The Establishment of Decision Making Support Tool for Inventory Control and Production Planning with Periodic Review System and Linear Programming Approach

Redy Ardiiansyah¹, I Nyoman Pujiawan², and Niniet Indah Arvitirda³
1Department of Management Technology, Institut Teknologi Sepuluh Nopember, Indonesia
2Department of Industrial Engineering, Institut Teknologi Sepuluh Nopember, Indonesia

Abstract—PT. Mortars is an instant cement producer with many product variants. Some problems that PT. Mortars encountered are uncertainty of demand, limitation on production capacity, and inventory capacity, which caused product shortages and high inventory costs. The production scheduling process is produced manually so it requires a long time, relying on the ability and experience of the production planner which is vulnerable to mistakes. Therefore, new methods and tools are needed for inventory control and production scheduling to make sure goods are delivered to customer just in time while maintaining operational efficiency. Periodic review system (R,S) and (R, s, S) methods are proposed in this study to improve inventory parameters and reorder systems that have an impact on service levels and inventory costs. The tools are designed using Microsoft Excel software with solver add-ins functions and linear programming approaches to generate optimal production schedule decisions automatically. In order to determine the level of service and inventory costs generated by each method, a simulation is conducted by using the tools that have been made. The simulation of the existing method produces a service level of 98.64% and a total inventory cost of Rp. 1.167,160.494. The periodic review system (R, S) method resulted in increasing service level of 0.96% and lower inventory cost of Rp. 15.130.801 while the periodic review system (R, s, S) method resulted in increasing service level of 1.29% and a lower inventory cost of Rp. 486.653 compared to the existing method. The periodic review system (R, S) method produces the lowest inventory costs while the method (R, s, S) produces the highest service level compared to other methods.

Keywords—Production Planning and Inventory Control, Periodic Review System (R, S), (R, s, S), Linear Programming.

I. INTRODUCTION

In the globalization era, companies that have reliable supply chain management will survive and win business competition. Although companies can produce good quality products at low prices, but the availability of products on the market is not guaranteed, then the customer will switch to competitor products or substitute products [1]. Uncertainty of demand is one of the problems faced by the company in meeting customer demands. To solve this problem, efficiency along the supply chain path is needed. So it takes inventory control planning and production scheduling in order to minimize production costs and improve service levels [2].

Good inventory management is needed to reduce the risk of demand uncertainty. In businesses that use make-to-stock operating system, efficient inventory management is very important. This is because the inventory along the supply chain path has major implications for company's financial performance [3]. The amount of inventory is usually very large, even the value exceeds 25% of the total value of assets held. To keep the inventory level at the desired amount, it needs to balance the supply and demand. Mathematical models programming plays a very important role in the scenario of inventory control strategies and production scheduling. [4]. With optimal inventory control and production scheduling, product availability and operational efficiency can be achieved in accordance with existing needs to balance the supply and demand. Mathematical inventory scenarios and inventory services have an impact on service levels and inventory costs. The tools are designed using Excel software with solver add-ins functions and linear programming approaches to generate optimal production schedule decisions automatically. In order to determine the level of service and inventory costs generated by each method, a simulation is conducted by using the tools that have been made. The simulation of the existing method produces a service level of 98.64% and a total inventory cost of Rp. 1.167,160.494. The periodic review system (R, S) method resulted in increasing service level of 0.96% and lower inventory cost of Rp. 15.130.801 while the periodic review system (R, s, S) method resulted in increasing service level of 1.29% and a lower inventory cost of Rp. 486.653 compared to the existing method. The periodic review system (R, S) method produces the lowest inventory costs while the method (R, s, S) produces the highest service level compared to other methods.

The periodic review system (R, S) method produces the highest service level compared to other methods.

