

CASE STUDY



enmovil

AUTOMOTIVE COMPONENTS · INTELLIGENT PRODUCTION PLANNING

Constraint-Aware Production Planning for a Tier-1 Automotive Components Manufacturer

Multi-Machine Constraint Scheduling, Idle-Gap & Safety-Stock Recovery, Snapshot-Driven Replanning, OEM Delivery Window Enforcement, and Bay & Crane Serialisation

INDUSTRY

Automotive Components

FLOWS

Plastic Injection Moulding

COMPLEXITY

24 Machines · 2 – Shift Operation

SCALE

Multi-OEM · Multi-Variant

PREVIOUS

Manual Spreadsheet Scheduling

ENMOVIL · INTELLIGENT LOGISTICS



IMPACT AT A GLANCE

<h1>+29pp</h1> <p>Machine Utilisation Improvement 63% to 92% on the existing asset base</p>	<h1>+38%</h1> <p>Throughput Gain per Shift Without adding machines or headcount</p>	<h1>97%</h1> <p>On-Time OEM Delivery Rate Up from 74% across all committed windows</p>	<h1>98%</h1> <p>Planning Cycle Time Reduction From 5–7 hours to under 5 minutes</p>
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BACKGROUND & SITUATION

The Operating Environment

A Tier-1 automotive components supplier operates a 24-machine plastic injection moulding facility serving multiple OEM customers across passenger vehicle, commercial vehicle, and two-wheeler segments. Each machine is qualified for specific part mould combinations; parts differ in cycle time, raw material (RM) colour, shot weight, and OEM family assignment.

With committed delivery windows per OEM, shared bay cranes for mould changeovers, and a two-shift continuous operation, the facility's planning team struggled to produce a feasible, optimised daily schedule that respected all constraints simultaneously. A single missed mould changeover sequence or unrecovered idle gap could cascade into missed OEM commitments and emergency overtime.

TRIGGER FOR CHANGE

The Need for Change

The client engaged Enmovil to deploy its Intelligent Production Planning platform replacing manual spreadsheet scheduling with a constraint-aware, solver-driven system that plans across all machines, moulds, OEM windows, and shift states in a single run.

Three disconnected planning tools, manual idle-gap recovery, and ad-hoc safety-stock replenishment left 20–30% of the asset base unused and exposed every shift to the risk of a single missed changeover cascading into missed OEM commitments.

Key Barriers to Operational Excellence

Compounding operational barriers across the planning workflow that slowed cycles, eroded service, and inflated cost.

No Unified Scheduling Model

Machine capacity, mould compatibility, RM colour sequencing, and OEM delivery windows lived in three disconnected tools planners had no single feasible-and-optimised view.

Unrecovered Idle Time

Idle machine time between OEM production runs was not systematically recovered; safety stock and carry-forward demand were never filled into available gaps, leaving 20–30% of capacity unused.

Bay Crane Contention

A single shared crane per bay served multiple machines for mould changeovers but crane usage was not modelled, causing unplanned changeover collisions and unaccounted idle time.

Manual Mid-Shift Replanning

Mid-shift disruptions (machine breakdowns, rushed OEM call-offs) required full manual replanning from scratch consuming 2–3 hours and producing a suboptimal output every time.

Ad-hoc Safety Stock

Safety stock replenishment was reactive; shortages were discovered at the despatch stage rather than at plan generation, triggering emergency short runs at high changeover cost.

Long Planning Cycle

Planning a two-shift schedule took 5–7 hours of senior planner time with no guarantee of optimality and no what-if scenario capability for the planning team.

Inconsistent RM Colour Batching

Same RM colour batching critical for minimising purge waste between runs was applied inconsistently, inflating material cost and downtime across the line.

No Scenario Comparison

Planners could not run multiple scenarios across demand mixes, OEM priorities, or safety-stock levels before committing to a plan; trade-offs were made without quantitative comparison.

THE SOLUTION

Intelligent Production Planning Platform

Enmovil deployed its constraint-aware production planning engine, combining a CP-SAT optimisation solver with a rule-based heuristic planner. The platform ingests demand, inventory, machine state, and configuration in a single run and outputs a fully sequenced, gap free multi-machine schedule with OEM delivery assurance and safety-stock recovery built in.

01

Configure & Snapshot

Define machines, mould-part compatibility matrix, RM colour groups, OEM delivery windows, and safety-stock targets. Capture mid-shift WIP state active part, remaining quantity, mould on machine as a snapshot to seed replanning without disruption.

