Sagar Optimization

3D FlexSim Simulation Projects

Mob: 0091 990 912 9188

www.sagaroptimization.com

Email: info@sagaroptimization.com

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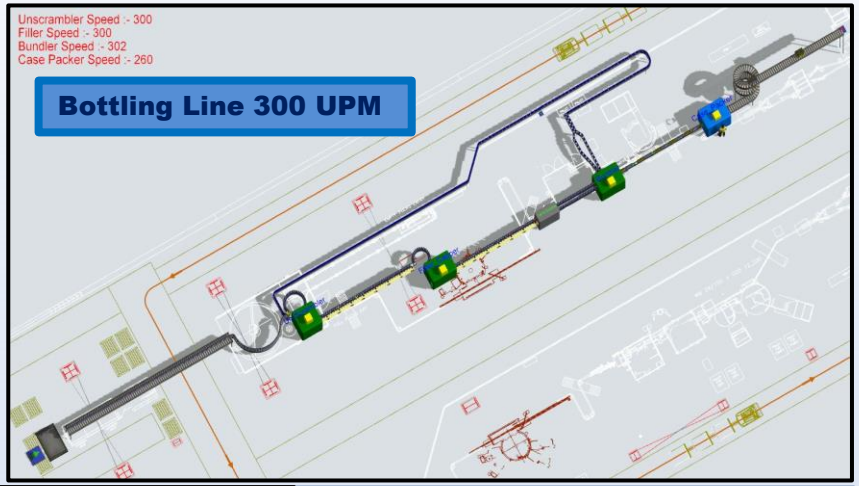
Bottling Line Simulation Model

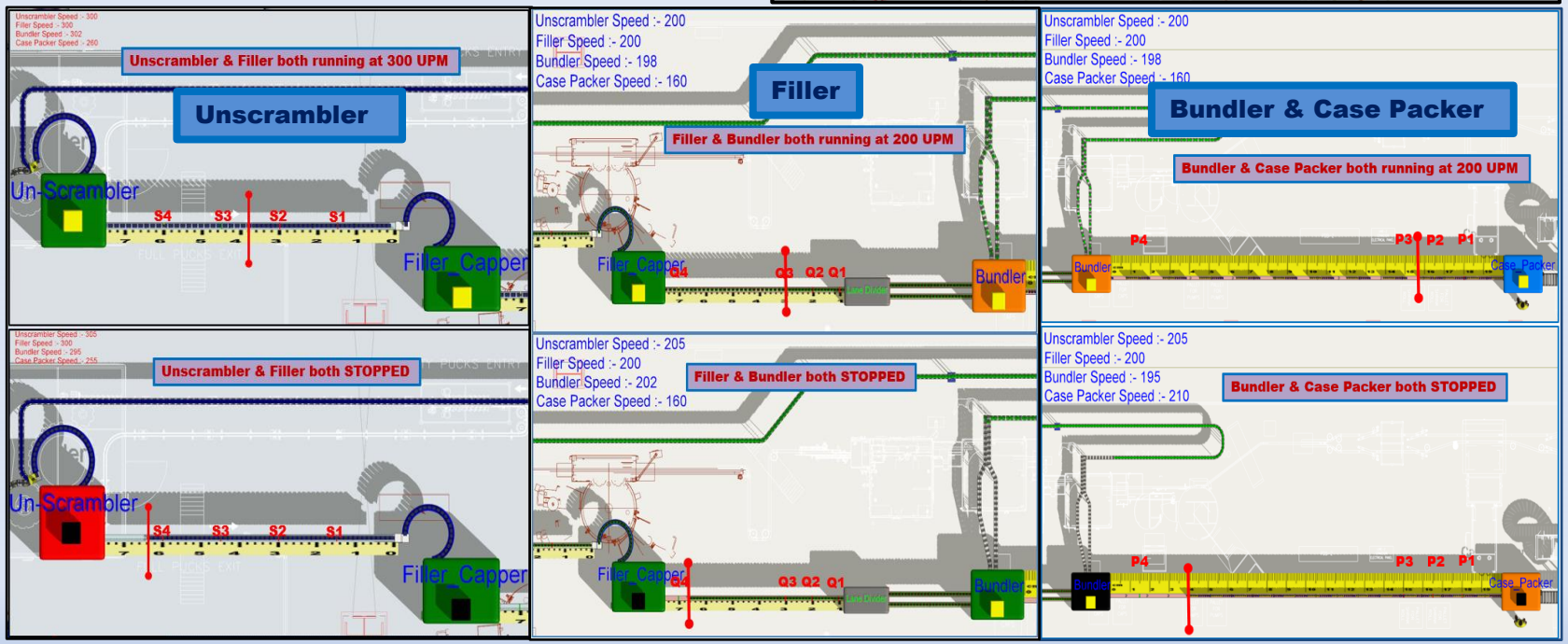
Purpose: Validating bottling line machine and conveyor speed parameters at each staging and optimizing material replenishment requirement for 300 UPM & 250 UPM lines.



Simulation Modelling:

- During steady run state i.e. when both unscramble & filler running at 300 UPM the length of conveyor b/w unscramble & filler requires => **3.8 Meters &** during STOPPED state i.e. when both unscramble & filler stopped the length of conveyor b/w unscramble & filler requires => **6.4 Meters**
- Analysed & scheduled Bottles, Cap, Label and packaging box replenishment requirement.

- ✓ Unscrambler Start Speed:- 305 UPM
- ✓ Unscrambler Ramp Up-Down: - 3 Sec
- ✓ Filler Speed:- 300 UPM (Constant)
- ✓ Filler Ramp Up-Down: - 1 Sec
- ✓ Conveyor speed b/w Unscrambler & Filler:- 390 UPM
- ✓ Total pucks requires in the in the system had been identified as :- 575
- ✓ Sensor Positions kept at different positions along the conveyors to start-stop as per buffer build up.



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Material Handling Automated Gantry System