| Products | Demand average | Inventory days | Order Up to level |
|----------|----------------|----------------|-------------------|
| Units    | bag/ day       | Days           | Bag               |
| Total    | 15,260         | 61,344         |
| MR-200-20KG | 568          | 6              | 3.408             |
| MR-200-40KG | 601          | 6              | 3.606             |
| MR-202-40KG | 462          | 6              | 2.772             |
| MR-250-40KG | 762          | 6              | 4.572             |
| MR-270-25KG | 98           | 15             | 1.470             |
| MR-272-40KG | 231          | 6              | 1.386             |
| MR-290-40KG | 118          | 8              | 944               |
| MR-100-40KG | 251          | 5              | 1.255             |
| MR-101-40KG | 14           | 6              | 84                |
| MR-301-40KG | 1.161        | 2              | 2.322             |
| MR-302-50KG | 4.614        | 3              | 13.842            |
| MR-380-40KG | 2.227        | 3              | 6.681             |
| MR-382-40KG | 727          | 3              | 2.181             |
| MR-400-25KG | 1.395        | 3              | 4.185             |
| MR-402-40KG | 258          | 5              | 1.290             |
| MR-410-25KG | 10           | 30             | 300               |
| MR-420-25KG | 411          | 4              | 1.644             |
| MR-422-40KG | 51           | 6              | 306               |
| MR-440-40KG | 26           | 15             | 390               |
| MR-440-50KG | 443          | 4              | 1.772             |
| MR-443-40KG | 93           | 2              | 186               |
| MR-445-40KG | 29           | 15             | 435               |
| MR-450-40KG | 316          | 4              | 1.264             |
| MR-460W-25KG | 69           | 15             | 1.035             |
| MR-480-25KG | 148          | 6              | 888               |
| MR-485-25KG | 48           | 4              | 192               |
| MR-700-25KG | 27           | 30             | 810               |
| MR-800-25KG | 50           | 30             | 1.500             |
| MR-830-40KG | 46           | 12             | 552               |
| MR-840-25KG | 6            | 12             | 72                |
PT. Mortars is an instant cement producer which has 2 production lines called the large bag production line (instant cement) and the small bag production line (tile grout). This research is focused on the large bag production line with 30 product types, which are divided into 2 types of product groups, namely plaster and adhesive (sand product) and skimcoat (non sand product). For each product changeover (set-up), the production line must be cleaned around 10 minutes, except for the initial change of plaster and adhesive product to the skimcoat product which takes 120 minutes (according to the standard quality procedure).

PT. Mortars has a warehouse capacity that can accommodate up to 70,000 bags and a production capacity of 21,000 bags / day. The average daily demand of PT. Mortars is 15,000 bags / day. Production capacity and storage capacity will be a constraint for PT. Mortars in fulfillment of customer demand. Inventory control of PT. Mortars should be efficient to reach the service level target with optimal costs.

Constraints. PT. Mortars is an instant cement producer which has 2 production lines called the large bag production line (instant cement) and the small bag production line (tile grout). This research is focused on the large bag production line with 30 product types, which are divided into 2 types of product groups, namely plaster and adhesive (sand product) and skimcoat (non sand product). For each product changeover (set-up), the production line must be cleaned around 10 minutes, except for the initial change of plaster and adhesive product to the skimcoat product which takes 120 minutes (according to the standard quality procedure).

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To maintain the balance of inventory levels, PT. Mortars conducts replenishment by producing based on production
The proposed inventory control method is the periodic review system (R, S) and (R, s, S) to determine the policy of replenishment mechanism and to improve the inventory schedule. Production scheduling at PT. Mortars are still manually so that it is less efficient, therefore distribution of production schedules is often late, frequent miss-scheduling (wrong in determining the quantity of products, typos, etc.) and relying on the ability and experience of the production planner. Production scheduling is done by allocating production time as needed and determining the production amount for each products.

From the explanation above, inventory control and production scheduling are important for PT. Mortars, so it is required for proper inventory control and production scheduling methods. The solution to overcome these problems is to design a decision making tool that combines inventory control and production scheduling methods. Application of right inventory control and production scheduling, will have an impact on optimal inventory costs and service levels in line with expectations.

The proposed inventory control method is the periodic review system (R, S) and (R, s, S) to determine the policy of replenishment mechanism and to improve the inventory parameters of PT. Mortars. In the proposed method there is consideration of safety stock to anticipate demand uncertainty. The linear programming method is used to produce optimal production scheduling in accordance with production capacity limits, storage capacity limits and production priorities. The tool is designed using Microsoft Excel software with the Solver Add-ins function. The scheduling process is no longer manual but has been computerized, so that the process of inventory control and production scheduling can be done quickly, precisely, standardized and minimize human error in the process.

II. LITERATUR REVIEW

To solve the problem described in the introduction, a inventory control with periodic review system method and production scheduling with linear programming approach is proposed.

