

OPTIMIZING AUTOMOTIVE PAINT SHOP THROUGHPUT AND BUFFER CAPACITY

ANYLOGIC CONFERENCE 2026



BE 6 SPORTEO

mahindra *Rise*



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A portrait of Anand Mahindra, Chairman of Mahindra Group, looking upwards and to the right. He is wearing a dark suit, a light blue shirt, and a red patterned tie. The background is a dark wood panel. A red and white diagonal graphic element is visible on the left and bottom right.

TOGETHER, WE RISE.

Anand Mahindra

Chairman, Mahindra Group
Padma Bhushan Awardee (for Trade and Industry)

**Auto Digital Centre – Aligned with
Corporate Tech and R&D Teams across all
Sectors**

**Auto, Farm, Truck & Bus, Electric Vehicles,
Engines, Two Wheelers verticals**

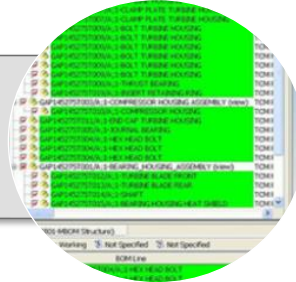
OUR TEAM & DEPARTMENT



**Manufacturing
Digital
Team CoE**

About CoE

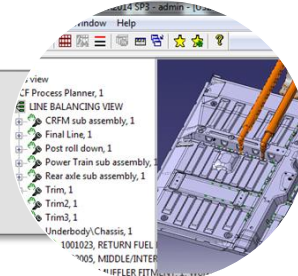
Mfg. BOM



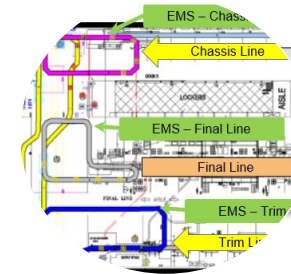
3D Factory VR / AR



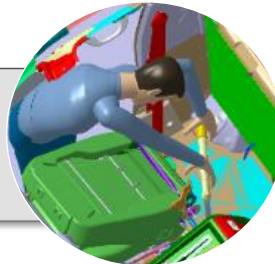
Process Planning Solutions



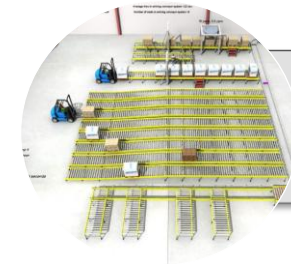
Discrete Event Simulation



Process Simulation



Logistic Planning

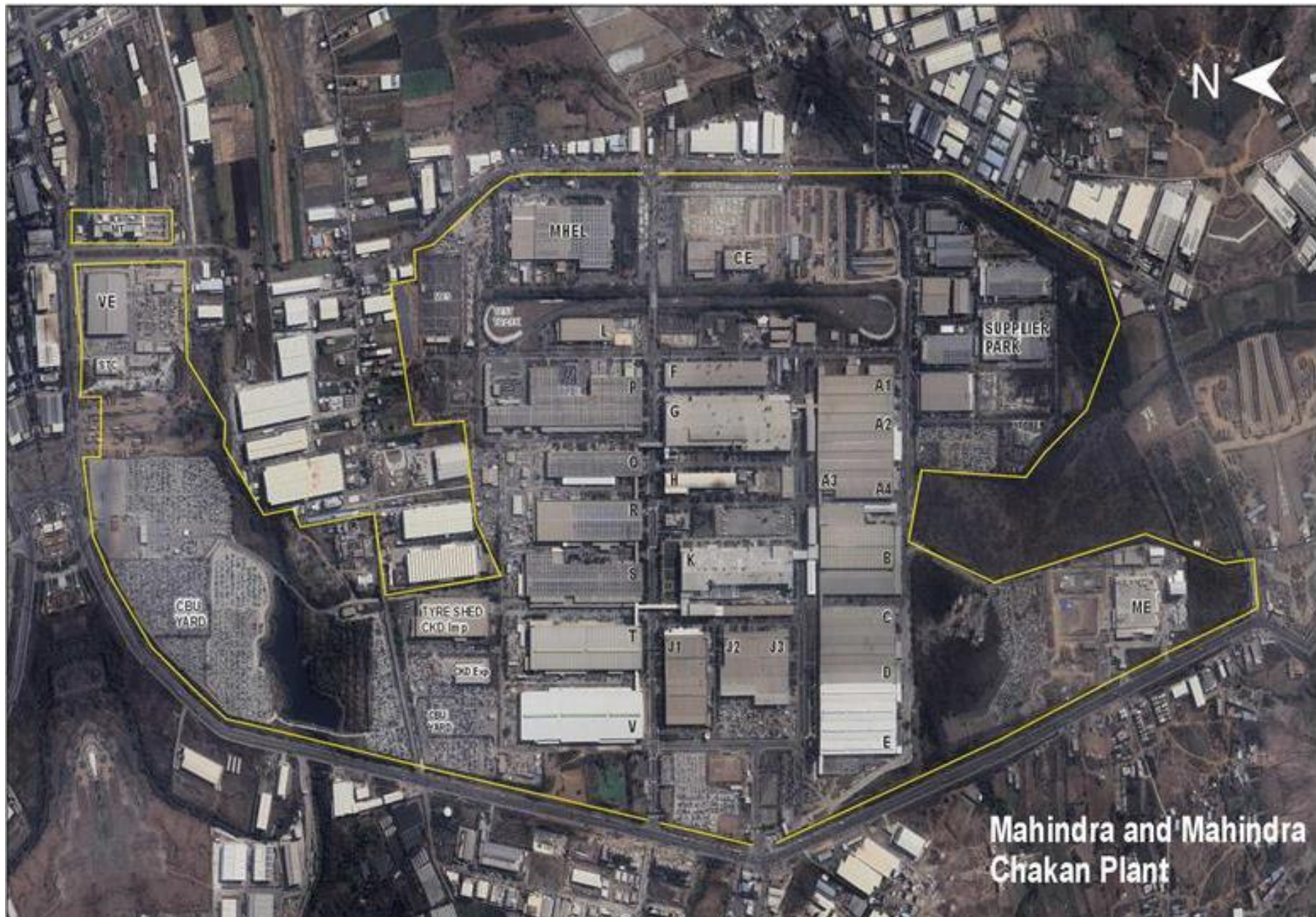


Digital Manufacturing

Product Design & Process Planning

Production & Capacity Planning

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Overview (1/2)



- Existing automotive paint shop designed to achieve a target throughput of **72 Jobs Per Hour (JPH)**.
- Proposed modification includes:
 - **Two Topcoat Booths** operating at **36 JPH each**
