

# Industry Solution Sheet: Manufacturing (Make to Order Approach)

## Challenges and Capabilities

The make to order (MTO) or build to order (BTO) manufacturing approach – which involves the production of goods based on confirmed customer orders and according to individual customer specifications – is used by manufacturing companies from a wide cross-section of industries including aviation, automotive, maritime, computer hardware, tooling, and construction.

These manufacturing companies must deliver highly customized products – such as aircraft, buildings, bridges, ships, computer servers, boring machines, and trucks – to customers in the shortest possible timeframe and at the lowest possible cost.

Although the MTO production process varies widely from project to project – sometimes requiring the complete design and development of a product from scratch (e.g. engineering-to-order) and other times merely entailing the assembly of a product using available inventory – there are some common challenges that all companies utilizing the MTO approach face, including:

- **Tight deadlines:** Customers expect short lead times, and the MTO production process only starts once an order has been received.
- **Supply chain complexity:** Each project involves a unique production process, and all the components needed to manufacture the product need to be custom ordered or procured.
- **Resource constraints:** Manufacturers using the MTO approach must be able to effectively manage scarce and critical resources such as skilled workers, machines, equipment, components, and spare parts.
- **Reducing operating costs:** Manufacturers employing the MTO approach must strive to minimize project costs by accurately estimating project timelines and budgets and efficiently using their resources throughout the production process.

In order to deliver MTO products on time and in full (OTIF) for customers, manufacturers must be able to manage the complexity of their supply chains, efficiently utilize their resources, and balance the tradeoff between project times and costs.

But achieving these goals – given the uncertainty and volatility in today's business world and the degree of

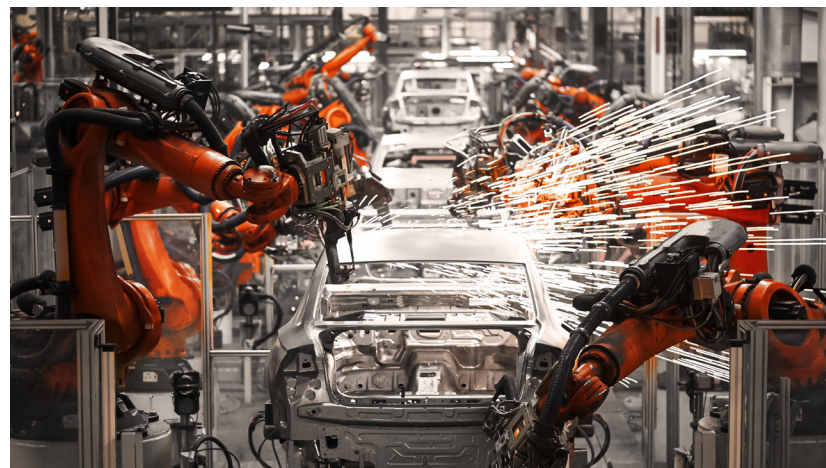
customization required for each and every customer order – can be a very challenging task.

For more than 50 years, MTO manufacturers have used the critical path method (CPM), program evaluation and review technique (PERT), along with mathematical optimization technologies to address the complex Resource Constrained Project Scheduling Problem (RCPSP) that they all face.

With mathematical optimization, manufacturers producing MTO goods can:

- Conduct scenario analysis during the bidding process to quantify and assess the tradeoff between project times and costs – so that they can accurately (and competitively) quote and bid for potential projects.
- Automatically generate optimal, data-driven plans under resource constraints that they can use to make optimal decisions on how to deploy their resources to maximize OTIF performance and minimize operating costs.
- Attain visibility over their end-to-end supply chains – so that they can track the progress of projects and tackle any bottlenecks that arise.
- Dynamically reoptimize their plans due to changing conditions in the market or on the shop floor.

With mathematical optimization, manufacturers of MTO products can balance the complex tradeoff between project costs and times, maximize the utilization of their resources, and manage their end-to-end supply chain operations – so that they can consistently deliver products to customers and profits to shareholders.



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## Opportunities for Optimization

Mathematical optimization enables companies using the MTO manufacturing approach to optimize many different planning and decision-making processes, including:



### Tactical

- Project Portfolio Selection and Optimization
- Capacity Planning
- Project Bidding and Planning Optimization
- Workforce Planning
- Spare Parts Inventory Planning



### Operational

- Resource-Constrained Project Scheduling
- Job Shop Production Scheduling
- Real-Time Dispatching
- Shift Assignment



## Business Benefits

With mathematical optimization, manufacturers adopting the MTO production approach can maximize their efficiency, balance the tradeoff between time and costs, and achieve numerous business benefits, including:

- Reduced operating costs
- Better utilization of resources such as skilled workers, machines, equipment, and spare parts
- Higher customer satisfaction and revenue growth
- Reduced project completion times
- Improved OTIF delivery performance
- Greater profitability

