TKI DINALOG
Dutch Institute for Advanced Logistics

MAINTENANCE PREDICTION

MODIFICATIVE MAINTENANCE AT OCÉ

Improving the Modificative Maintenance process in the high tech industry.

Océ is a global leader in graphic arts, industrial printing and collaborative business services. One of Océ's products is the VarioPrint i300 (VPi300) printer, which was introduced to the market in 2015. The VPi300 has been designed in a short period of time and as a result there was room for improvement in the reliability of the first version of the printer. In the first few years multiple modifications have been performed; we propose a structured approach to deal with them.

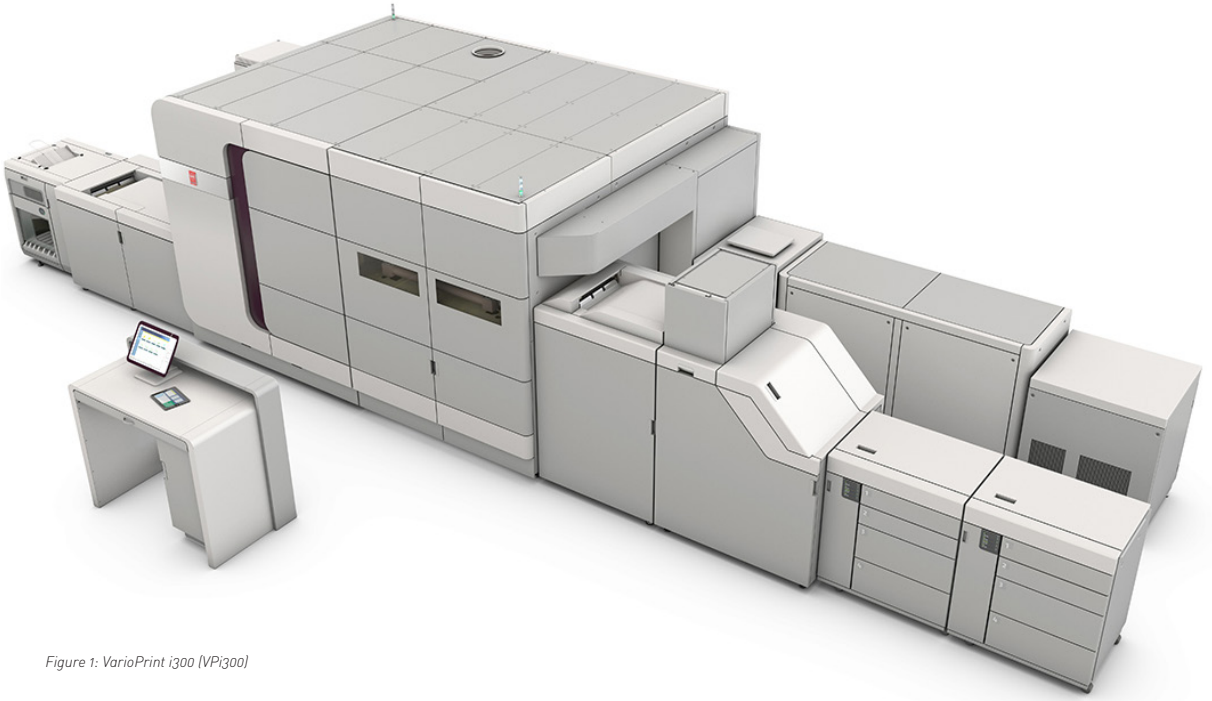

Figure 1: VarioPrint i300 (VPi300)

MODIFICATIVE MAINTENANCE PROCESS

The main topic of this research is Modificative Maintenance, which concerns developing and implementing an improved part in order to improve a maintenance related aspect, such as the component's reliability. We create an improved Modificative Maintenance process as shown in Figure 2. We use scientific literature of New Product Development Processes and input of several companies to find a process that results in the most suitable modifications. As a first step, we identify which parts underperform and we decide which problems the Research and Development department should address. Afterwards, a conceptual design is developed, which is judged in the decision step by a multidisciplinary team of specialists. If the response is positive, the design can be finished and several departments can start preparing for the change. We have further elaborated three steps in this research.

IDENTIFICATION OF PARTS

The first step in the process is identifying the most suitable parts. To get a better overview of how the performance of a part can be measured, a categorization of multiple possible performance indicators has been developed with five categories: Frequency, Maintainability, (Part) Costs, Consequences and Planability. This can be used to provide insight in the performance of parts in just five values. Furthermore, we have developed a model that uses the real data of several performance indicators together with the categorization, to identify how parts of the VPi300 perform which gives new insight in which parts should be modified. In this model, priority can be given to certain indicators. Within Océ, we found that the failure consequences and plannability are the most important categories.