 - **One TuTone Booth** operating at **20 JPH**
 - Multiple curing ovens, conveyors, and intermediate buffer zones
- Complex multi-variant flow with vehicle sequencing and routing constraints between booths and ovens.
- Production impacted by shift changes, breaks, and end-of-day stoppages, requiring careful synchronization of operations.

Overview (2/2)

Key Focus Area:-

1. Throughput validation



2. Oven Strip-out capacity



3. Buffer Capacity Optimization



4. Bottleneck identification



Why Simulation ?

AnyLogic software was used to evaluate the proposed configuration and ensure smooth integration of the TuTone process with minimal operational disruption.

Executive Summary

Objective

- To validate the new proposed setup of two new 36JPH painting booths with TuTone Booth of 20JPH to meet a total throughput of 72 JPH(gross)
- To derive the buffer capacities of booth inlet and oven outlet
- To decide the requirement of ASRS or floor buffers

Background

- Concern-1 is sequencing of TuTone bodies after converting/modifications of existing booths to 36JPH(Line-A & Line-D). The current booth inlet floor buffers capacity for accommodating the new setup of 36JPH of each booth - might not be sufficient
- Concern-2 is strip-out capacity of the ovens - might not be sufficient

Assumptions – 1/2

- Proposed Capacity Planning for Booth and Ovens

Process Line	JPH
Sealer Oven	72
Line – A TC Booth	36
Line – D TC Booth	36
Tutone Booth	20
Oven-A	18
Oven-D	32
Oven-C	22
Oven-B	22

