Fuzzy lead time application to material requirement planning piano UP B1 PE

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ABSTRACT

All the manufacturers are always tries to fulfill fluctuating and uncertain market demand in satisfy the customer needs. PT. XYZ is a music equipment manufacturing, especially piano. Over the last 2 years piano type UP B1 PE has the highest sales.

This research aims to estimate the length of lead time an optimal ordering of raw materials and raw materials requirement planning for next 5 months. Estimated lead time of ordering raw materials made using two methods, namely fuzzy techniques and Monte Carlo simulations. Both methods will then be compared using statistical techniques two side independent test using a significance level of 0.05 to determine the shortest lead time of ordering raw materials. To plan the requirement of raw materials use techniques of material requirements planning (MRP) because this method can be implemented in the company.

The results showed that the lead time of ordering raw materials using fuzzy techniques is smaller than the Monte Carlo simulation. To plan raw material piano UP B1 PE companies must begin planning on 6 November 2010 are for a component Treble Bridge. While the raw materials requirements planning piano UP B1 PE will end on June 23, 2011 as many as 26 types of components

Keywords

Lead time, material requirement planning, order, fuzzy, simulation

1. INTRODUCTION

All manufacturers always try to fulfill fluctuating and uncertain market demand accurately according to customer needs. With a good material requirement planning, the company can make the process of production according to customer demands. PT. XYZ an industry in the field of manufacturing of pianos. There are two types of pianos is produced by this company which are Grand type and UP Right type. Based on the historical data, known that the number of piano UP Right types has a higher rate of sales than Grand piano type. We choose B1 PE for the highest sales of piano UP right type.

In material requirement planning estimated delivery times of raw materials from suppliers who has planned is often does not match with the actual time that have set. There are several ways that can be used for estimate the lead time of ordering raw materials, 2 of them using fuzzy techniques and Monte Carlo Simulation. The problems occur at this time in the PT. XYZ is company do not have a good method for their material requirement planning. PT. XYZ do not apply a special method in planning of raw materials, currently company only calculate it manually. Planning done by setting the amount of production during a few period for be used as reference in planning ordering raw materials for the next period.

Based on background, the problem can be formulated as follows:
1. Which most method appropriate for determining the estimate lead time of ordering raw materials piano UP B1 PE using fuzzy technique or Monte Carlo Simulation?
2. How the sequence of raw materials requirements planning appropriate to piano UP B1 PE?

The objectives to be achieved in this research are:
1. Estimating the optimal lead order of arrival raw material piano UP B1 PE on time so that piano production process can went well.
2. Plan right number and the time needs for raw materials for piano UP B1 PE in order to fulfill the production targets that have been set.
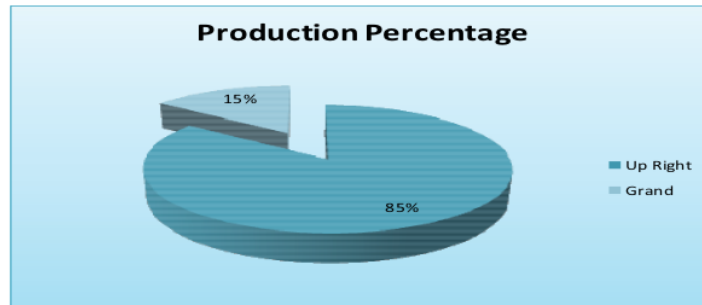
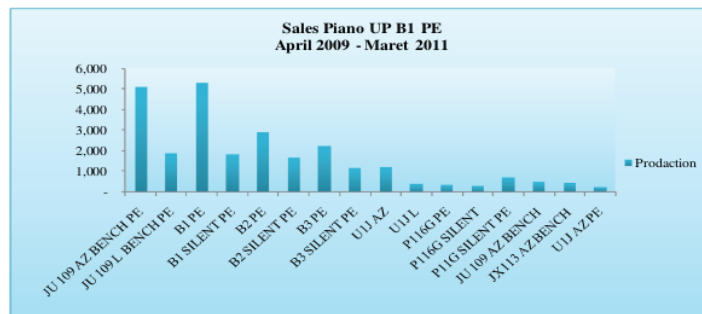Figure 1 : Production Percentage of PT. XYZ