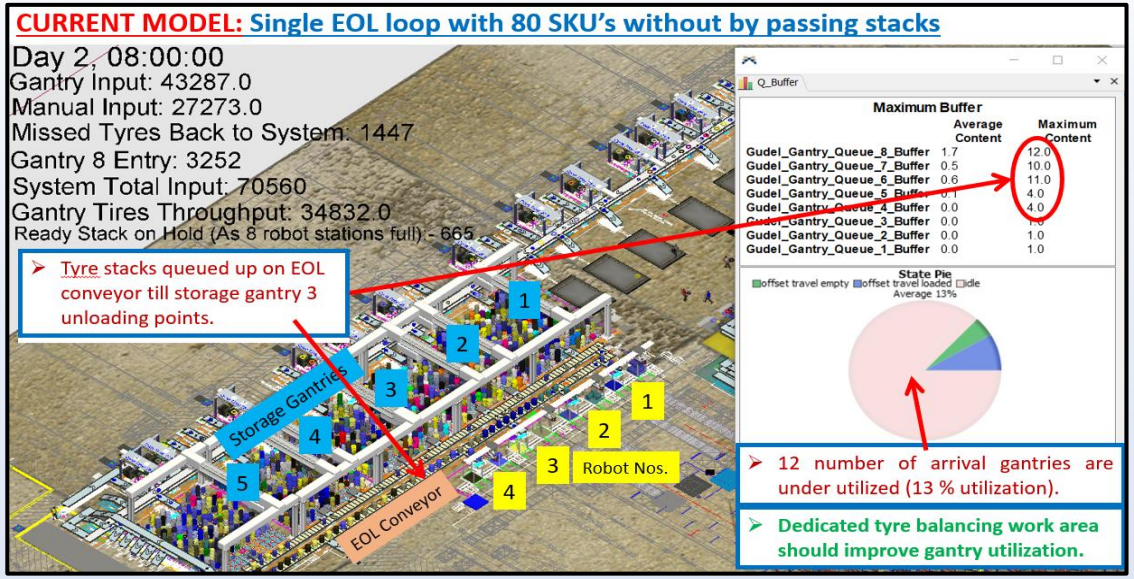
Purpose: Identify bottleneck in the finish tire automation system and propose optimized solution.

IDENTIFIED BOTTLENECK IN CURRENT MODEL:- Tire stacks build up at EOL conveyor. This bottleneck did not have any tire stack bypass flow for robot 1/2/3 unloading stations when robot 2/3/4 make up the pallet. When two consecutive pallet worth of tire stacks follow next to each other or randomly then waiting for robot 1 was 2 pallets worth of tire stacks.

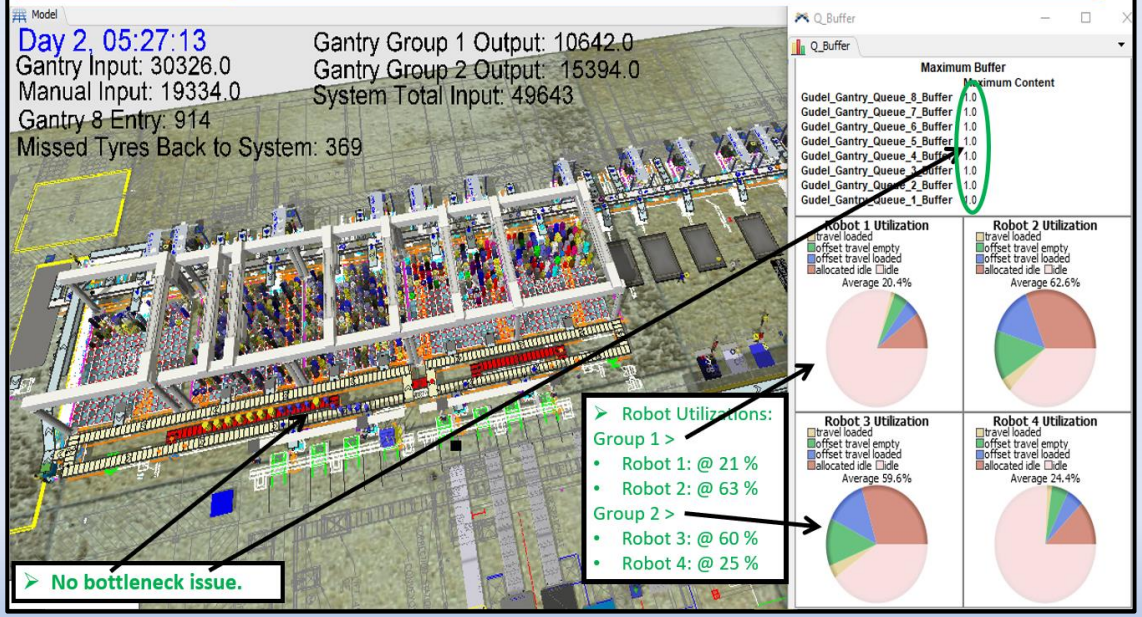
PROPOSE MODEL SOLUTION FOR ELIMINATING BOTTLENECK:-

- ✓ Installed two EOL conveyor loop with 2 dedicated robots in each loop with bypass flow for robot 1 & 3 tire stacks in loop one and two respectively.
- ✓ 1st & 2nd loop had 3 & 5 storage gantry exit connection with EOL conveyor.
- ✓ First loop had minimum 80% SKU's that has 8 tire stacks. If this configuration will not be considered then tire stacks build at first loop EOL conveyor.
- ✓ Robot utilization in both the loops were less utilize, which considered as reserved capacity when higher system throughput will be required.
- ✓ Top & Bottom express conveyor speed had to kept at minimum 65 meters / minute to eliminate tire blockage at entry conveyors 1 & 2.
- ✓ Model ran for different operator cycle time to process 49,500 tires / day.
  1) Operator cycle time: 20 - 25 seconds -> Target hit within : 18 hours
  2) Operator cycle time: 25 - 35 seconds -> Target hit within : 20 hours
  3) Operator cycle time: 30 - 40 seconds -> Target hit within : 22.5 hours

CURRENT MODEL: Single EOL loop with 80 SKU's without by passing stacks



PROPOSE MODEL: Two EOL loops with Group 1: 30 & Group 2: 40 SKU's with by passing stacks



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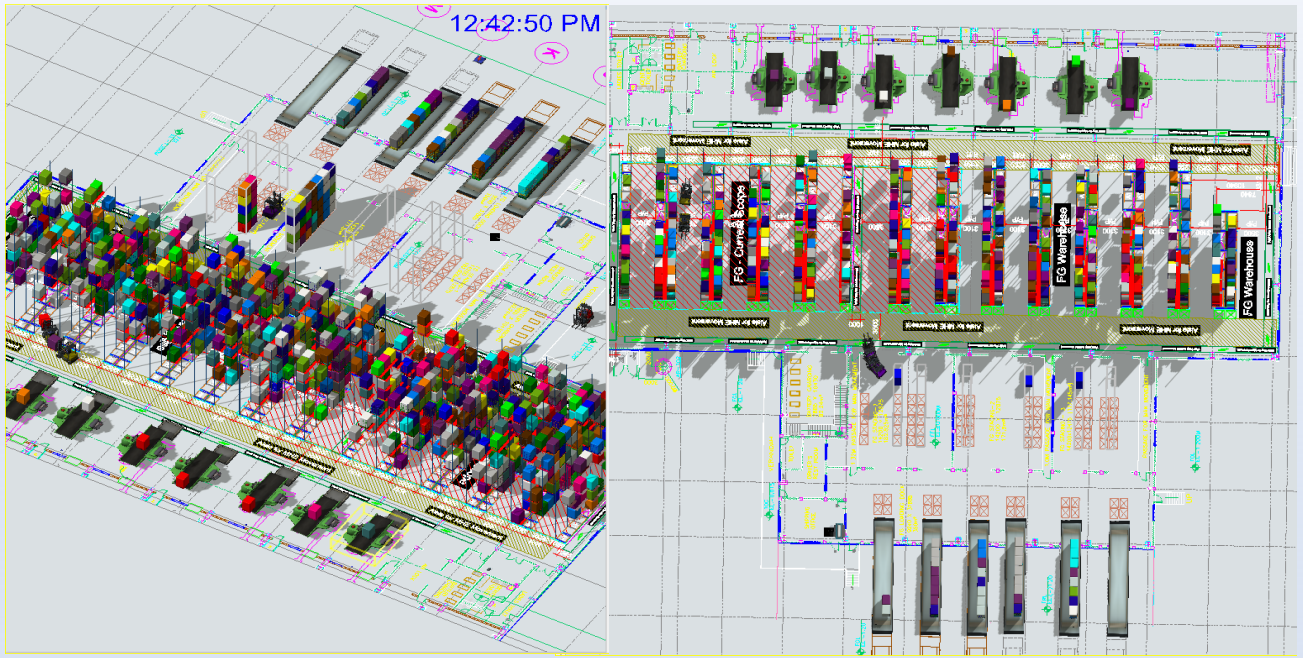
Warehouse Design Model