According to Silver et al. [5], there are two methods of inventory control: continuous review (Q- system) and periodic review (T-system). There are 2 types of continuous review methods, (s, Q) and (s) methods. In the continuous review method, replenishment of inventory is carried out if the inventory level has reached or lower than the reorder point (s), and the number of reorder quantity as much as Q. In method (s, Q), the reorder quantity (Q) will be ordered by economic production quantity (EPQ), while in method (s, S) the reorder quantity (Q) will be ordered by a number of differences between maximum inventory (S) and inventory level, where (S) is s + EPQ.

There are 2 types of periodic review methods, methods (R, S) and methods (R, s, S). The method (R, S) is a combination of the periodic review system (R, S) and continuous review system (s, S). In the method (R, S) the reorder is carried out if the review period (R) has arrived, whereas in the method (R, s, S) the reorder is carried out when the review period (R) has arrived and the inventory level is smaller equals to the reorder point (s). In the method (R, S) and (R, s, S) methods reorder quantity (Q) will be ordered by a number of differences between (S) and the inventory level.
Optimization is one of the scientific disciplines in mathematics that focuses on getting the maximum or minimum values systematically from a function [6]. Optimization is needed by companies in order to optimize resources such as raw materials, labor and production facilities that are used so that the production process can produce products in the quantity and quality expected [7].

### Table 6. Simulation Results for The First Quarter of 2019

| Q1 2019 Period | Description | Unit | Existing Method | Periodic Review System Method. |
|----------------|-------------|------|----------------|-------------------------------|
|                |             |      | R, S           | R, s, S                       |
| Start inventory level | Bag | 61.344 | 60.177 | 77.101 |
| Total demand    | Bag       | 1.222.032 | 1.222.032 | 1.222.032 |
| Total production | Bag      | 1.198.226 | 1.206.971 | 1.186.077 |
| Set-up frequency | (x freq) | 587 | 607 | 298 |
| Inventory average | Bag | 51.176 | 50.718 | 53.841 |
| End inventory level | Bag | 36.590 | 45.116 | 41.146 |
| Product shortage | Bag | (16.648) | (4.963) | (834) |
| Service level    | %         | 98.64% | 99.59% | 99.93% |
| Utilization loss | hours     | 1.62 | 1.62 | 12.35 |
| Inventory cost   | Rupiah    | 322.099.779 | 304.134.294 | 309.604.090 |
| Set-up cost      | Rupiah    | 61.938.062 | 63.634.432 | 67.927.547 |
| Process cost     | Rupiah    | 764.488.302 | 772.076.736 | 764.730.621 |
| Inventory deviation cost | Rupiah | 18.634.350 | 12.184.231 | 25.346.889 |
| Total Cost       | Rupiah    | 1.167.160.494 | 1.152.029.693 | 1.167.609.147 |

### Table 7. February 2019 Simulation Results

| Description | Unit | Existing Method | Periodic Review System Method. |
|-------------|------|----------------|-------------------------------|
|             |      | R, S           | R, s, S                       |
| Start inventory level | Bag | 45.200 | 44.033 | 42.365 |
| Total demand    | Bag       | 410.539 | 410.539 | 410.539 |
| Total production | Bag      | 401.641 | 403.045 | 414.220 |
| Set-up frequency | (x freq) | 193 | 197 | 102 |
| Inventory average | Bag | 51.098 | 49.787 | 54.600 |
| End inventory level | Bag | 37.662 | 36.539 | 46.046 |
| Product shortage | Bag | (5.141) | (925) | - |
| Service level    | %         | 98.75% | 99.77% | 100.00% |
| Utilization loss | hours     | 0 | 0 | 0 |
| Inventory cost   | Rupiah    | 97.560.260 | 91.312.856 | 97.605.682 |
| Set-up cost      | Rupiah    | 20.108.310 | 20.447.584 | 25.728.472 |
| Process cost     | Rupiah    | 263.951.328 | 263.951.639 | 272.533.168 |
| Inventory deviation cost | Rupiah | 5.167.081 | 5.167.125 | (2.127.489) |
| Total Cost       | Rupiah    | 386.786.979 | 380.879.204 | 393.739.833 |

