.2 Exchange

The inbound logistics process of Exchange group is the process to exchange the products within the same product group at the same price and quantity. The process will start from checking the products (batch, code, amount of product, expired date and physical conditions), keying in received document into the computer system (divided into 3 clients; client A, client BR and client W due to different ways), sorting and dispatching. The exchange process is concluded in figure 5.

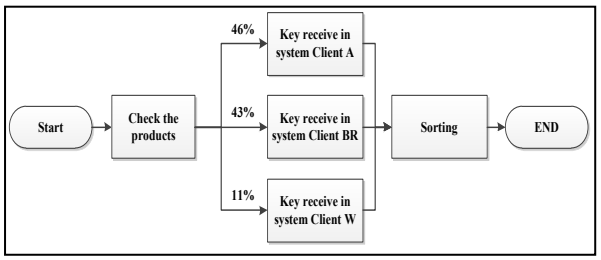



Figure 5: Exchange process

2.3 Transfer Delivery Order

The inbound logistics process of Transfer Delivery Order group will start from scanning the products returned, checking the products (amount of product and physical conditions), keying in received document into the computer system (divided into 3 clients; client B, client BB and client S due to different ways ) and dispatching. The Tranfer delivery order process is shown in figure 6.

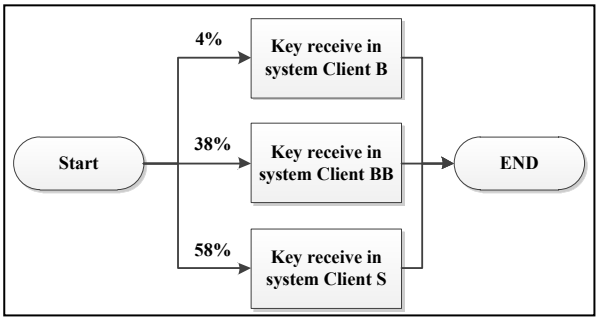



Figure 6: Transfer Delivery Order process

2.4 Cleaning

Cleaning group is divided into 2 clients that are client BB and client S. The inbound logistics process for the two clients is similar. It will start from checking the products (amount of products and physical products), keying in received document into the computer system (before washing), washing the product by machine, key receiving document into the computer system (after washing) and dispatching. The cleaning process is described in figure 7.

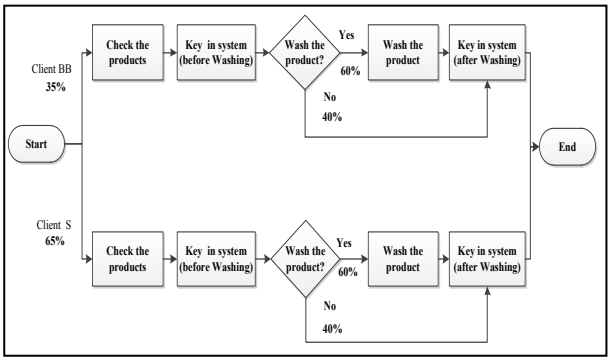



Figure 7: Cleaning process

The inbound logistics process is divided into 5 departments. Each department will have responsibility for each product group as shown in table 1. The priority of the process when the product come in together, the workers in the receiving department must do their works by creating inbound (newshipment) and creating queue (newshipment and replenishment). Creating queue is high priority because it spends a short time in working. In the part of the return department, product exchanging is high priority. The process of working is more complex than that of credit note. For the putaway department, the product for replenishment is high priority. The workers do their work 8 hours per day from 8.00 a.m. to 17.00 p.m. with a one-hour lunch break at 12 a.m. For a part-time job, they start working

from 18.00 p.m. to 20.00 p.m. from Monday to Saturday (6 days per week).