Production Line	Operations	Total Production Capacity
Sealer Line	2 Shifts	1128
Topcoat Line(Line-A & Line-D)	2 Shifts	1128
TuTone Line (Part of Line A & D output)	2 Shifts	626

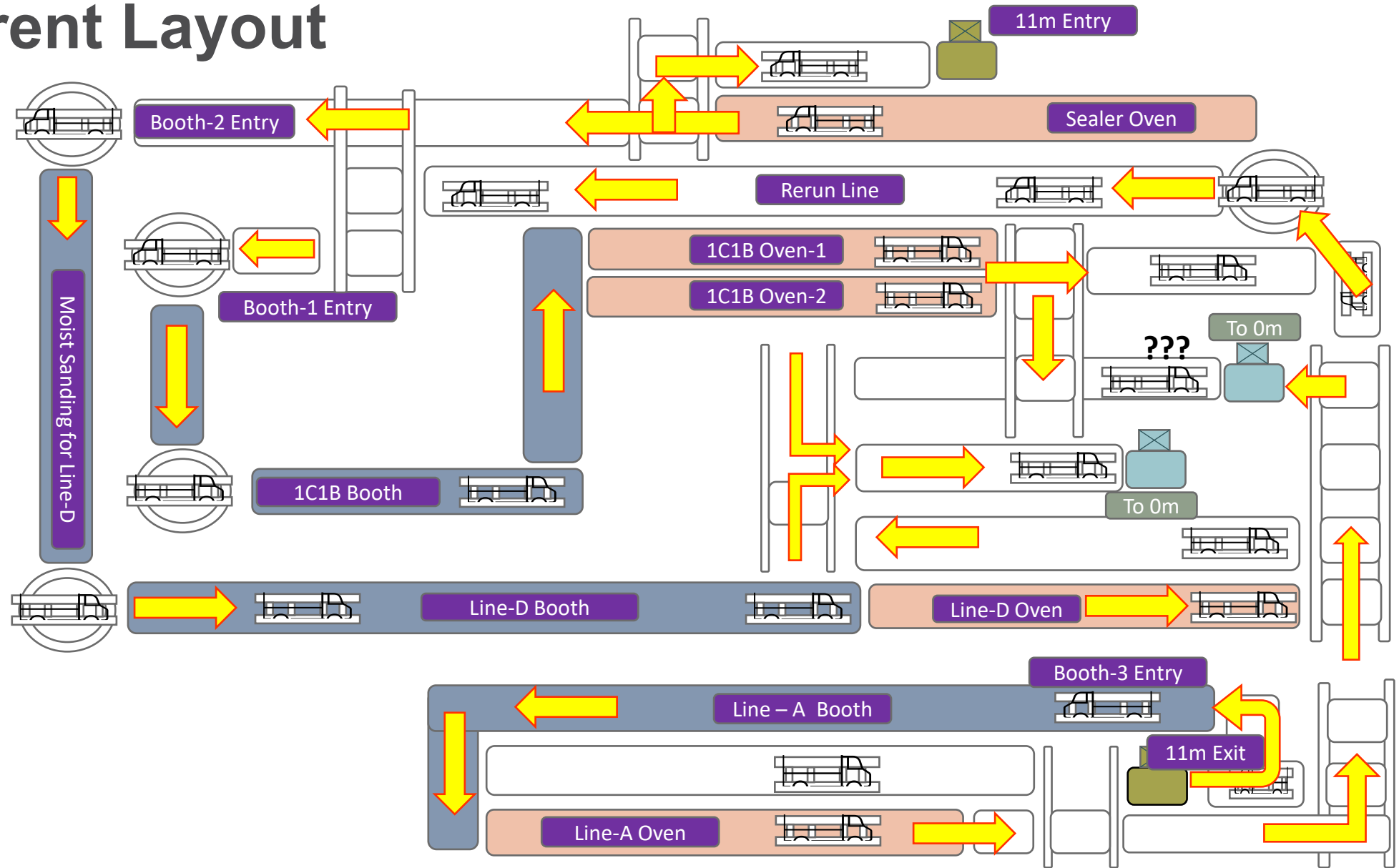
- Pitch : Booth pitch is 6.1m and Oven pitch is 5.6m.
- Operation Type : Booth is Stop&Go and Oven is Continuous
- Other transit locations : Roller beds of 5.8m pitch(Transfer time 14sec max.)
- Drop lifts operation : 72JPH(50sec total)
- Booth -1 Exit Ratio for Oven : 1:1
- Booth -2 Exit Ratio for Oven : Dynamic ratio split, depends on availability of conveyor