### Table 8. March Simulation Result

| March 2019 Period | Description | Unit | Existing Method | Periodic Review System Method. |
|-------------------|-------------|------|----------------|-------------------------------|
|                   |             |      | R, S           | R, s, S                       |
| Start inventory level | Bag | 37.662 | 36.539 | 46.046 |
| Total demand    | Bag       | 419.496 | 419.496 | 419.496 |
| Total production | Bag      | 420.732 | 428.073 | 414.596 |
| Set-up frequency | (x freq) | 201 | 212 | 103 |
| Inventory average | Bag | 51.316 | 51.299 | 51.440 |
| End inventory level | Bag | 36.590 | 45.116 | 41.146 |
| Product shortage | Bag | (3.856) | (1.943) | (834) |
| Service level    | %         | 99.08% | 99.54% | 99.80% |
| Utilization loss | hours     | 0 | 0 | 0 |
| Inventory cost   | Rupiah    | 107.242.085 | 101.375.353 | 101.080.583 |
| Set-up cost      | Rupiah    | 21.721.443 | 22.654.446 | 22.839.898 |
| Process cost     | Rupiah    | 271.332.478 | 278.920.621 | 269.818.199 |
| Inventory deviation cost | Rupiah | 1.057.392 | 5.392.772 | 2.344.389 |
| Total Cost       | Rupiah    | 403.353.398 | 397.557.648 | 396.083.069 |

Linear Programming (LP) is one method in operations research that can be used for planning and decision making in allocating limited resources (constraints) to achieve company goals (objective function) such as maximizing profits or minimizing costs. The method represents the real world into a mathematical model consisting of a linear objective function and several linear constraints. Linear
programming is widely applied in economic, industrial, military, social and others.

III. METHODOLOGY

After the problem definition and literature study are completed, the data collection is performed. Data of demand quantity, inventory costs and set-up costs will be processed into inventory parameter according to the calculation mechanism in the proposed method.

The next stage is the design of models and the development of decision making systems. At this stage a production scheduling decision making tool will be designed using Microsoft Excel software, using the Solver add-ins function. Decisions generated by tools are determined based on a linear programming approach so mathematical modeling is needed in accordance with the inventory control method used. After the tool has been designed, a numerical test is validated by comparing the results of manual calculations with the results of calculations using tools that are designed.

If the result of both calculations are match, then the tool can be declared reliable. The next step is the simulation of inventory control. The aim of this stage is to obtain the total cost and service level from each method. The simulation will be carried out by scheduling the daily production during the first quarter period (Q1 2019). From the simulation results, an analysis and discussion is carried out to find out the method that produces the best total cost and service level. The results of this analysis will be concluded as the right method to be used as a method of inventory control at Pt. Mortars. All the research results can be used to give suggestions for companies and further research.

IV. RESULT AND DISCUSSION

A. Data Collection

At this stage, data collection is carried out in the form of data on the number of demand per product per day during the Q1 2019 period, inventory costs, set-up costs, processing costs, inventory deviation costs and the number of existing inventory parameters of PT. Mortars.

The value of storage costs is determined at 30% per year per bag or 2.5% per month per bag of the product cost. The process cost is determined from the labor cost Rp. 249,711/hour (12 operators) and energy costs Rp. 259,200/hour. The process of changeover for similar products and skimcoat to adhesive products needs about 10 minutes with costs Rp. 84,818 which consists of labor and energy costs that remains consumed during the changeover process. Especially for the changeover from plaster or adhesive to skimcoat products, cleaning for production lines must be carried out so that the
skimcoat products is not contaminated by residual sand used during the production process of plaster or adhesive products (skimcoat cleaning). The cleaning process is carried out about 3 hours with 5 workers with cost of Rp 934,585 for a single cleaning process.

Inventory control policies currently used by PT. Mortras, almost resembles the periodic review system (R, S) method because the review period (R) is done once a day. However, the target inventory value (S) does not use calculations according to the method (R, S), but uses the inventory days of supply policy for each product. The calculation mechanism to determine PT. Mortars' order up to level (S) is to take the biggest demand in a particular month in the previous year, then it will be divided by 22 working days to obtain the daily demand average. The average will be multiplied by the amount of inventory should be owned in units of days determined based on the results of discussions between the SCM team and the operation manager. The parameters of the order up to level are as follows at Table 1.

