

DynReAct PDP Newsletter #2

Optimizing Steel Coil Allocation with AI

In the steel industry, allocating steel coils to customer orders (*Coil Order Allocation - COA*) is a crucial challenge to ensure production efficiency, reduce waste, and meet delivery deadlines. Traditionally, this task has been performed manually by experienced operators who must balance numerous technical and operational constraints. However, thanks to recent advancements in Artificial Intelligence, it is now possible to significantly enhance this process, optimizing material usage and increasing productivity.

As part of the European project **DynReActPDP**, a team of researchers has developed an advanced coil allocation system based on Genetic Algorithms (GA), utilizing two innovative approaches: a standard method and an enhanced method incorporating a Fuzzy Inference System (FIS). Both methods have demonstrated superior performance compared to manual allocation, reducing material discrepancies and improving order completion rates.



Two innovative approaches to coils allocation

Coil allocation is a complex problem involving multiple factors such as material quality, dimensions, weights, and delivery schedules. The first developed approach employs a traditional Genetic Algorithm to minimize discrepancies between requested and allocated material while ensuring delivery priorities are met.







This method has significantly improved over manual allocation, increasing the **number of completed orders by 27%** and substantially reducing material waste. The second approach integrates a *Fuzzy Inference System* to **simulate human decision-making**. With this technology, the system can handle allocation criteria more flexibly, adapting better to production needs. While achieving similar performance to the standard algorithm, this solution offers greater adaptability and ease of customization, allowing the incorporation of

new optimization parameters without requiring complex mathematical model reformulations.



Concrete Results and Industry Benefits

Tests conducted at a tinplate production plant have confirmed the effectiveness of both approaches. The key benefits include:



- Increased order
 completion: Rising from
 54% (manual allocation)
 to 69% with the
 developed algorithms.
- Waste reduction: The average discrepancy between requested and allocated material
- **Resource optimization:** Better utilization of available coils, reducing the number of partially fulfilled orders.

These improvements not only enhance production efficiency but also provide significant economic advantages, reducing raw material consumption and improving customer service.







Future prospects

The implementation of Artificial Intelligence in coil allocation represents a major step toward **smarter and more automated steel production** management. Future developments aim to extend these algorithms to include additional optimization criteria, such as dynamic cost considerations and real-time coil availability variations. Additionally, combining Genetic Algorithms with other Machine Learning techniques could lead to even more efficient and adaptable solutions tailored to industry needs.

Thanks to the progress achieved in DynReAct_PDP, steel production management is becoming more **efficient**, **flexible**, **and sustainable**, marking a significant evolution in the **digitalization of the steel industry**.

Dissemination

The paper related to the work described in this newsletter, titled "Beyond optimality: Genetic Algorithms and Fuzzy Inference for Coil-Order allocation in the steel industry" authored by Marco Vannucci, Valentina Colla, Laura Laid and Erwin Sirovnik, will be presented at the 11th IFAC Conference on Manufacturing Modelling, Management and Control – IFAC MIM2025, which will take place in Trondheim, Norway, from June 30 to July 3, 2025.



D NTNU Production Managerr Research Group 11th IFAC Conference on Manufacturing Modelling, Management and Control Trondheim, Norway, 30 June - 3 July 2025