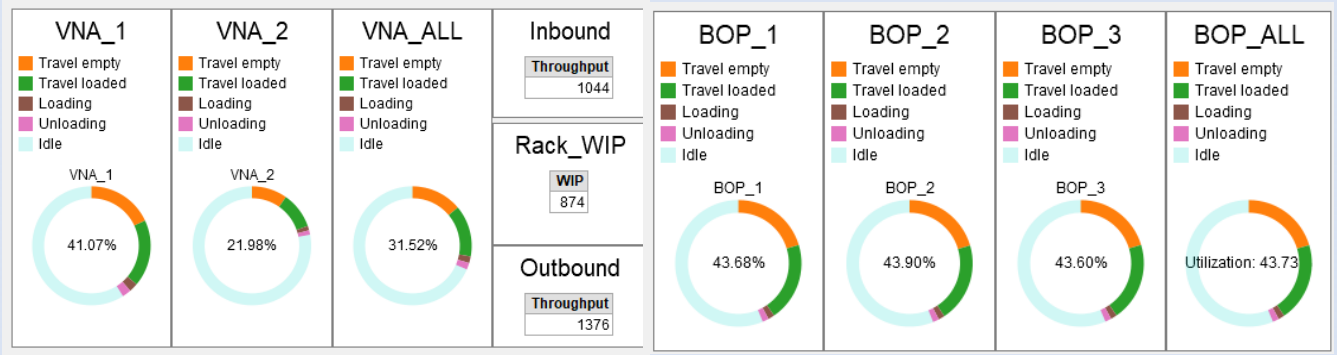
Purpose:

Design 3D warehouse simulation model to validate designed capacity, identify capacity constraints and number of BOP & VNA material handling equipment requirement.

Simulation Modelling:

- Warehouse simulation model developed identified below points:
  - ✓ BOP requirement reduced from 3 quantity to 2 quantity.
  - ✓ VNA requirement reduced from 2 quantity to 1 quantity.
  - ✓ Warehouse simulated to work worst case scenario.
  - ✓ Effect of weekend delivery only on internal warehouse storage capacity and next week production capacity requirement.
  - ✓ Analysis done to balance workload among BOP delivery team to work on multiple delivery requirement at one time instead all work on one delivery.
  - ✓ Identified bottleneck after palletisation due to no buffer storage after the process, which reduced production capacity to 780 per day instead of 1100 per day requirement.
  - ✓ Simulated product mixed warehouse storage capacity from minimum 19 types of 27 types of product mixed. Increased product mixed identified effect on delivery schedule due to less storage type in the warehouse.
  - ✓ Reduced rack requirement from 38 to 33 quantity due to production capacity constraint.





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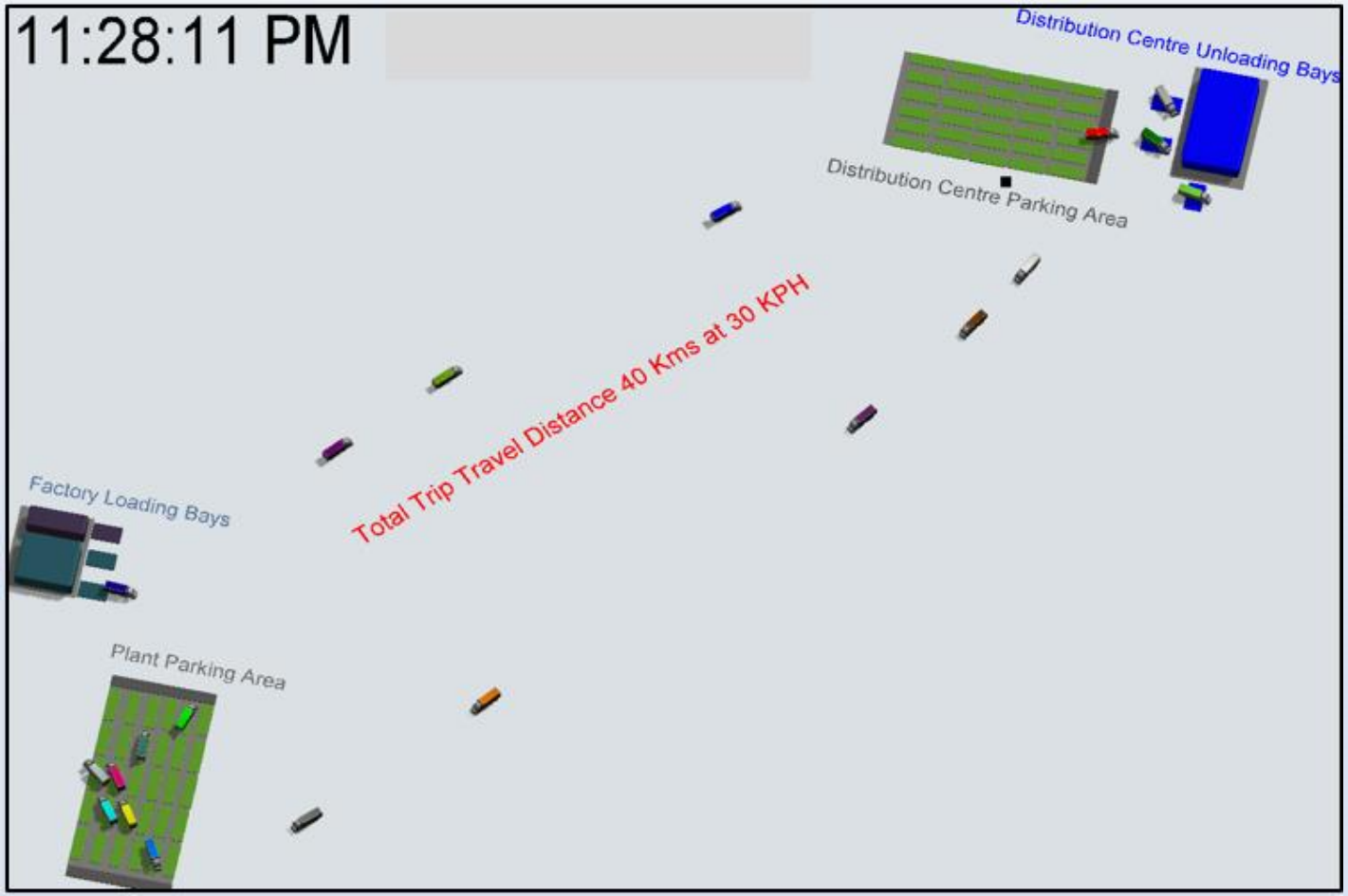
Supply Chain Transportation Optimization Model

Purpose: Develop simulation model to identify number of trucks require for To and From delivery between Factory and Distribution Centre locations considering different carrying capacity of individual transport trucks.