Assumptions – 2/2

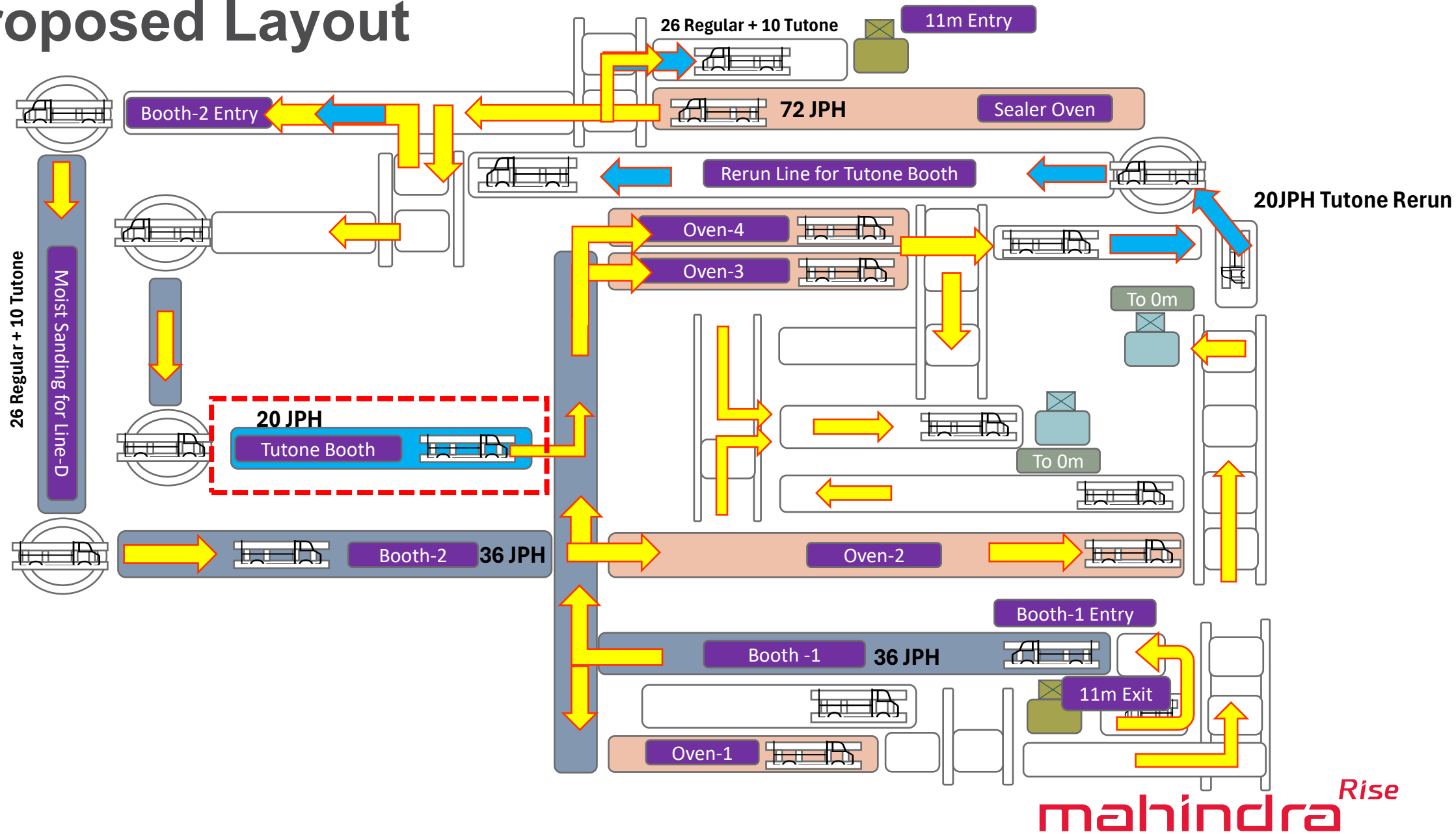
- Daily timings for 3 shifts

Day	Shift - 1		Shift - 2		Shift - 3	
Activity	Start Time	End Time	Start Time	End Time	Start Time	End Time
Prod.	06:30:00	08:30:00	15:10:00	17:15:00	23:50:00	01:00:00
Breakfast / Tea	08:30:00	08:45:00	17:15:00	17:30:00	01:00:00	01:07:30
Prod.	08:45:00	11:30:00	17:30:00	20:15:00	01:07:30	04:00:00
Lunch / Tea	11:30:00	11:55:00	20:15:00	20:40:00	04:00:00	04:07:30
Prod.	11:55:00	13:30:00	20:40:00	22:00:00	04:07:30	05:00:00
Tea	13:30:00	13:35:00	22:00:00	22:05:00		
Prod.	13:35:00	15:05:00	22:05:00	23:45:00		
JH	15:05:00	15:10:00	23:45:00	23:50:00		
Cleaning					05:00:00	06:30:00
Active Production Hours	7.83		7.83		4.92	