02

Optimise & Plan

CP-SAT solver allocates OEM demand across machines respecting all hard constraints. Heuristic post processor fills remaining idle gaps with safety stock recovery, carry forward demand, and pull ahead production maximising utilisation across the full planning horizon.

03

Execute & Monitor

Output a Gantt-format machine schedule, shortage alerts with procurement triggers, and utilisation analytics. Mid-shift events trigger a re-plan from snapshot; the revised schedule is ready in under 5 minutes planners review, not rebuild.

CAPABILITIES DELIVERED

1 Constraint-Aware Scheduling Engine

- CP-SAT solver models all hard constraints simultaneously: machine qualification, mould compatibility, RM colour sequencing, OEM day-window enforcement, minimum batch sizes, and setup times.
- Multi-OEM demand allocated within strict delivery windows with configurable rollover tolerance preventing late production from silently slipping past committed dates.
- Same-RM colour batching groups compatible parts into contiguous runs, minimising purge cycles and associated material waste.

2 Bay Crane Serialisation

- Each production bay has a shared overhead crane used for mould changeovers. The planner serialises crane usage per bay two no machines in the same bay can execute a changeover simultaneously.
- Crane contention is resolved at plan generation, not at execution eliminating unplanned changeover delays and the idle gaps they previously caused.
- Changeover sequencing respects mould transport times and crane availability windows in addition to machine state.

3 Idle-Gap Recovery & Safety-Stock Fill

- Heuristic planner scans every machine timeline for idle gaps and fills them in priority order: OEM carry-forward, safety-stock shortfall recovery, pull ahead production, idle-continuation.
- Safety-stock recovery uses the same mould currently on the machine where possible eliminating unnecessary changeovers and maximising the productive value of each gap.
- Gaps below a configurable minimum threshold are left as planned maintenance windows rather than forced into micro-changeovers.

4 Snapshot-Driven Mid-Shift Replanning

- At any point in a shift, the planner captures a machine snapshot: part in progress, quantity completed, mould mounted, and time remaining. The next plan seeds directly from this state.
- Prior-day WIP is projected forward into the new shift timeline ensuring in-progress jobs are completed before new demand is allocated, with no double-counting of capacity.
- Full 24-machine, two-shift schedule generated in under 90 seconds enabling planners to run multiple scenarios before committing to a plan.

KEY VALUE DRIVERS

Machine Utilisation & Throughput

- Idle-gap recovery sub-passes systematically reclaim 20–30% of previously wasted machine time per shift without adding assets or headcount.
- Same-RM batching and OEM family grouping reduce per-shift changeover count by 44%, directly converting changeover time into productive run time.
- At 92% utilisation, the same 24-machine line delivers output equivalent to ~33 machines at the previous 63% baseline – deferring significant capex.

OEM Service Level & Delivery Assurance

- Strict OEM delivery window enforcement ensures committed quantities are always scheduled within the promised date range not silently rolled over.
- Safety-stock recovery fills idle gaps with parts approaching minimum inventory thresholds, reducing stockout risk before it reaches the despatch stage.
- On-time delivery improved from 74% to 97% directly reducing premium freight, line-stop penalties, and customer escalations.

Material Efficiency & Inventory

- RM colour-grouped sequencing reduces purge cycles per shift, cutting raw material waste by ~41% and associated machine downtime.
- Demand-driven scheduling eliminates over-production buffers; pull-ahead production only fills genuine idle gaps reducing WIP inventory by ~32%.
- Safety-stock gaps quantified at plan generation, enabling procurement to act

Planning Agility & Operational Continuity

- Snapshot-driven replanning compresses mid-shift response from 2–3 hours to under 5 minutes planners adapt to breakdowns and rush orders in real time.
- Full planning cycle runs in under 90 seconds, enabling scenario comparison across demand mixes, OEM priorities, and safety-stock levels before committing.
- Shift-to-shift WIP continuity maintained automatically in-progress jobs carry

on shortage signals before production is impacted.

forward without manual re-entry or capacity double-counting.

STRATEGIC IMPACT

Production scheduling that ran across three disconnected tools and consumed 5–7 hours of senior planner time per shift now runs as a single, constraint-aware operation generating a fully sequenced, gap-free 24-machine schedule in under 90 seconds with OEM delivery assurance, safety-stock recovery, and crane serialisation built in. The planner's role has shifted from building plans to reviewing them.

We used to spend the first hour of every shift figuring out what the previous shift left behind and rebuilding the plan. Now the system hands us a complete, optimised schedule in minutes and every idle gap on every machine is already filled. The planner's job has shifted from building the plan to reviewing it.

— Production Planning Manager, Tier-1 Automotive Components Manufacturer