Simulation Model:

- ✓ Developed model identified to reduce 18 trucks and to work with 21 number of trucks for the goods movement between locations.
- ✓ Model considered both bay loading and unloading time as per truck carrying capacity.
- ✓ With help of simulation model analysis showed reduced lead times, more availability of company trucks and elimination of hiring contractual trucks.
- ✓ Inventory levels at both factory and distribution center optimally managed for further supply chain distribution at on time delivery.
- ✓ Parking area at both the locations had been used for other business use rather unnecessary hired trucks.



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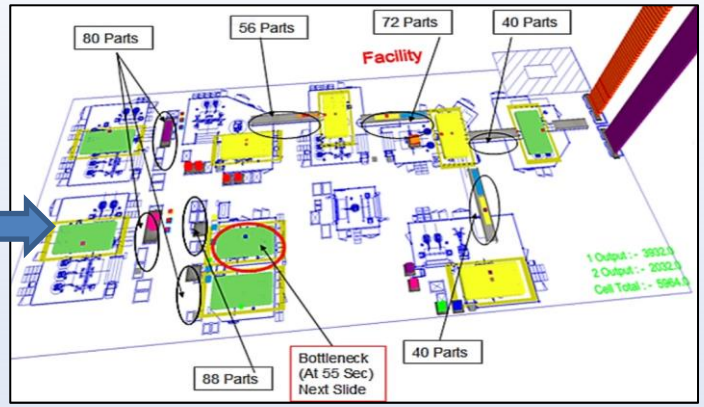
Robotic Weld Cell Layout Design

Purpose: Validating supplier designed robotic weld cell layout for number of BIW (Body In White) parts & propose optimized cell layout as per yearly forecasted demand.

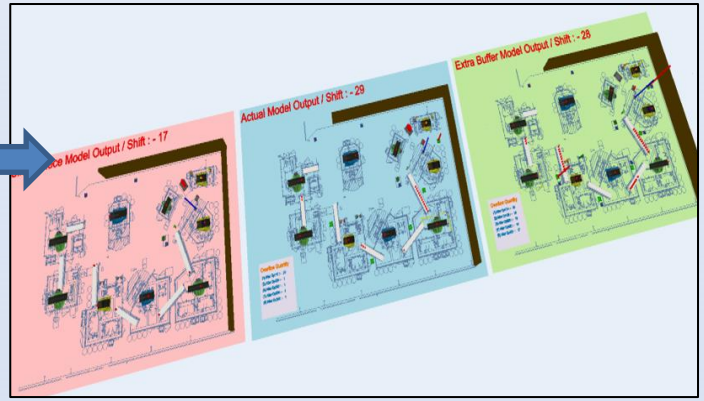
Simulation Modelling:

- simulation model developed for number of cell designing element:
  - ✓ Deciding Gangway size for forklift crossing
  - ✓ Sub assembled cell throughput effect on complete weld cell
  - ✓ Logistic material replenishment frequency and scheduling
  - ✓ Operator ergonomics & Cell layout shape validation.
  - ✓ Process flow analysis for balancing workload as per Takt time
  - ✓ Cell breakdown effect on system throughput
  - ✓ Identifying bottleneck for optimal buffer / inventory level
  - ✓ Propose new layout as per available space and process data
  - ✓ Effect of conveyor buffer size on cell throughput
  - ✓ Identifying WIP & operator necessity to balance work load
  - ✓ Effect of cell layout on throughput based on single piece flow
  - ✓ Verifying effect of implementing Kanban / 2 Bin system

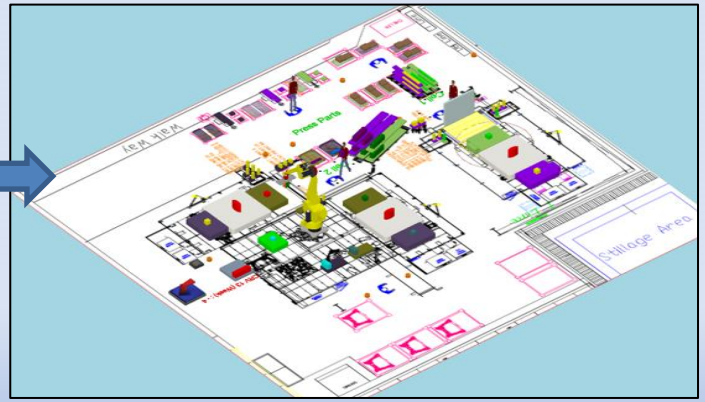
1) A Pillar Reinforcement Cell Layout showing bottleneck process



2) Carrier Under structure Cell Layout showing 3 models scenarios



3) Seat cross member Cell Layout showing operator requirement as per Takt time of the cell



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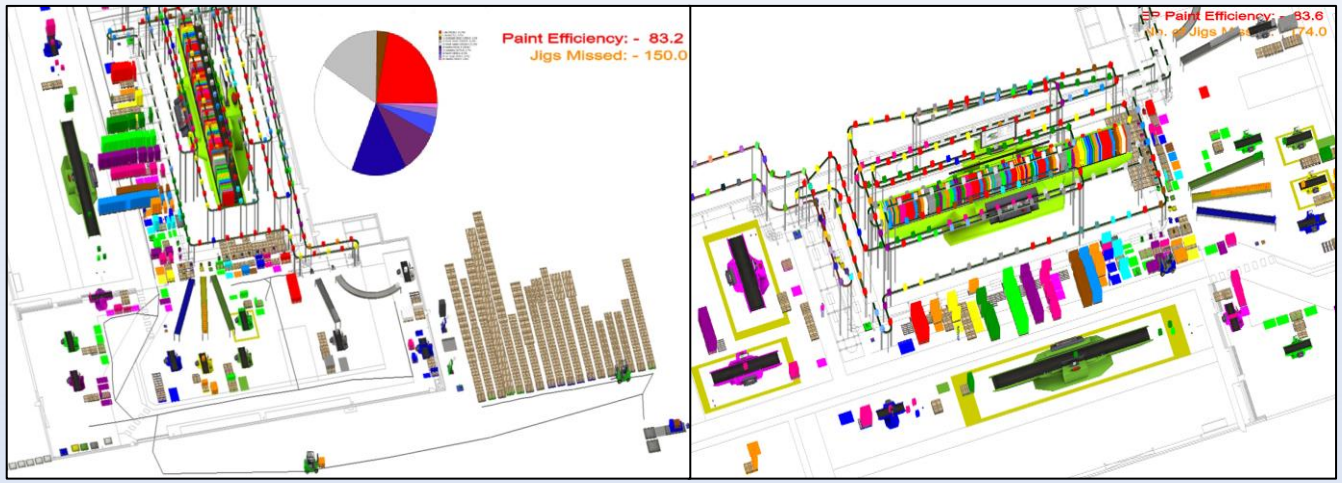
Paint Plant Capacity Planning Model