Table 1: Tasks and number of workers

| Department | Tasks | Number of worker |
|---|---|---|
| 1.Receive | Check the products, Sticker and Barcode UID (Newshipment) | 1 |
| | Create Inbound (Newshipment) and Create Queue (Newshipment and Replenishment) | 2 |
| 2.Return | Check the products (Credit note and Exchange) | 2 |
| | Key receiving document into system (Credit note and Exchange) | 4 |
| 3.Putaway | Check the products (Replenishment) and Sorting (Exchange) | 4 |
| 4.TDO-IN | Receive the products (Transfer Delivery Order) | 4 |
| 5.Cleaning | Receive the products Client S (Cleaning) | 2 |
| | Receive the products Client B (Cleaning) | 2 |

**Simulation**

The simulation model of inbound logistics process from creating queue until printing the putaway report was constructed. The information which is used to conduct the simulation is from October – December 2015. The data is divided into 2 parts. Firstly, the primary data is gathered by interviewing the specialists of the case study and the processing time records. In each process, it has different time units such as time per document, time per line item and time per piece. The secondary data is obtained from the company' s databases that are the arrival rate of each product group, the quantity of products and the number of line items. The data will be analyzed by using Input Analyzer to find the best distribution fit. The example of the arrival rate and the process time of Newshipment group is shown in table 2-3. Both the arrival rate and the process time of each product group are controlled by Common Random Numbers (CRN) to reduce the variation of the data between replications.

Table 2**:** Arrival rate of Newshipment

| Period | Arrival rate of Newshipment (Document) |
|---|---|
| 8 p.m – 9 p.m | DISC (0.722, 0, 0.861, 1, 0.937, 2, 0.962, 3, 1.000,4) |
| 9 p.m – 10 p.m | DISC (0.747, 0, 0.785, 1, 0.873, 2, 0.911, 3, 0.949, 4, 0.987, 6, 1.000, 8) |
| 10 p.m – 11 p.m | DISC (0.671, 0, 0.899, 1, 0.962, 2, 1.000, 3) |
| 11 p.m – 12 p.m | DISC (0.772, 0, 0.899, 1, 0.924, 2, 0.962, 3, 0.987,4, 1.000, 8) |
| 12 p.m – 13 a.m | DISC (0.810, 0, 0.949, 1, 0.975, 2, 0.987, 4, 1.000, 5) |
| 13 a.m – 14 a.m | DISC (0.747, 0, 0.924, 1, 0.949, 2, 0.975, 3, 0.987,5, 1.000, 6) |
| 14 a.m – 15 a.m | DISC (0.418, 0, 0.595, 1, 0.747, 2, 0.848, 3, 0.873,4, 0.899, 5, 0.924, 7, 0.937, 8, 0.962, 9, 0.987, 10, 1.000, 11) |
| 15 a.m – 16 a.m | DISC (0.696, 0, 0.797, 1, 0.886, 2, 0.924, 3, 0.937, 4,0.949, 5, 0.962, 6, 0.975, 7, 1.000, 8) |
| 16 a.m – 17 a.m | DISC (0.633,0 , 0.823,1 ,0.911 ,2 ,0.949 , 3, 0.975,5, 1.000, 7) |
| 17 a.m – 8 p.m | 0 (None) |

Table 3: Distribution of process time (Newshipment)

| Operation | Distribution of process time |
|---|---|
| Create Queue | 18 + 78 * BETA(1.17, 1.05)(Sec /Doc) |
| Check the products | TRIA(4.28, 6.64, 9) (Sec /Piece) |
| Sticker | TRIA(7.15, 9.65, 14.9)(Sec /Piece) |
| Barcode UID | TRIA(5.03, 6.66, 8.91)(Sec /Piece) |
| Sticker & Barcode UID | TRIA(14, 15.5, 17.9)(Sec /Piece) |
| Create PO | TRIA(3.17, 5.19, 9.92)(Sec /Line item) |
| Create Inbound(serial) | TRIA(13, 17.6, 23)(Sec /Piece) |
| Create Inbound(No serial) | 18 + 16 * BETA(1.33, 1.27)(Sec /Line item) |

This study does not include warehouse management tools such as scanners and computers as those tools are sufficient. Resources of the study are then mainly workers.

**Verification and Validation**

Verfication has been conducted for each module in order to assure that the simulation program can perform as required. The average documents per month of 5 product groups are used to validate with real life performances. It was found that the document of each product group obtained by simulation is within the minimum and maximum of actual performances as shown in table 4.

