

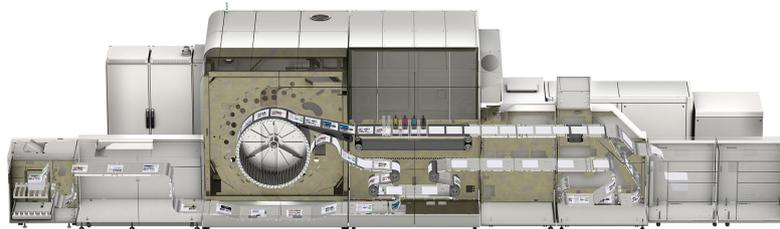
# Modeling of Océ production printers as manufacturing systems

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## 1 Subject

In this assignment we look at modeling the paper path of a large-scale production printer as a manufacturing system and optimizing the sheet schedules. Such a printer prints thousands of duplex images per day (e.g. books for Amazon), transaction printing (bank statements) on different media. The paper path of the printer is large enough to fit up to 100 sheets at the same time. As these sheets are to be printed on the front and the back by the same print head, the sheets printed once should be efficiently interleaved with unprinted sheets. The media and size of the paper may influence the minimum time between subsequent sheets at the print head, and the return loop needs to operate within a minimum and maximum speed.



To investigate the large-scale production printer in terms of timing and productivity, we propose to use a mathematical model that allows automated analysis and optimization of the manufacturing system. Recently, we have developed a formal modeling approach [1] to model manufacturing systems. In this assignment, you will investigate the application of this approach to create a behavioral model of the large-scale production printer. This model needs to capture the timing aspects, and in which order, and when, the printer can execute certain tasks. This model can then be used to optimize the printing sequence. If certain aspects of the production printer cannot be captured using the current modeling approach of [1], or cannot be analyzed with existing analysis methods, the approach needs to be extended.

## 2 About Océ

Océ Technologies, a Canon Group company, is an international leader in digital document management and printing for professionals. Many Fortune 500 companies and leading commercial printers use Océ solutions for wide format printing, high-speed production printing and document-related business services. Océ employs 4,000 specialists at innovation and technology centres in Europe, North America and Asia. Through its own Research & Development (R&D), Océ develops core technologies and the majority of its own product concepts.

## 3 Assignment

The assignment of this Master Project is to model and optimize the large-scale production printer using the formal modeling approach in [1]. The approach needs to be extended if certain aspects of the production printer cannot be captured.

The following steps are suggested:

1. Get familiar with the problem domain, and the formal modeling approach.

2. Develop models of the production printer that capture the relevant timing behavior and productivity aspects.
3. Use the models to optimize productivity
4. Evaluate the suitability of the modeling approach for this problem domain.
5. Extend or adapt the modeling approach and the supporting analysis methods if needed.
6. Optionally, develop domain-specific tool support for domain experts in using the formal modeling approach.
7. Report your approach and findings in a written report and a public presentation.

## 4 I want to know more!

The project is hosted by the Electronic Systems (ES) group, Electrical Engineering department. The project will be carried out at Océ in Venlo.

If you are interested in this topic (or something similar) for a project or internship, please contact Bram van der Sanden ([b.v.d.sanden@tue.nl](mailto:b.v.d.sanden@tue.nl)), Joost van Pinxten ([j.h.h.v.pinxten@tue.nl](mailto:j.h.h.v.pinxten@tue.nl)) and Marc Geilen ([m.c.w.geilen@tue.nl](mailto:m.c.w.geilen@tue.nl)) for more information.

## References

- [1] Bram van der Sanden, Joao Bastos, Jeroen Voeten, Marc Geilen, Michel A. Reniers, Twan Basten, Johan Jacobs, and Ramon R. H. Schiffelers. Compositional specification of functionality and timing of manufacturing systems. In *Forum on Specification and Design Languages, FDL 2016, Bremen, Germany, September 14 - 16, 2016*, 2016. in submission.