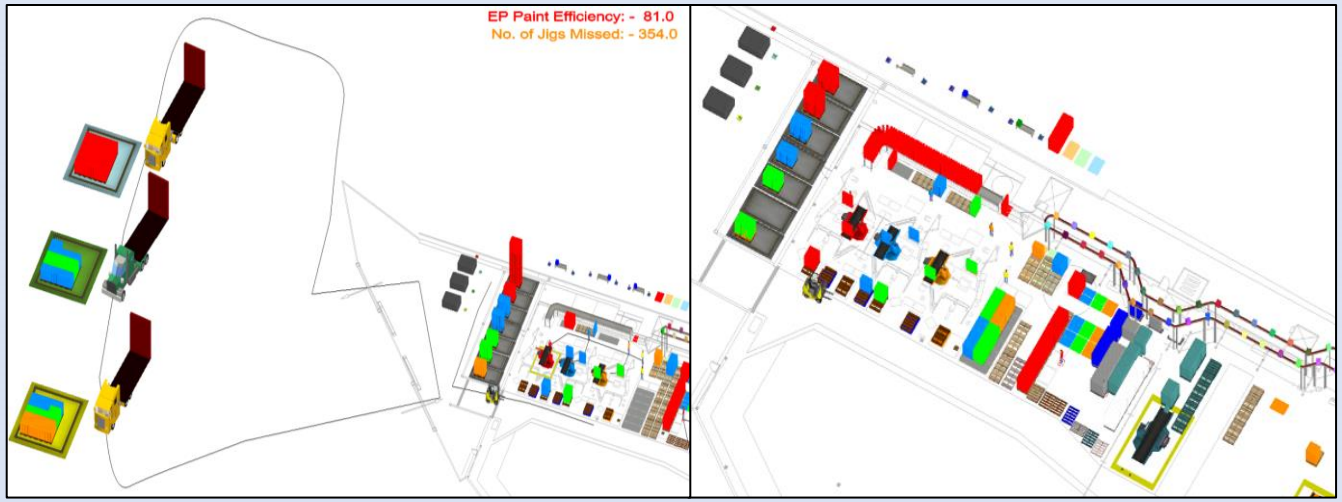
Purpose: Optimize current paint plant capacity for painting 18 current and 7 future weld facilities and Identify whether requires to increase paint capital by invest £ 2 million new paint plant facility.

Simulation Modeling:

- ✓ Current plant 2 simulation model identified that the plant capacity is not fully utilized due to disorganized weld facility location & complex production schedule of all weld facilities including paint plant.
- ✓ Simulation model developed for current & future weld facilities to streamline plant 2 processes by implementing JIT delivery system to & from paint plant.
- ✓ Developed simulation model due to 35% shortage in capacity for newly build manufacturing plant (next to plant 2) with 7 new weld facilities and paint plant.
- ✓ Proposed simulation model showed their will be no need to invest in new paint plant as processes around existing paint plant in plant 2 and 3 can be balanced by outsourcing low volume products for painting.



Plant 2 South and North weld facility with paint plant



Plant 2 JIT delivery weld and finish line with low volume products outsourced delivery

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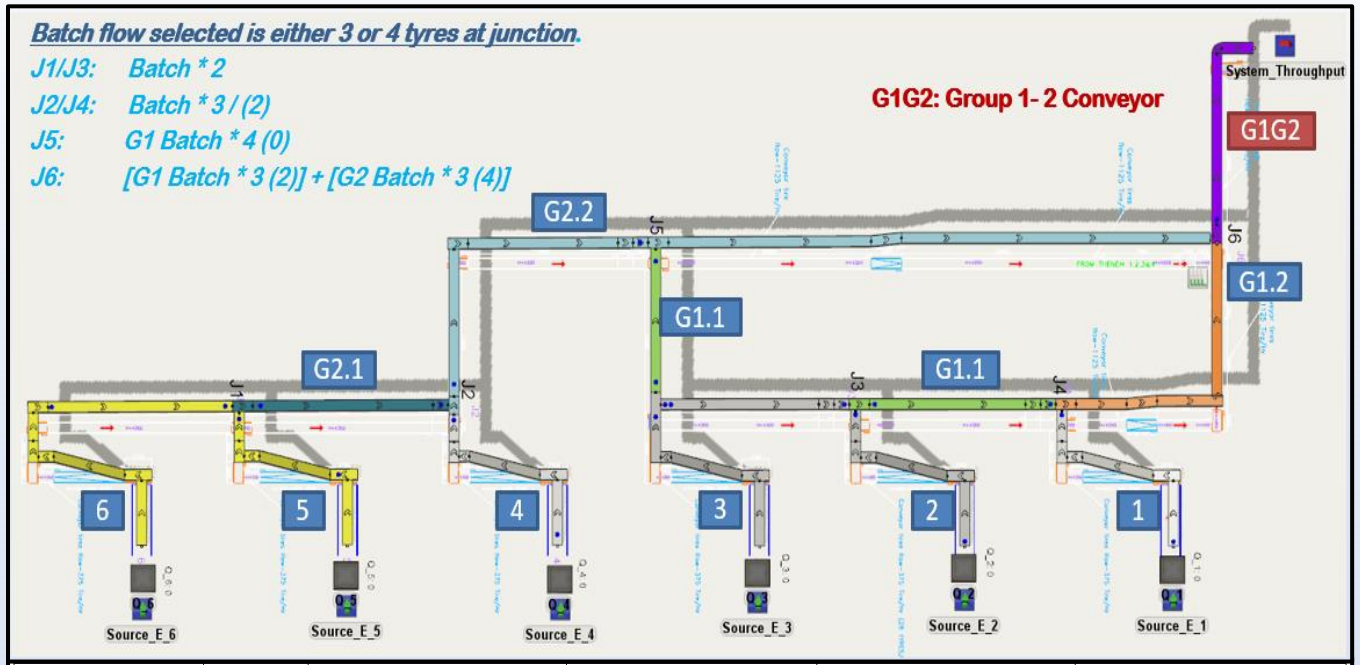
Conveyor Parameter Configuration Design

Purpose: Identify conveyor speed requirement and product mix flow configuration at junction point to achieve 1800 product output at every hour.