B. Data Processing

After all the data needed for research is collected, then the data is processed to determine the inventory parameters in accordance with the proposed method. In the (R, S) method the parameter of review period (R) is set at one day for the plaster and adhesive product and one week for the skimcoat product. The use of different review periods between plaster and adhesive products with skimcoat products is expected to reduce the cost of skimcoat cleaning. Inventory level parameters order up to level (S) are determined based on the following formula: d x (1 + R) + SS (equation 1),

with:

\[ d = \text{average demand} \]
\[ l = \text{lead time} \]
\[ S = \text{set-up cost per unit} \]
\[ P = \text{production rate per period} \]

To calculate the value of safety stock, a service level of 95% is used. Leadtime is determined based on the production rate for each product. From the calculation based on the formula, the results of the calculation of the order up to level are obtained as follows Table 2

In the method (R, s, S) the period of the review period (R) used is one day for the adhesive product and the acian product. So that in this period skimcoat products can be produced every day. There are 2 parameters of the target inventory, namely reorder point (s) and maximum inventory (S). This is what distinguishes the method (R, s, S) and the method (R, S). To determine the reorder point parameter (s), the following formula is used:

\[ \text{ROP} (s) = d \times l + SS (\text{equation 2}) \]

with:

\[ d = \text{average demand} \]
\[ l = \text{lead time} \]
\[ SS = \text{safety stock} \]

The safety stock and leadtime values used are the same as the method (R, S). From the calculations performed the following results are obtained:

- The maximum inventory value (S) is the sum of the reorder point (s) and EPQ (Q) in Table 4. Therefore, an EPQ calculation must be performed before calculating the maximum inventory. To determine the EPQ value, the following formula is used:

\[ \text{EPQ} (Q) = \sqrt{2DS / (l - d/p)} H) \] (equation 3)

with:

\[ D = \text{demand per period} \]
\[ S = \text{set-up cost per unit} \]
\[ P = \text{production rate per period} \]
\[ H = \text{holding cost per period} \]

From the calculation based on the formula, the results of the calculation of inventory targets are obtained as follows Table 3.
To prove that the designed tool is capable of producing the right decision, a numerical test is then performed by comparing the optimization results using the tool that has been designed with manual calculations. Date 01/31/2019 was chosen as a sample numerical test date with the calculation results as in Table 5.
Table 5 shows the updated inventory level information and the number of re-orders. The total need for production hours is 31.6 hours, so not all products can be produced, but production can be done with an allocation of 22 hours of production hours. Products that must be produced because the level of supply is less than consecutive demand are: MR-402-40KG (1), MR-301-40KG (2), MR-440-50KG (3), MR-480-25KG (4), MR-101-40KG (5). The need for production hours for all products is 8.1 hours. So that there are 15.9 production hours remaining, which will be used to produce products with the largest re-order quantity, MR-302-50kg (6), MR-400-25kg (7), MR-380-40kg (8), etc. If the results of the manual calculation in table 5 are compared to the results of optimization with the tools in figure 5, both results are match and the tools can be declared valid.

The next step is to simulate inventory control to find out the total cost and service level produced by each method so that it can be known which method is suitable for application. Simulation results for each method with demand data in the first quarter of 2019 can be seen in Table 6 to Table 8.

From Table 6, it can be concluded that in the January period, the method (R, s, S) produced the highest service level up to 100%. The method (R, s, S) is able to produce a higher service level 1.95% compared to the existing method. In terms of cost, the method (R, S) produces the lowest total cost of Rp. 373.592.841. Method (R, S) is able to produce cost savings of Rp. 5,427,636 compared to the existing method.

From Table 7, it can be concluded that in the February period, the method (R, s, S) still produced a service level value of 100%. The method (R, s, S) becomes the method with the highest service level and results 1.25% higher service level compared to the existing method. In terms of cost, the method (R, S) still produces the lowest total cost of Rp. 380.879.204. Method (R, S) able to produce cost savings of Rp. 5,907,775 compared to the existing method.

From Table 8, it can be concluded that in the March period, the method (R, s, S) produced a service level value of 99.80% and a total cost of Rp. 396,083,069. The method (R, s, S) becomes the method with the highest service level and the lowest total cost. This method results in a 1.25% higher service level and a cost savings of Rp. 5,270,329 when compared to the existing method.

V. CONCLUSION

From Table 9, it can be concluded that in the Q1 2019 period, the overall method (R, s, S) produced the highest service level value of 99.93% with a product shortage of (834) bags. This value is 1.29% higher than the existing method with a service level of 99.59% and product shortages (4,963). The service level in the method (R, s, S) is 0.34% higher than the method (R, S) which produces a service level of 98.64% and a shortage of products (16,648).