Current Layout



Proposed Layout



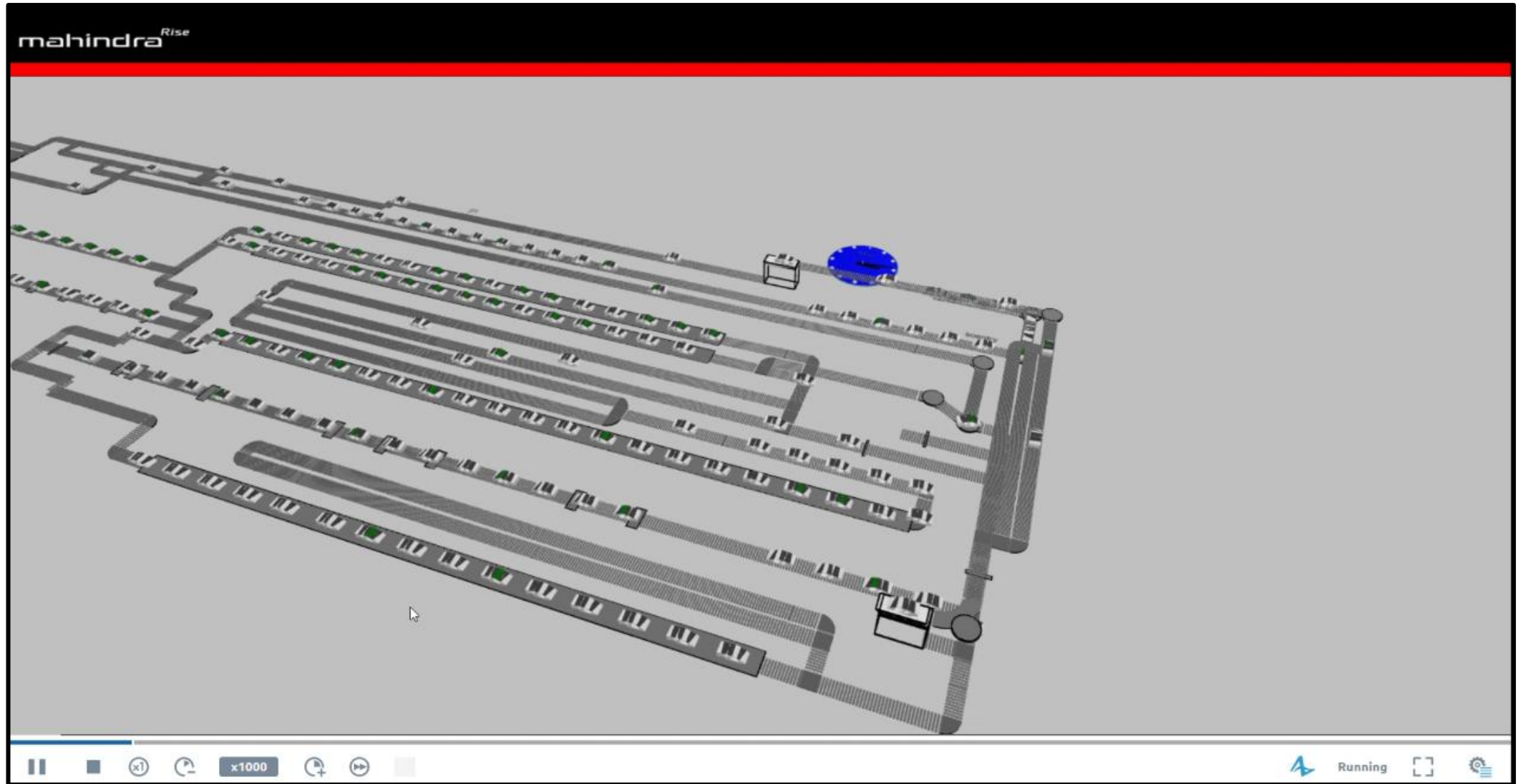
Modelling



Approach in Any Logic

- Developed a detailed Discrete Event Simulation (DES) model of the proposed paint shop layout using AnyLogic Material Handling Library.
- Modelled conveyors, turntables, drop lifters, buffers, painting booths, and curing ovens to accurately replicate the real production flow.
- Configured conveyor and process speeds based on actual pitch lengths and target JPH requirements to represent system capacities realistically.