Simulation modeling:

- ✓ Developed simulation model for number of configuration for speed and product mix flow.
- ✓ Constraint was not to exceed speed limit of 63 Mtr/Min.
- ✓ Their were no product arrival data only data was hourly input at each entry conveyors. Used statistical distribution as per engineer experience and past data.
- ✓ Final model identified different speed configuration at every stage of conveyors with product mix configuration:
  - > J1/J3 – Batch size * 2
  - > J2/J4 – Batch size * 3 or 2
  - > J5 – Group 1 Batch size * 4
  - > J6 – Group 1 Batch size * 3 or 2
    + Group 2 Batch size * 3 or 4



Scenarios		G123 & G456 at 28 tyres every 4.5 minutes	G123 & G456 at 28 tyres every 4.5 minutes	G123 at 28 & G456 22.5 tyres every 4.5 minutes	G123 at 28 & G456 22.5 tyres every 4.5 minutes (Input 3 merged with G456)
G123 & G456 Arrival / 4.5 Min. & Batch size	G123	28	28	28	28
	G123 Batch	3	3	3	3
	G456	28	28	22.5	22.5
	G456 Batch	3	3	3	3 (At J5: - Batch of 6 for input 3)
Internal Conveyors Speed (M/Min)	1	28	28	28	28
	2-3	28	28	28	28
	G1.1	40	40	38	38
	G1.2	40	40	50	50
	4	28	28	28	28
	5-6	28	28	28	28
	G2.1	40	40	38	38
	G2.2	40	40	50	50
EOL Conveyor Speed	G1G2	60	94	60	60
	Hourly Throughput	2029	2236	2018	2018
	Comments	Buffer build up - Not Suitable	Exceed Speed - Not Suitable	G123 & G456 :- Working	G12 & G3456 : - Working

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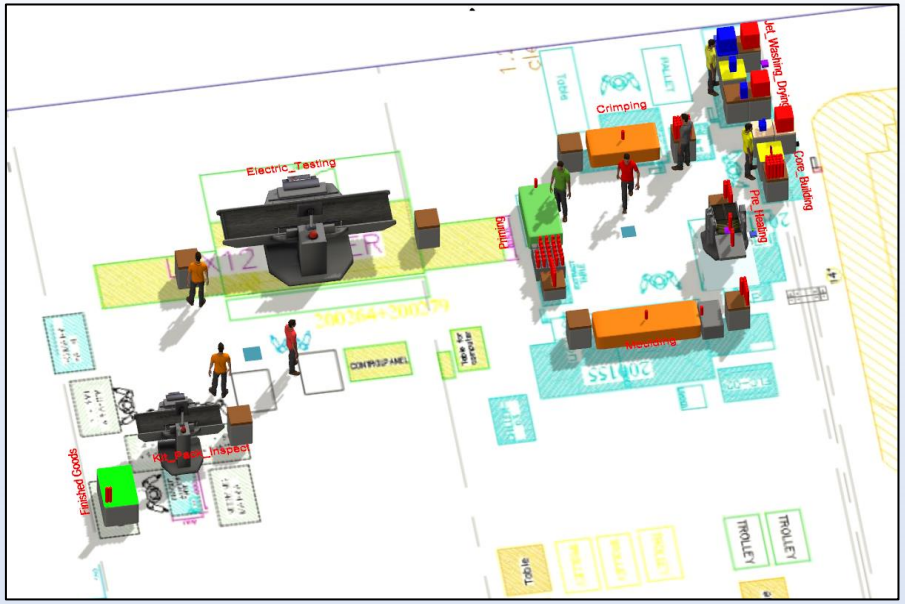
Operator Utilization Cell Design

Purpose: Identify actual utilization for number of operators for new LW insulator cell and recommend standard work procedure for all operators.

Simulation modeling:

- ✓ Developed simulation model for LW moulding insulator cell using 7 operators first and then balanced each process workload in a sequence order, which reduced number of operators from 7 to 4.
- ✓ Balancing overall workload and sequencing process of the cell to desired Takt time, Reduction of takt time increased cell output to 18 %.
- ✓ WIP along process staging area has gone down to maximum required level as heating process had been identified as bottleneck process, which defined throughput of the cell.
- ✓ Proposed to introduced two automated load unload moulding units in one machine that way throughput of cell will increase and work can be balanced to new proposed cell layout.

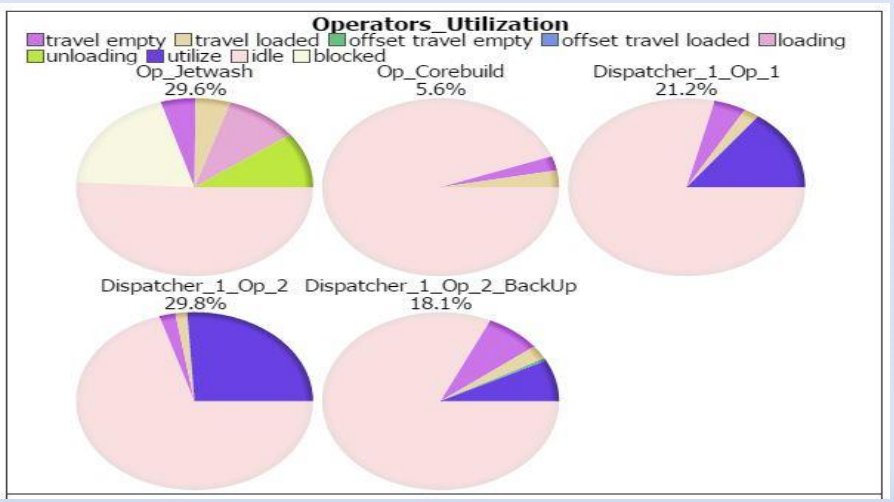


LW Insulator Model

State Pie

	Total	processing	collecting	setup	idle	blocked	waiting for operator	waiting for transporter
Core_Building	40.2%	37.3%	3.0%	0.0%	26.2%	33.5%	0.0%	0.0%
Priming	32.9%	28.2%	0.0%	4.7%	65.7%	0.0%	0.6%	0.7%
ScrapingBeforeMoulding	24.9%	24.9%	0.0%	0.0%	53.1%	21.2%	0.4%	0.4%
Crimping_Mulitprocess	69.9%	69.9%	0.0%	0.0%	26.4%	0.0%	3.6%	0.1%
Moulding_Mulitprocess	43.9%	43.9%	0.0%	0.0%	55.2%	0.0%	0.8%	0.0%

Process Utilization Table in FlexSim



Operator Utilization Pie Chart in FlexSim

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Warehouse Associates Optimization Model