Figure 2 : Graph of Total Sales Up Right Piano Period April 2009 to March 2011

2. LITERATURE REVIEW

Earlier studies were can be used as a source of literature conducted by [1] with title Application of Fuzzy Lead Time to a Material Requirement Planning System. Discussion of this research is the application of fuzzy techniques for estimating the lead time of ordering in material requirements planning. Estimated lead time ordering using fuzzy techniques will be compared with Monte Carlo simulation. Monte Carlo simulations created using a random number between 1 to 10.000 for 20 independent samples. To compare both methods used 2-way ANOVA statistical techniques. The results showed the fuzzy technique has the raw material ordering lead time is shorter compared to the Monte Carlo simulations

3. RESEARCH METODOLOGY

Estimating lead time is conducted to determine lead time optimal to be used for planning ordering raw material piano UP B1 PE. Estimating lead time done in 2 ways with fuzzy technique and Monte Carlo simulations. Both methods will be tested with statistical technique to choose the best method in estimating a lead time of ordering raw material B1 piano UP PE.
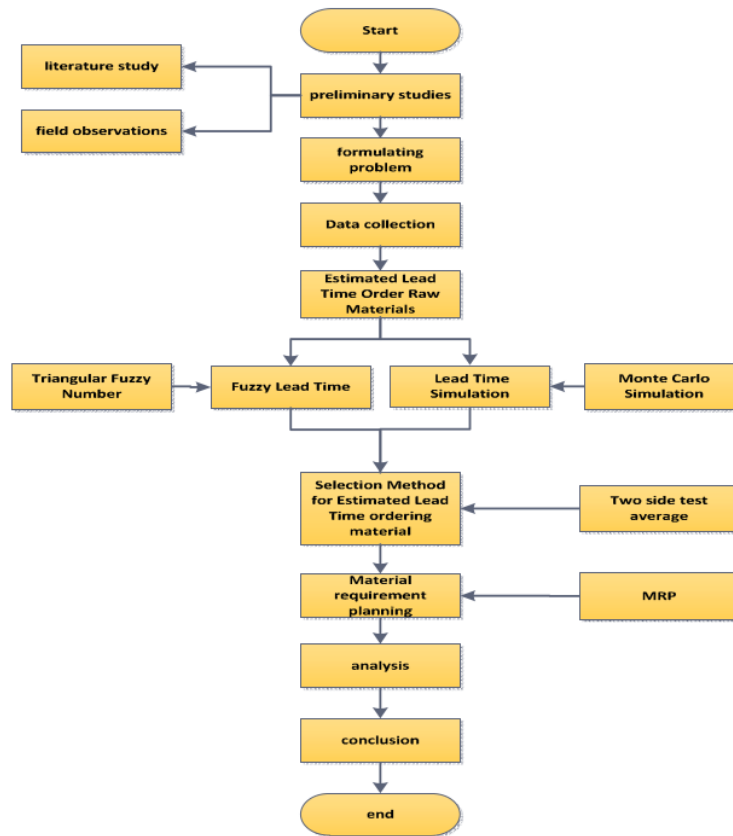
Figure 3 : Research Flowchart

Membership functions used in this research is triangle function (triangular fuzzy number). The steps in estimating a lead time of ordering raw materials consists of two processes that is fuzzyfication and defuzzyfication. [2]
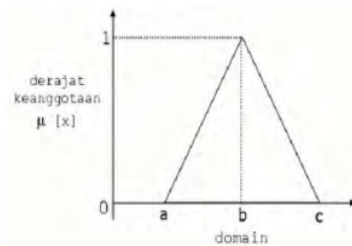

Figure 4 : Triangular function

To choose the best method between fuzzy techniques and Monte Carlo simulations in estimating lead time ordering raw materials used testing two hypotheses concerning two independent averages. From this statistical test is selected the average amount of lead time smallest.

The results of the plot pattern data used to determine the appropriate forecasting methods to forecast demand for the next 5 months. Piano sales forecasting UP B1 PE is calculated based on sales data last 24 periods. To forecast the demand piano UP

B1 PE comparison is done three forecasting methods. Forecasting methods used to forecast sales of pianos UP B1 PE in this research are a double moving average (3 monthly, 4 monthly, and 6 months), double exponential smoothing (using an alpha value of 0,1 to 0,9), and the naive method. To test accuracy of forecasting techniques are used MAPE (mean absolute percentage). The results MAPE smallest among forecasting method will be selected to forecast sales of pianos UP B1 PE.

