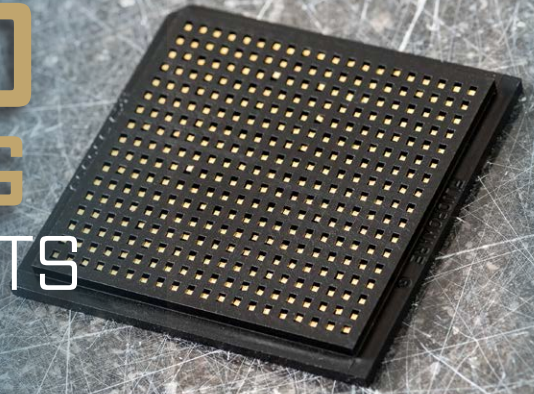


# AI-ENHANCED ORDER SCHEDULING OF HIGH-END COMPONENTS FOR THE SEMICONDUCTOR INDUSTRY



**T**he growing importance of semiconductors directly impacts the demand for high-end components in their supply chain. In particular, the requirements for these components need to be tailored to various applications. This high level of customization introduces greater complexity and flexibility into the manufacturing process. In particular, this creates challenges for cost-optimized scheduling of orders, machines and personnel – an optimization problem known as order scheduling or production program planning. MINTRES B.V. has therefore joined forces with Fraunhofer Institute for Production Technology IPT and Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente (FIP-AM@UT) to develop an intelligent production program planning module for their Enterprise Resource Planning (ERP) system.

## Introduction and Challenge

The semiconductor industry provides essential components for new technologies. Advances in artificial intelligence (AI), the Internet of Things (IoT), and 5G rely heavily on this sector. It serves as both a key enabler and a driver of innovation for these fields. As a result, the growing demand for advanced technologies is also amplifying the importance of this rapidly evolving industry. In recent years, it has also become clear that disruptions in semiconductor supply can cause breakdowns across global supply chains.

Mintres B.V., headquartered in Cuijk, the Netherlands, manufactures advanced thermal management solutions that are crucial to the global semiconductor industry as well as to the opto-electronic and photonics sectors.

As a supplier of high-end components for these industries, Mintres B.V. specializes in the development and in-house production of custom submounts and heat spreaders for high-performance applications.

The ability of Mintres B.V. to manufacture tailored high-end components for a wide variety of products, with highly variable turnaround times, requires the highest degrees of flexibility in product design and manufacturing processes. The flexibility to adapt to customer requirements adds complexity to production planning, as different products may necessitate a different sequence of processing steps. The increased complexity of planning affects the task of allocating resources to work stations and of order sequence scheduling. Moreover, Mintres B.V. operates in a constantly evolving environment, necessitating frequent re-planning due to unforeseen disruptions such as equipment breakdowns, staff shortages, or urgent order modifications. This further complicates the high-dimensional optimization problem of production planning.

Currently, solving this optimization problem (i.e. planning and re-planning of orders) is done exclusively by hand. Due to the complexity of the task and the dynamic nature of production at Mintres B.V., the planning process is





The usability of the intelligent planning module is enhanced through the integration into the existing system landscape of Mintres B.V.. The model seamlessly integrates with the ERP system for easy use. This ensures that current open orders in the system are always considered for planning purposes.

Moreover, a key component of the intelligent planning module is its user interface, which presents the final schedule to the planner and visualizes crucial insights into this schedule, such as potential lateness or punctuality of each order.

## Outlook

The intelligent planning module is the first step on the digitalization roadmap of Mintres B.V.. In the long term, Mintres B.V. aims to realize a digital and intelligent production utilizing a real-time-capable traceability system. The purpose of the traceability system is to precisely track orders and, consequently, to support the evolution of the production planning module. Additionally, it enables real-time monitoring of production through integrated dashboards.

Mintres B.V.'s strategy for digitizing their production responds to growing market demand for high-end components. The semiconductor industry in particular, with its evolving requirements for modern technologies such as AI, IoT and 5G, makes a faster and more flexible reaction an important competitive advantage. ■

time-consuming and often leads to not fully optimized production schedules, particularly in terms of punctuality, production volume, and efficiency.

## Target

In a joint digitization project with Fraunhofer IPT and FIP-AM@UT, Mintres B.V. aims to develop an intelligent and collaborative order scheduling ERP-module that provides planners with suggestions for highly efficient and timely manufacturing order schedules. Furthermore, the planner must have the option of re-planning under changed conditions and to manually adjust individual orders. This module is designed to tackle the challenges of resource allocation and order scheduling by assisting the planner in creating more efficient schedules and responding more quickly to disruptions.

The module needs to optimize scheduling by considering multiple factors, including machine capacity, varying worker skill levels, availability, and unforeseen changes. These constraints further add complexity to the planning task.

By implementing an intelligent scheduling solution, manufacturers can reduce planning complexity, enhance production efficiency, and establish a scalable framework that adapts to evolving operational demands. Such an intelligent planning tool not only

reduces planning efforts, but also improves resource utilization, reduces costs through bundling orders - where possible -, and identifies orders at high risk of delay. Consequently, an intelligent planning module provides a significant competitive advantage.

## Approach and Collaboration

The intelligent planning module facilitates evolutionary algorithms that mimic natural evolutionary processes, improving solutions over successive generations. In several successive iterations, the algorithm generates a variety of different production program plans, evaluates them regarding a specific optimization target, e.g. punctuality and efficiency, and refines them so that an optimal production program is ultimately proposed to the planner.