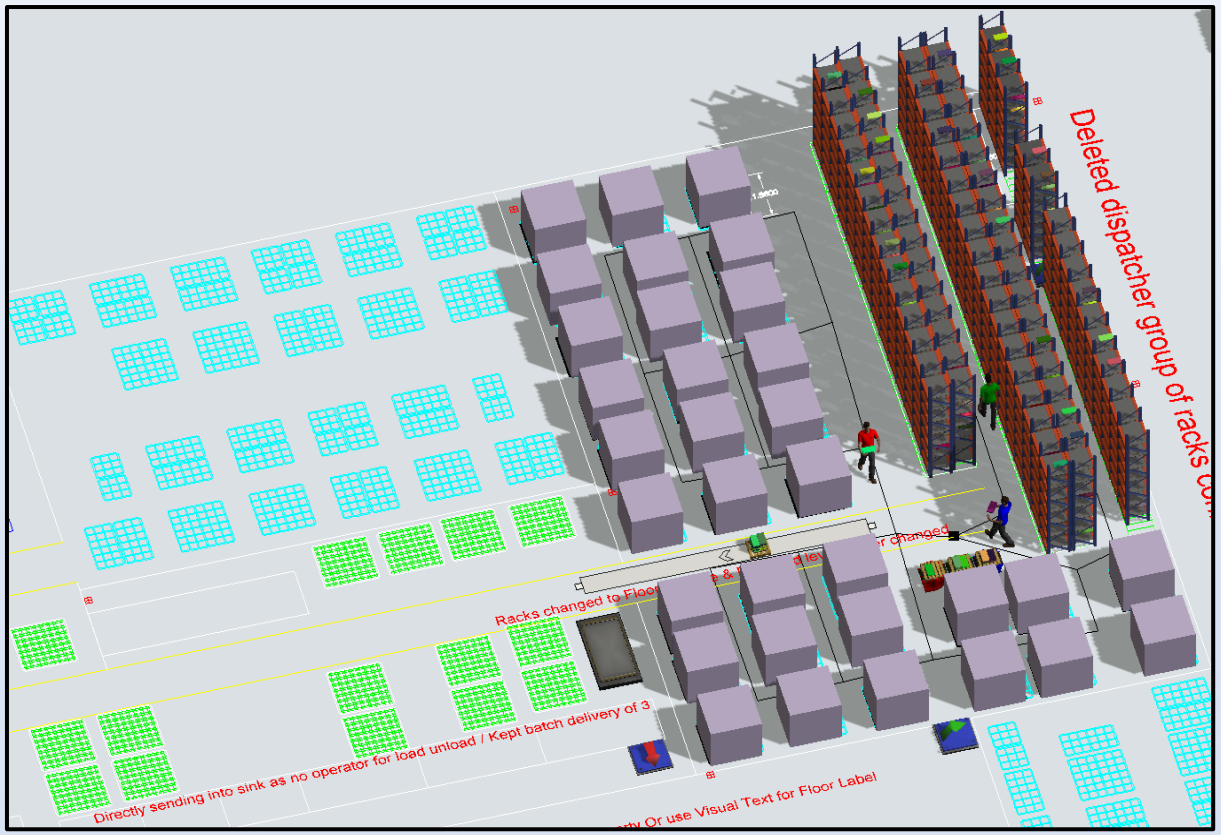
Purpose: To make the customer better enabled to schedule future inventories of raw materials and finished goods at their manufacturing plant and distribution centers & Optimize resource requirement.

Objective of Warehouse Model:

- ✓ Warehouse capacity analysis
- ✓ Analysis of ROI through increased modernisation such as Automatic storage and retrieval system (ASRS), etc.
- ✓ Metric compares the warehouse efficiency based on number of pallets loaded in and unloaded out .
- ✓ Streamlined warehouse processes to optimized inventory throughout and laboure requirement in the plant.

Outputs:

- ✓ Weekly inventory levels of raw materials and finished goods at the manufacturing plants and at the DCs also weekly service levels at each DC and the min, avg, and max delay times.
- ✓ Model allowed the customer to calculate an expected service level based on user specified safety stock percent and forecasted sales data
- ✓ Model helped the customer to calculate the expected inventory levels at the manufacturing plant and DCs based on the user specified lead times, build time, safety stock percent, and forecasted sales data



Garment Warehouse area Model

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Batched Bulk Fluid Shop Floor Model

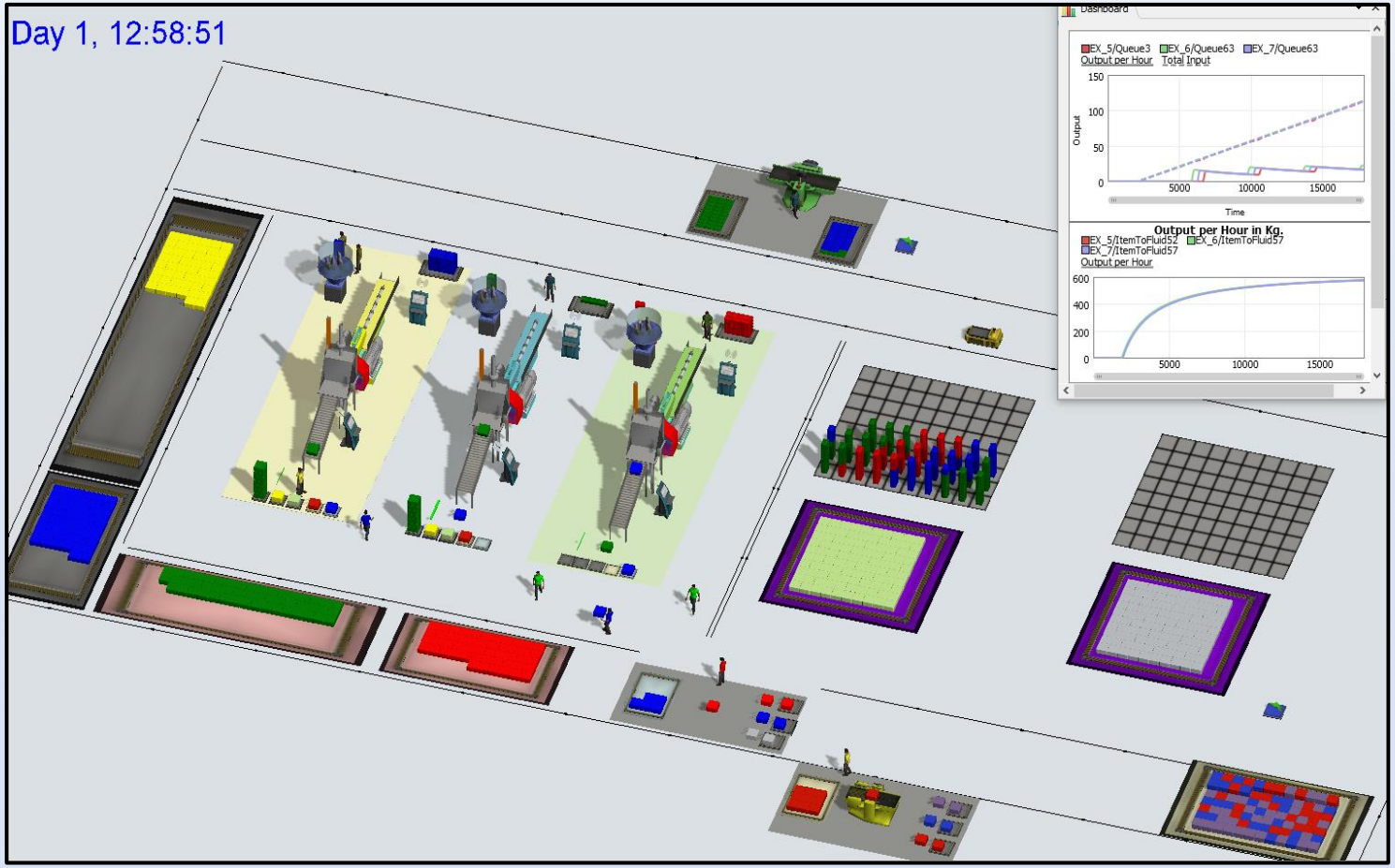
Purpose: Optimizing bulk power processing shop floor for complete plan effectiveness in terms of space, manpower, transportation, machinery utilization for plastic granule making production unit.