- Implemented dynamic routing logic for vehicle distribution between Topcoat and TuTone processes, considering downstream availability and sequencing constraints.
- Incorporated shift calendars, breaks, cleaning periods, and end-of-day stoppages to capture real-world operational conditions.
- Used 3D layout visualization to improve stakeholder understanding and accelerate validation of the proposed implementation.

Simulation Video



Results



Scenarios

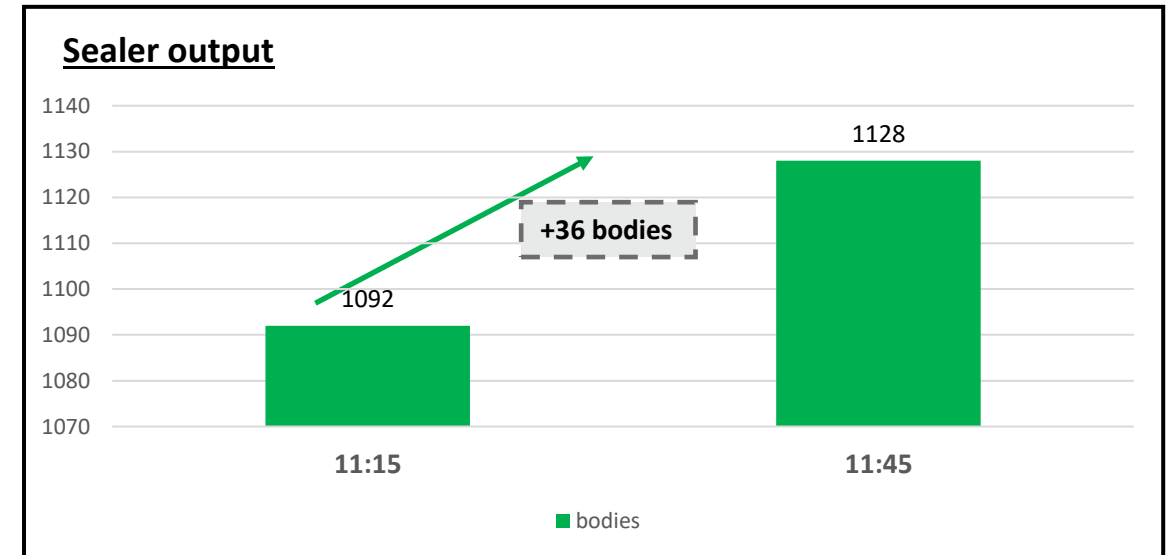
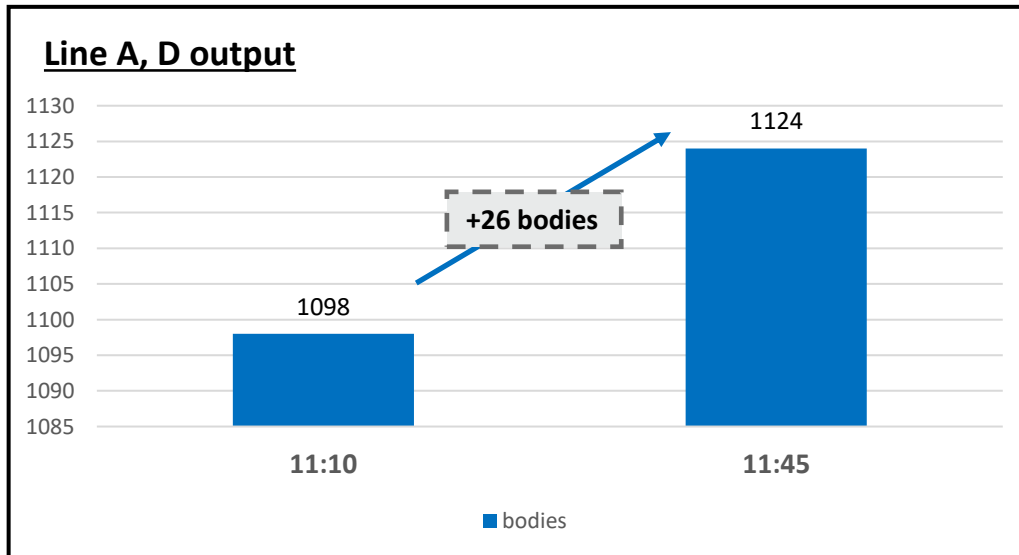
Scenarios Drafted (KPI) :-