Table 4: Output Validation

| Product | Actual (Doc/Month) | | | Simulation (Doc/Month) | | |
|---|---|---|---|---|---|---|
| | Average | Min | Max | Average | Min | Max |
| Newshipment | 166 | 126 | 250 | 239.32 | 233.83 | 244.81 |
| Replenishment | 113 | 92 | 138 | 129.16 | 124.48 | 133.84 |
| Credit Note | 2787 | 1888 | 3433 | 2099.39 | 1997.10 | 2201.68 |
| Exchange | 3034 | 2244 | 3733 | 2449.31 | 2344.61 | 2554.01 |
| Transfer Delivery Order | 1922 | 1214 | 2747 | 2111.57 | 2023.51 | 2199.63 |
| Cleaning | 2910 | 2453 | 3223 | 2699.45 | 2591.71 | 2807.19 |

To identify run length and run replication, equation 1 was used (Kelton et al. 2007)

$$n \cong n_0 \frac{h_0^2}{h^2} \qquad (1)$$

The expected number of replications is represented by n. The desired half width is h and $n_0$ represents the number of replications for the pilot run. The half width obtained from the pilot run is $h_0$. The simulation is conducted based on terminating system as the case study starts working from Create Queue and finishing printing putaway. The number of replications is 260 and run length is 26 days.

**RESULTS**

**Current situation**

The As-is process of individual department has been simulated. It was found that the longest lead time in product groups is the Exchange group. The exchange group consumes the highest average total time at 562.22 minutes per document. It is followed by that of Newshipment and Cleaning group at 413.67 and 345.96 minutes per document respectively. The lowest average total time is found in the Replenishment group at 30.49

minutes per document. Table 5 shows the average total time for each product group.

Table 5: Current Total Time per Document

| Product group | Average total time (Min/Document) | |
|---|---|---|
| | Average | Half-Width |
| Newshipment | 413.67 | 19.90 |
| Replenishment | 30.49 | 2.07 |
| Credit note | 167.16 | 19.60 |
| Exchange | 562.22 | 48.62 |
| Transfer Delivery Order | 105.20 | 16.50 |
| Cleaning | 345.96 | 32.21 |

In each process of the product groups it was found that washing for client S has the highest average total waiting time at 394.72 minutes per document. In the meantime, the checking products of Exchange, Credit note and Newshipment group have the average total waiting time at 101.13, 164.03 and 162.01 minutes per document, relatively. Besides this, the process of Sticker, Barcode UID and Sticker & Barcode UID have the average total waiting time at 195.93, 171.96 and 146.21 minutes per document, consecutively. The key receiving document process of Credit note group is 0.76 minutes per document. More details are shown in table 6.

Table 6: Current total wait time for each process

| Product group | Operation | Average total wait time (Min/Document) | |
|---|---|---|---|
| | | Average | Half-Width |
| New shipment | Create Queue | 26.67 | 1.52 |
| | Check the products | 101.13 | 10.60 |
| | Sticker | 171.96 | 13.45 |
| | Barcode UID | 146.21 | 13.43 |
| | Sticker & Barcode UID | 195.93 | 16.91 |
| | Create PO | 42.28 | 2.25 |
| | Create Inbound(serial) | 123.32 | 3.77 |
| | Create Inbound(No serial) | 37.07 | 2.20 |
| Exchange | Check the products | 164.03 | 23.06 |
| | Key receiving document A | 3.42 | 0.30 |
| | Key receiving document BR | 2.04 | 0.19 |
| | Key receiving document W | 3.54 | 0.38 |
| | Sorting | 23.90 | 1.29 |
| Credit note | Create Request | 20.66 | 4.73 |
| | Check the products | 162.01 | 19.59 |
| | Key receiving document | 0.76 | 0.07 |
| Replenishment | Create Queue | 18.51 | 2.02 |
| | Check the products | 0.83 | 0.19 |
| Transfer Delivery Order | Receiving product B | 84.38 | 16.78 |
| | Receiving product BB | 76.23 | 16.19 |
| | Receiving product S | 100.54 | 16.72 |
| Cleaning | Check the products B | 20.13 | 1.82 |
| | Key receiving document B(before) | 9.80 | 1.84 |
| | Washing B | 58.92 | 5.29 |
| | Key receiving document B(after) | 64.73 | 3.52 |
| | Check the products S | 66.64 | 8.79 |
| | Key receiving document S(before) | 66.31 | 8.79 |
| | Washing S | 394.72 | 92.48 |
| | Key receiving document S(after) | 79.37 | 2.15 |

The result of the current workload leads to imbalance of worker utilizations. The putaway department has the lowest average utilization about 8%. For the receive department (Worker B and C), worker utilizations are high at 58%. Other worker utilizations are shown in table 7.