4. RESULT AND DISCUSSION

Fuzzification process can be seen in table 2. Domain fuzzy set is consists of three values represented by the triangular fuzzy number. Linguistic language used are:
- Fast (F). Fast interpreted orders component pedal rail iron up to fast with fuzzy variables 19, 19, 39.5 in units of days
- Medium (M). Medium interpreted orders component pedal rail iron up to Medium with fuzzy variables 19, 39,5, 49 in units of days
- Slow (S). Slow interpreted orders component pedal rail iron up to slow with fuzzy variables 39,5, 49, 49 in units of days

Table 1: Determination of the variable and
the Universe Discussion Ordering Component Pedal Rail Iron
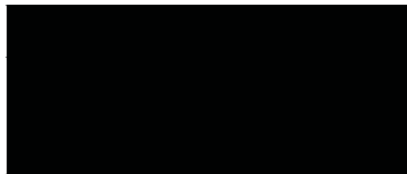

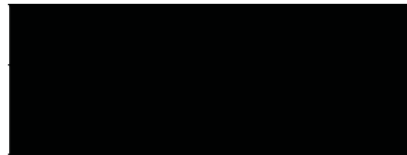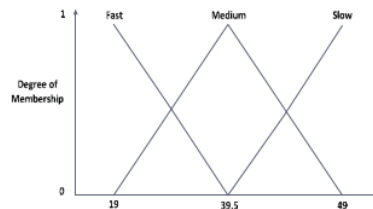*Table 2: Fuzzyfication Lead Time Oder Component Pedal Rail Iron*

Figure 5: TFN Curve Representation Lead Time Order Components Pedal Rail Iron
Based on table 3 both experts are equally say fast, so defuzzification lead time order Components Pedal Rail Iron as:

Table 3: Expert opinion, Average Geometry and
Crisp Value Components Pedal Iron rail

The basis of the Monte Carlo simulation is the experimental probability distribution using random numbers. Column order is defined as a period of raw material orders. On column LT defined as lead time actual delivery orders period n with the actual number of actual delivery orders (SUM). Cumulative column is cumulative probability ordering. Column interval is the limit number representing the probability of each result. Determination of the interval based on cumulative probability. Here are the results of Monte Carlo simulations for the components Pedal Rail Iron:

Table 4: Probability Distributions and
Cumulative Probability Distribution

Tabel 5: Recap Replication Monte Carlo Simulation

Table 6: Monte Carlo Simulation
Component Pedal Rail Iron

For selection estimation method of lead time ordering raw material piano UP B1 PE used statistical techniques two side independent test average. The purpose of this test is to determine the smallest estimate of lead time. The company wants raw materials can come fast. Here is two side independent test average:

Hypothesis:
$$H_0 \, : \, \mu_1 = \mu_2$$
$$H_1 \, : \, \mu_1 > \mu_2$$

As $Z > Z_{0.05}$, then Z is in the region of rejection so the decision H0 is rejected. Based on these decisions can be interpreted that estimated average lead time ordering raw materials using fuzzy techniques is smaller than using Monte Carlo simulations

Plot of sales data shown in Figure. 6. Based on a plot of data patterns on Figure 6 data in the period September 2009, November 2009 and December 2009 had an abnormal data patterns. A third data is removed then created a new plot of data patterns, shown in Figure 7. Based on table 8 forecasting methods has the smallest MAPE is double moving average 3 (DMA 3), and it will be selected in this research.

Lead time is result of fuzzy techniques for ordering the components Pedal Iron Rail is 24 days. Amount required to make 1 unit of the piano is as much as 2 units. Based on the inventory records that have been described, requirement planning component Pedal Rail iron are as:

Table 9: Recap MRP

4. CONCLUSION

1. Using a statistical technique two side independent test using significant level 0,05 z test statistic value of 5.83 and 1.645 for the z value table. Z value obtained test statistic is greater than the value of the z table, based on hypotheses which have made can be concluded that the optimal method for estimating the lead time of ordering raw materials piano type B1 UP PE is a fuzzy technique.
2. The method used for material requirement planning for pianos UP B1 PE is MRP technique. To plan material requirement planning pianos UP B1 PE companies must begin on 6 November 2010 for component Treble Bridge. Material requirement planning pianos UP B1 PE will be end on 23 June 2011 as many as 26 types of component

ACKNOWLEDGMENT

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