1. 36JPH both booths. Without TuTone (JPH)
2. 36JPH both booths. 22JPH TuTone (JPH)
3. Scenario 2 with 2 shifts and breaks (JPH)
4. Scenario 2 with 2 shifts and breaks. Roof painting then body (JPH)

Process	Rated JPH	Speed (m/sec)	Scenario 1 Results JPH – 5 days	Scenario 2 Results JPH – 5 days	Scenario 3 Results JPH – 5 days	Scenario 4 Results JPH – 7 days
Sealer Oven Exit	72	0.4	72	72	66.76!!	65.99!!
Booth-1 Exit	36	0.061	36.00	36.00	33.33	32.97
Booth-2 Exit	36	0.061	36.00	36.00	32.6	32.6
Tutone Booth Exit	20	0.037	0	19.24	21.3	17.99
Oven 3, 4 entry	42	0.4	-	-	-	-
Oven-1 Exit	18	0.028	18.00	18.00	16.66	16.48
Oven-2 Exit	32	0.05	31.03	31.03	29.41	29.26
Oven-3 Exit	22	0.034	11.49	21.1	18.77	18.76
Oven-4 Exit	22	0.034	11.48	21.1	18.76	18.76
6.5m Out	72		72	72.08	66.5	66.18
Inferences			- Current infrastructure is sufficient when running without breaks and without TuTone. - Keeping oven 3, 4 working is optimal for achieving 72 JPH but now they are clearly under-utilized.	Adding TuTone bodies, we see a healthy usage of both the ovens with a slight headroom present	- Running with 2 shifts and break times creates an imbalance due to more bodies being produced by sealer compared to booths - Bodies are unable to exit sealer oven due to the buffer spaces becoming full.	- No change in this scenario because of the same underlying issue. - Tutone booth JPH dropped from ~21 to ~18 JPH in this scenario.