Table 7: Current worker utilization

| Worker | Utilization (%) | |
|---|---|---|
| | Average | Half-Width |
| Receive Worker A | 41.75 | 1 |
| Receive Worker B | 58.86 | 1 |
| Receive Worker C | 58.16 | 1 |
| Return Worker D | 46.97 | 1 |
| Return Worker E | 46.97 | 1 |
| Return Worker F | 18.37 | 1 |
| Return Worker G | 18.38 | 1 |
| Return Worker H | 18.32 | 1 |
| Return Worker I | 32.48 | 1 |
| Putaway Worker J | 8.55 | 0 |
| Putaway Worker K | 8.52 | 0 |
| Putaway Worker L | 8.54 | 0 |
| Putaway Worker M | 8.50 | 0 |
| TDO Worker N | 49.73 | 2 |
| TDO Worker O | 49.82 | 2 |
| TDO Worker P | 49.66 | 2 |
| TDO Worker Q | 49.81 | 2 |
| Cleaning B Worker R | 22.58 | 1 |
| Cleaning B Worker S | 22.52 | 1 |
| Cleaning S Worker T | 48.05 | 2 |
| Cleaning S Worker U | 48.01 | 2 |

**Alternative worker allocation strategies**

From the current situation, it was found that the average total time of each product group is signicantly different. The waiting time of each process is high and the workload of workers has fluctuated greatly. The promising method to gain a better performance on the inbound logistics process is to adjust the worker allocation plan. Thus, two guidelines were proposed.

1. To manage group of the workers who are working the same tasks together.
2. To adjust workers to balance workers' utilization.

The first alternative

- Grouping workers in checking product; receive department (A) and return department (D,E) together for checking in newshipment, exchange and credit note because their works are similar. To move 1 worker from putaway (M) to work checking product.
- Reducing the workers in putaway to three workers (J,K,L) and get them help in receive for placing stickers and bacode UID (when they are available).
- Adding 3 workers (F,G,H) to create request documents.
- Adding 1 worker (S) who moves from cleaning department works in Transfer Delivery Order group.
- Grouping workers in cleaning department (client B (R) and client S (T,U)) work and use cleaning machines together in cleaning process.

The second alternative

- Grouping workers in checking product; receive department (A), return department (D,E) and replenishment department (J,K,L) together for checking in newshipment, exchange, credit note and replenishment. Beside this, they place stickers and bacode UID.
- Reducing the workers in putaway to three workers (J,K,L).
- Adding 3 workers (F,G,H) to create request documents.
- Adding 1 worker (M) who moves from putaway department works in Transfer Delivery Order group.
- Grouping workers in cleaning department (client B (R,S) and client S (T,U)) work and use cleaning machines together in cleaning process.

The conclusion of improvement is shown in table 8.

Table 8: Current and Alternatives worker allocation

| Product group | Operation | As-Is | To-be 1 | To-be 2 |
|---|---|---|---|---|
| New shipment | Create Queue | B C | B C | B C |
| | Check the products | A B C | A D E M | A D E J K L |
| | Sticker | | B C J K L | |
| | Barcode UID | | | |
| | Sticker and Barcode UID | | | |
| | Create PO | B C | B C | B C |
| | Create Inbound(serial) | | | |
| | Create Inbound(No serial) | | | |
| Exchange | Check the products | D E | A D E M | A D E J K L |
| | Key receiving document A | F G H I | F G H I | F G H I |
| | Key receiving document BR | | | |
| | Key receiving document W | | | |
| | Sorting | J K L M | J K L | J K L |
| Credit note | Create Request | I | F G H I | F G H I |
| | Check the products | D E | A D E M | A D E J K L |
| | Key receiving document | F G H I | F G H I | F G H I |
| Replenishment | Create Queue | B C | B C | A D E J K L |
| | Check the products | J K L M | J K L | J K L |
| Transfer Delivery Order | Receiving product B | O N P Q | O N P Q U | O N P Q M |
| | Receiving product BB | | | |
| | Receiving product S | | | |
| Cleaning | Check the products S | R S Mc-S | R S T Mc-S Mc-B | R S T U Mc-S Mc-B |
| | Key receiving document S (before) | | | |
| | Key receiving document S (after) | | | |
| | Check the products B | T U Mc-B | | |
| | Key receiving document B (before) | | | |
| | Key receiving document B (after) | | | |