ASSESSING MODIFICATION PROPOSALS

We next focus on step three: how can we assess possible modification proposals so insight is gained in whether we should finish the proposal or should stop the modification project. We develop a decision tree that incorporates several, quantifiable reasons

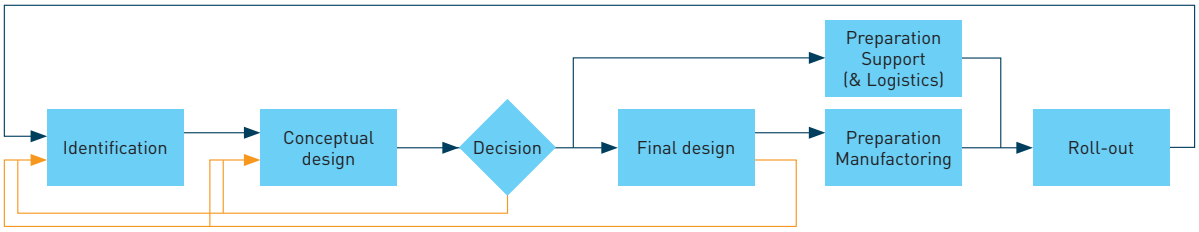

Figure 2: An overview of the renewed Modificative Maintenance process

for approving or rejecting a proposal as is shown in Figure 3. The last step in this tree is a formal cost-benefit analysis in which the costs for the current and future machines are incorporated as well as one-time costs. In a sensitivity analysis we show that in general improving the failure rate is the easiest way to reduce the costs of a part. Furthermore, we recommend to reduce Follow-Up Damage significantly and develop modifications as soon as possible so benefits will be gained over a longer period of time.

INTRODUCING MODIFICATION IN THE FIELD

The last step we investigate, is how to introduce modifications into the field. We developed a model that calculates the costs and consequences of several introduction strategies. In general there are two decisions that can be made: do we want to use our old spare parts inventory and how many parts do we want to replace preventively. We conclude this model especially works well, according to specialists, in complicated situations with several aspects that turn out to be high or low. Also, we showed the information found is useful and consistent with the expectations.

PRACTICAL EXAMPLES

To show the usefulness of the last two models, we have elaborated three case-studies within Océ. One of them, about the steamer of the VPi300, shows the renewed steamer will be beneficial for Océ and a large decrease of costs will be made; in the normal and worst case situation respectively around 62% and 39% of the costs can be saved. Also, we showed in this case, Océ should not use the old spare parts and change the old steamers preventively as soon as possible; in practice, this could happen during an already planned service visit to clean the steamer. This decision is different than the one developed by just the specialists. This example, together with the other ones, shows how this project is useful in a practical environment, using the theoretical background.

CONCLUSIONS

All in all, we have created a renewed process for Modificative Maintenance. We have further elaborated three steps in this process and showed the benefits for Océ in a case study. This process could be used in other companies as well and could improve modification processes in a wide variety of capital goods. The opportunities in this area are enormous, especially since the design times of new machines are decreasing.

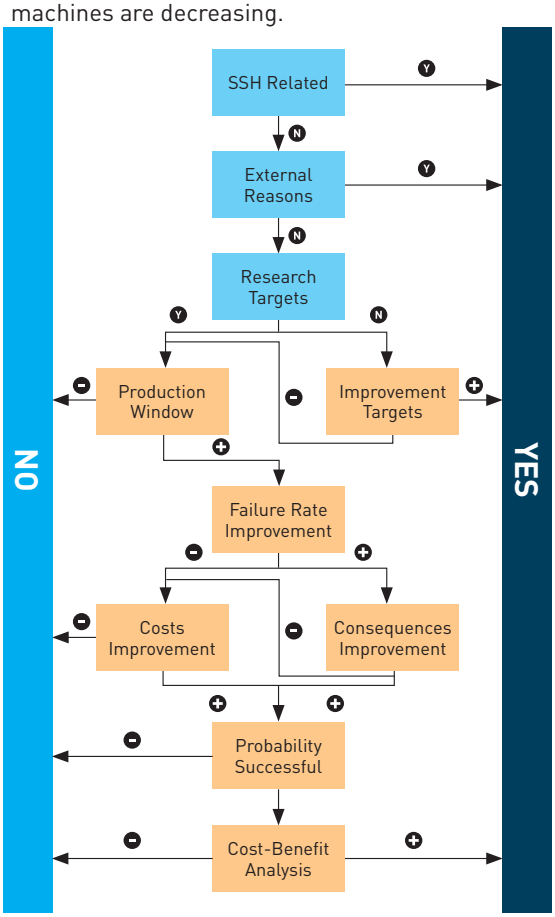

Figure 3: The decision tree to assess modification proposals

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ProSeLoNext project – Powered by:

Gordian Logistic Experts
TU/e Technische Universiteit Eindhoven University of Technology
UNIVERSITEIT TWENTE.
ERASMUS UNIVERSITEIT ROTTERDAM

Topsector Logistiek

This activity was co-financed by the Netherlands Organization for Scientific Research (NWO), on behalf of the Ministry of Infrastructure and Water Management.

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