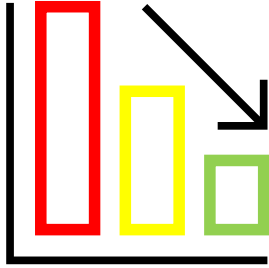
Inferences of optimization

- The working hours in day for **2 shifts** is **15.66 hours**. Including booth EOD inlet stoppage time (**11:10PM**), then it is **15.076 hours**
- With this, the number of bodies required to be produced by both booths in a day at **72 JPH** is
 $15.076 * 72 = 1086$ bodies
- **9 buffers** are required for the 9 stages at roof masking line (current Rerun line). At EOD, dual tone bodies exiting oven need to get stored. Provision can be made at **oven 3, 4 stripout buffers**
- If using Rerun line outlet stoppage:
 - More buffer space can be made available
 - Sealer can be run for 5 minutes extra per day (**11:20PM** instead of **11:15PM**)



Line A, D stoppage times. Sealer stop fixed at 11:45PM

Outcomes



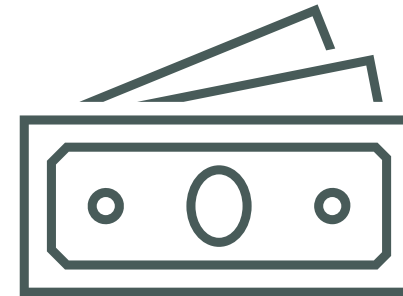
Lower Capital Expenditure



ASRS-Free Solution

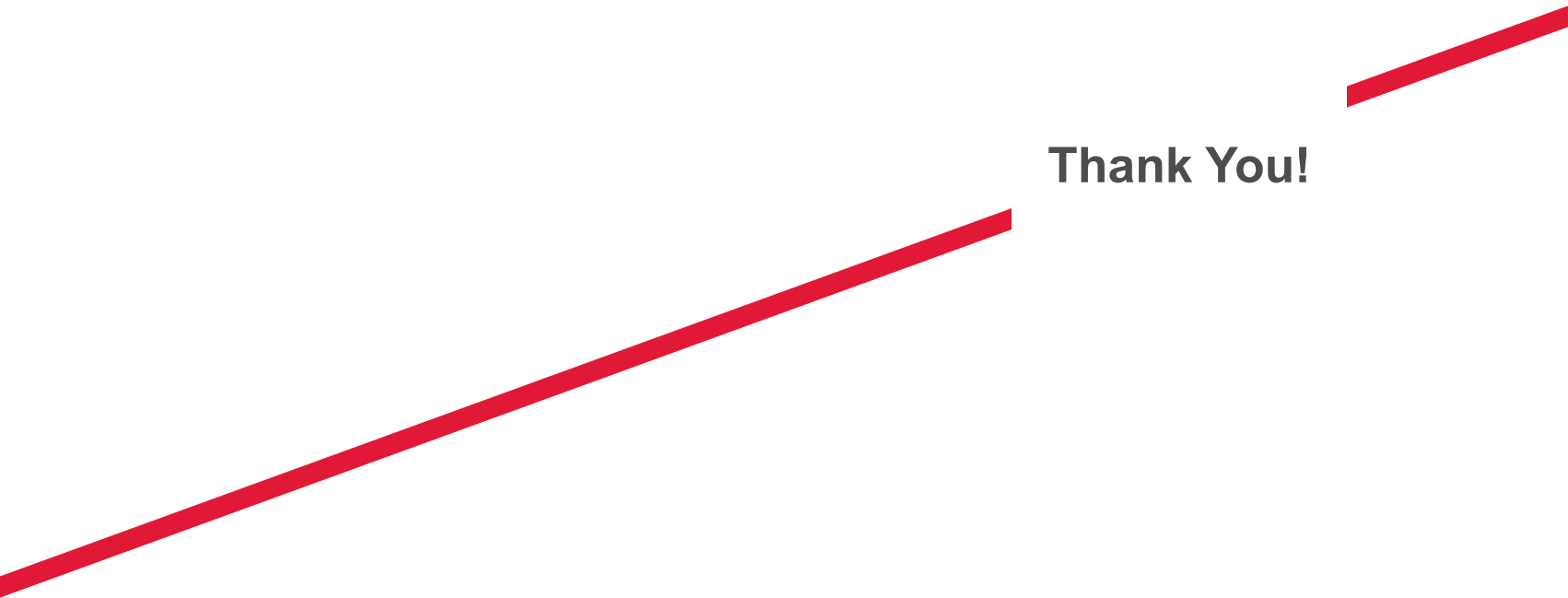


Layout Feasibility Validated



Significant Cost Savings

Q & A



Thank You!