From the comparison of two alternatives with the current situation, we can reduce the average total lead time in every product groups. However, the second alternative can perform better than the others. Most of the product groups can have a shorter lead time when alternative 2 was employed . It is shown in table 9. For the workers' utilization, both of the alternatives can improve and balance the workes' utilization better than the current situation.

Table 9: Average total lead time

| Product group | Average total lead time (Min/ document) | | |
|---|---|---|---|
| | As-Is | To-Be 1 | To-Be 2 |
| | Average | Average | Average |
| Newshipment | 413.67 | 315.50 | 290.01 |
| Replenishment | 30.49 | 31.06 | 29.76 |
| Credit note | 167.16 | 59.29 | 56.71 |
| Exchange | 562.22 | 378.94 | 389.35 |
| Transfer Delivery Order | 105.20 | 67.82 | 68.19 |
| Cleaning | 345.96 | 300.49 | 249.95 |

For the balancing of workers, the second alternative is seemed to be better than the first alternative as the utilizations are ranged from 30% to 40%, while those of the first alternative are more variable. The details are shown in table 10.

Table 10: Worker Workload of Current and Alternative

| Worker | Workload (%) | | |
|---|---|---|---|
| | As-Is | To-Be 1 | To-Be 2 |
| | Average | Average | Average |
| Receive Worker A | 41.75 | 35.56 | 34.02 |
| Receive Worker B | 58.86 | 43.73 | 38.58 |
| Receive Worker C | 58.16 | 42.96 | 38.20 |
| Return Worker D | 46.97 | 35.66 | 34.53 |
| Return Worker E | 46.97 | 35.54 | 34.45 |
| Return Worker F | 18.37 | 21.89 | 21.90 |
| Return Worker G | 18.38 | 21.86 | 21.89 |
| Return Worker H | 18.32 | 21.82 | 21.88 |
| Return Worker I | 32.48 | 21.83 | 21.84 |
| Putaway Worker J | 8.55 | 21.54 | 37.95 |
| Putaway Worker K | 8.52 | 21.18 | 37.76 |
| Putaway Worker L | 8.54 | 20.75 | 37.28 |
| Putaway Worker M | 8.50 | 35.38 | 39.53 |
| TDO Worker N | 49.73 | 39.82 | 39.83 |
| TDO Worker O | 49.82 | 39.91 | 39.56 |
| TDO Worker P | 49.66 | 39.83 | 39.83 |
| TDO Worker Q | 49.81 | 39.68 | 39.67 |
| Cleaning BWorker R | 22.58 | 46.79 | 35.27 |
| Cleaning BWorker S | 22.52 | 39.64 | 35.19 |
| Cleaning SWorker T | 48.05 | 46.74 | 35.12 |
| Cleaning SWorker U | 48.01 | 46.56 | 35.15 |

## CONCLUSION

From the results, it can be concluded that the second alternative is the best alternative as it can reduce the average total lead time for every product groups. The highest reduction on the average total lead time is the Exchange group. The average total lead time can be reduced to 176.87 minutes per document (30.75%). It was followed by the Newshipment group as the average total lead time can be shrinked to 123.66 minutes per document(29.89%). The Replenishment group can minimize the average total lead time to 0.73 minutes per document (2.39%). For the workers' workload, the overall of utilizations are about 30%-40%. Although the alternatives are conducted by grouping the workers who are working the same tasks or processes together, each process such as credit note and replenishment can be different regarding to client's requirement. On The Job training is necessary for every process to assure that the workers can successfully perform their work for every clint. In addition, the alternatives suggested may dissatisfy the workers who have to work more. The executives may need to add some incentives by evaluating performance on the total output of the inbound logistics process. If the teamworks can reduce the average total inbound process time; the productivity of the inbound process will be increased. The teamworks will then get more incentives. Then, collaboration of the workers can achieve win-win situation.

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