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Last Time Buys and Reuse at Océ

A last time buy decision tool for reusable service parts.

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Management Summary

Océ is one of the leading companies in document management and printing services for professionals. Océ offers all kinds of copying and printing systems. Most machines are sold with a service contract. In case the machine is broken, Océ needs to repair the machine within a certain time period. For this, service parts are needed. At Océ, the Planning and Inventory Control department (PLIC) is responsible for the availability of service parts. PLIC copes with difficulties in case a supplier stops producing a part; then Océ has the opportunity to buy a last amount of parts. This is called a "last time buy" (LTB). Océ needs to make an LTB decision, such that sufficient service parts are available to cover the demand over the remaining life cycle with high probability.

In case a LTB decision is needed, Océ can decide to make use of the Asset Recovery department (AR), or to execute only a LTB. AR can deliver reusable parts and distinguishes two types of supply:

- reusable parts from the field; parts that failed during their use, but which are repairable
- reusable parts from dismantled machines

AR has difficulties with forecasting the quantities and timing of reusable parts. Hence, the objective of this research is

to analyze whether and how the forecast of quantities and timing of reusable parts can be improved such that it can be integrated in an appropriate existing LTB calculation model while minimizing costs and obtaining an overall service target

Research approach

First, we analyze the current way of working with respect to LTBs and reuse. After that, we analyze the current performance of LTBs. The following step is to find in the scientific literature an appropriate existing LTB model for Océ. Subsequently we search for appropriate forecasting methods for the quantities and timing of reusable parts. Following, we design an LTB model for reusable parts that combines LTBs with reusing parts, such that PLIC and AR can make integrated decisions. Thereafter, we test whether the designed model is appropriate for Océ. Finally, we define an implementation plan such that Océ can use the designed model.

Results

The analysis of the current way of working shows that PLIC and AR have separate models to determine the LTB quantity and to decide whether to reuse parts respectively. Moreover, in case of an LTB, PLIC and AR do not collaborate well; LTBs and reuse are not combined and little communication takes place.

During the analysis of the current performance of LTBs, we encounter some data difficulties; among others, Océ did not register all LTB dates and quantities in the past. Nevertheless, we estimate that the total inventory value at the central supply center in Venlo (the Netherlands) consists for 10% of parts for which an LTB is executed. We observe from 7 example parts that PLIC scraps on average 53% of their LTB quantity and has sufficient stock for 99,97% of the demand. We expect that a LTB model may improve the relation between LTBs and reuse and may improve the average scrap percentage.

We cannot find any appropriate existing LTB model from the scientific literature for Océ, because we cannot apply generally used assumptions from literature to Océ; at Océ, the expected demand can be smaller than the expected supply in several time intervals, and the costs to make broken parts reusable can be higher than buying new parts. Therefore, we develop a model from own ideas and from the existing scientific literature.

In order to find appropriate forecasting methods for the quantities and timing of both types of reusable parts, we try several forecasting methods. We choose the best forecasting methods based on historical data. Compared to the current forecasting methods, we improve the:

- demand forecast by using an ellipse function, which is found in literature
- forecast for the timing and quantity of supply parts from the field by using the demand forecast, a deterministic yield rate, and the lead time
- forecast for the timing and quantity of supply parts from dismantling, by using the installed base forecast, a deterministic yield rate, and the lead time
- installed base forecast by using a Gamma pattern

For a LTB model for reusable parts at Océ, we design a decision tool for PLIC and AR, based on a heuristic. The objective of the heuristic is *to minimize costs while obtaining a certain probability that no stock out exists before the end of service date.* Given two alternative sources of supply (failed parts that can be repaired and parts from dismantling), the decision tool considers four scenarios: one, both or neither type(s) of supply are used. For each scenario, the tool gives as output the number of desired supply parts from the field and from dismantling, the optimal LTB quantity, and the total expected costs. We built the decision tool in Excel. Next, PLIC and AR can choose the scenario they prefer, combining the outcomes with their expert opinions.

We validate the model with the help of expert opinions and using real LTB cases. Engineers and managers of PLIC and AR expect that the generated forecasts are better than ones currently used. Unfortunately, we are not able to measure the performance of the new model accurately, since we have little data available. By only using the new demand forecast instead of the current one, it seems that Océ can decrease their LTB buying costs with about 22%. In case Océ is able to use both supply parts from the field and dismantling, we noticed from two real examples that the cost difference between using supply parts or only executing a LTB is 50%. So, we expect that Océ can decrease their overall costs and improve their LTB performance.

Conclusions

We conclude from our research that:

- It is hard to measure the current LTB performance. Not all information about LTBs is stored accurately in the past. We estimate that PLIC currently scraps 53% of their LTB quantities.
- The forecast for the quantities and timing of reusable parts can be improved and integrated in a designed heuristic that minimizes costs and obtains a certain no stock out probability.
- With use of the designed model, Océ is able to combine LTBs and reusing parts.
- Océ can increase their LTB performance by using the designed model. We expect that the LTB buying costs can decrease with 22% and the total expected costs can decrease more when the possibilities of AR will be used.

Recommendations

After conducting this research, we have the following recommendations:

- Implement the designed model; 1) define a committee of PLIC, AR, and service members, 2) make the model understandable to the LTB committee, 3) register decisions; store the LTB date and quantity, the chosen scenario, and for both types of supply, the desired supply for each interval 4) monitor executed decisions, 5) make the model more accurate, evaluate the developed model after several years.
- The committee should monitor the real and expected demand and supply numbers frequently. In case of differences, AR can take action in time by stopping or increasing the supply.
- For further research, we recommend to extend the model with a multi-item approach. If a machine is not dismantled yet, we want to decide whether it is interesting to set up the dismantle process.

Preface

This thesis is the last part of my master study Industrial Engineering & Management at the University of Twente. After completing my bachelor program and following master courses for one and a half year, I started with my master thesis project at Océ.

I fulfilled my research at the Planning and Inventory Control department and focused on last time buys in combination with reuse. A last time buy means that Océ has one last opportunity to order parts, which needs to be sufficient to be able to deliver service until the end of service date. At the time when I started with my research, Océ was not combining last time buys with the possibilities of the Asset Recovery department, which can deliver reusable parts. I designed a decision tool that calculates the expected demand, the expected supply from the field, the optimal last time buy quantity, and the total expected costs. With this decision tool, the involved departments can together make decisions. Last time buys and reuse can be combined in the future.

Without the support of several people, it would not have been possible to complete this master thesis. First of all, I would like to thank my first supervisor from Océ, Paul Rijk, for his suggestions, critical questions, and his time and effort to read parts of my thesis time after time. Secondly, I would like to thank Michiel Levels who gave me the opportunity to conduct my thesis at Océ and for his penetrating questions.
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