Product shortages in existing methods and (R, S) methods are dominated by the skimcoat product type that is only produced once a week. Inventories of skimcoat products have been exhausted before the next production period, this is due to the factor of an increase in the amount of demand that is greater than the safety stock. While this does not occur in the method (R, s, S) because the skimcoat product can be produced every day if the inventory level is below the reorder point.

The existing method becomes the method with the lowest set-up cost when compared to the (R, S) and (R, s, S) methods. The set-up cost in the existing method is Rp. 61,938,062, save more Rp. 1,696,370 compared to the methods (R, S) and Rp. 5,989,485 compared to the method (R, s, S). The set-up cost is influenced by the frequency of product change and skimcoat cleaning frequency.

The existing method and (R, S) method produced 587 times and 607 times set-up number. The method (R, s, S) produces much lower set-up number with only 298 times (almost 50% compared to other methods). This is because the method (R, s, S) has 2 inventory parameters namely reorder point (s) and maximum inventory (S), so production will only be carried out if the review period has arrived and the inventory level is less equal than the reorder point so the amount reorder will be optimal according to EPQ. Whereas in the existing method and method (R, S) when the review period has arrived, re-orders must still be made even though the number of re-orders is less than EPQ. The number of re-orders will have an impact on the set-up frequency.

Although the method (R, S) has a smaller number of product changes, the set-up costs obtained do not have a significant difference when compared to the existing method and method (R, S). In the method (R, s, S) skimcoat product replenishment can be done every day, this will have an impact on the cost of skimcoat cleaning in every changeover of plastering and adhesives products to skimcoat products.

The method (R, s, S) obtained the lowest inventory cost of Rp. 304,134,294. The inventory cost is Rp. 17,965,505 lower than the existing method and Rp. 5,469,796 lower when compared to the method (R, s, S). The amount of inventory costs will be influenced by the average of inventory amount that is owned every day. This is in line with the average inventory method (R, S) which is lower when compared to the other methods.

The amount of processing costs and the cost of inventory deviations will influence by the production amount (the number of requests for each method is the same). If the production amount is less than the amount of demand, automatically the amount of ending inventory will be less than the initial inventory.

The existing method produces the lowest processing cost, which is Rp. 764,488,302. The process cost of existing method a little more efficient when compared to the method (R, s, S) in the amount of Rp. 159,004 and Rp. 7,588,434 less than the (R, S) method. The higher processing cost in the method (R, s, S) is influenced by the initial inventory method (R, S) which is lower than the other methods. Although the existing method has a lower processing cost than the (R, S) method, this method has an higher inventory deviation Rp. 6,450,119 than the method (R, S). Likewise Method (R, s, S) which has an higher inventory deviation cost Rp. 13,161,658 compared to the methods (R, S)

Overall the lowest total cost obtained by the method (R, S) with a value of Rp. 1,152,029,693. The total cost is Rp. 15,130,801 more efficient compared to the existing method and Rp. 15,579,454 more efficient compared to the method (R, s, S). So it can be concluded that the method (R, s, S) is the best method in producing the highest service level, while the method (R, S) is the best method in producing the lowest total cost.
REFERENCES

[1] L. I. Nicolae, D. Tanasescu, and V. Popa, “Customer Expectations Management,” Valahian J. Econ. Stud., vol. 4, no. 3, pp. 91–100, 2013.

[2] M. Gansterer, “Aggregate planning and forecasting in make-to-order production systems,” 2015, doi: 10.1016/j.ijpe.2015.06.001.

[3] I. N. Pujawan and E. Mahendrawathi, “Supply Chain Management.” Penerbit Andi, Yogyakarta, 2017.

[4] F. M. Takey and M. A. Mesquita, “Aggregate Planning for a Large Food Manufacturer with High Seasonal Demand,” Brazilian J. Oper. Prod. Manag., vol. 3, no. 1, pp. 05–20, 2006.

[5] E. A. Silver, D. F. Pyke, and D. J. Thomas, Inventory and Production Management in Supply Chains, 3rd ed. John Wiley and Sons, 1998.

[6] J. Heizer, B. Render, and C. Munson, Operations Management, 10th ed. New Jersey: Pearson Education Inc, 2011.

[7] R. B. Chase, F. R. Jacobs, and N. J. Adequilano, Operation Management for Competitive Advantage. New York: McGraw-Hill/Irwin, 2006.