Simulation Model:

- ✓ Developed model identified number of processing area for optimization.

1) Labour required reduced to 30 %
2) Space utilization improved and managed as per weekly production demand of 10,000 tons
3) Different production mix schedule as per weekly customer demand that increased production capacity to 22 %.

- ✓ Developed model also identified NVA repetitive process, which improved through training workshop conducted on lean methodology.
- ✓ Transportation within plant and operator work had been balanced ergonomically.



Plastic Granule production unit

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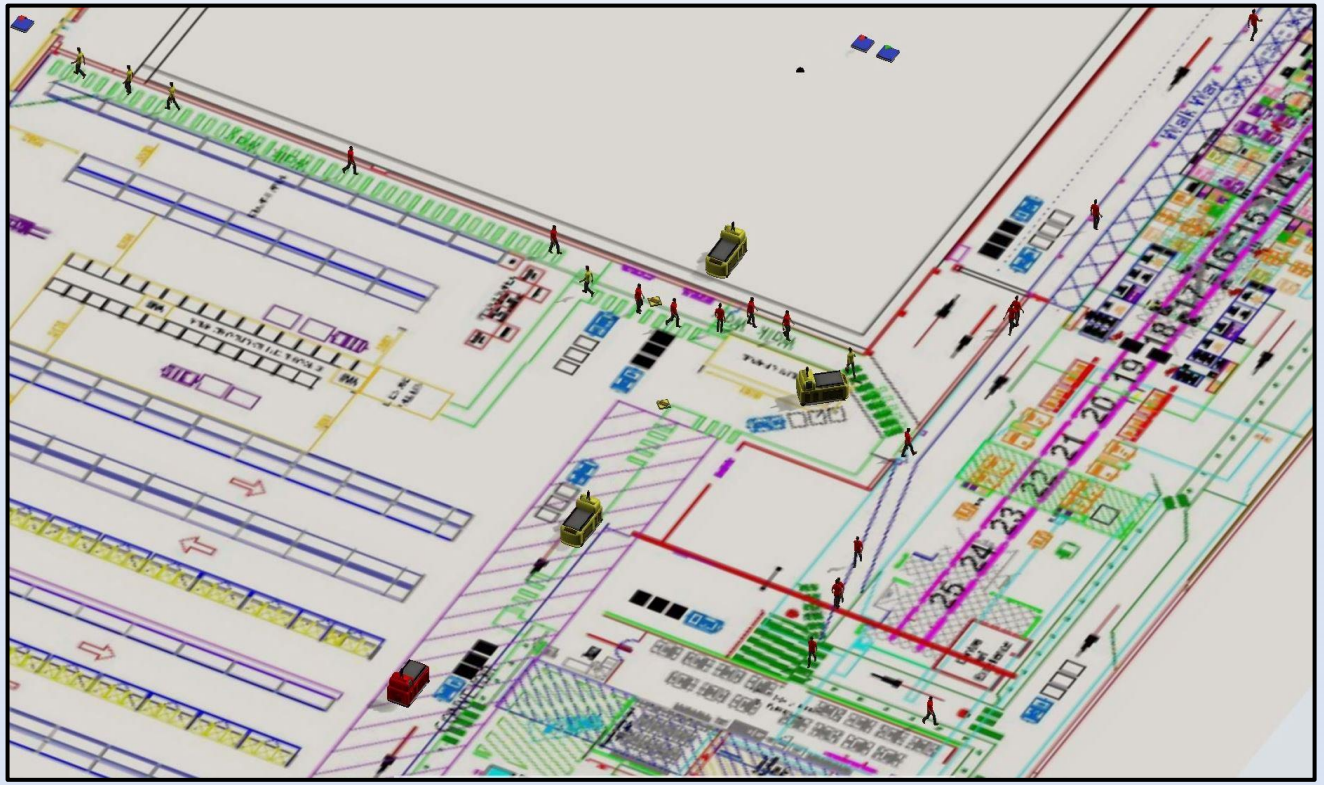
Proposal: Walkway Moving Project Model

Purpose: New ASRS facility installed next to Zone 7 (Door Line). Issue with number of miss fit and lineside delivery delay cause production loss onto MP&L department. Within G1 marketplace at ASRS entry associate walkway cause main concern for these delay which showed through simulation model. Decision has been taken to move walk way away from ASRS entry area so that MHE does not have to stop at many stops.

Simulation Model:

- ✓ Developed simulation model by considering associate entry and exit during shift start and end timing, MHE flow from-to ASRS for lineside delivery, random lineside delivery schedule for lineside zone 7 and 6.
- ✓ Model considered two way traffic flow for both JLE associate and MHE delivery flow.
- ✓ Simulation model identified major stoppage issue at ASRS entry and just before Zone 7 tunnel area, where most of the stops are happening.
- ✓ Walkway move away from ASRS entry into market place improved production throughput and reduced line delivery losses.



Working associates walkway next to newly build ASRS facility cause more loses at lineside simulation model shows major issue area.

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Optimize Processes and flow route model

Purpose: Shop floor project to analyze, identify capacity constraint (Bottleneck) and optimize process flow route in complete manufacturing process. Starting from casting raw material till finished all machining process on number of machines like Drilling, Tapping, Milling, Powder coating, Hardening treatment, etc. till dispatch to inhouse storage area. Through project 35% throughput increased.

	Item Name	Item T	Batch S	Throughput_Pallets	Throughput_Parts
Row 1	PB 30202 BODY	1	300	25	7500
Row 2	PB 30202 PLAIN COVER	2	1000	8	8000
Row 3	PB 30202 START/STOP COVER	3	1000	7	7000
Row 4	ELFC 61.SERIES BODY	4	150	66	9900
Row 5	ELFC 61.SERIES COVER	5	500	16	8000
Row 6	ELFS 61.SERIES MAIN RING	6	500	16	8000
Row 7	ELFS 61.SERIES RET RING	7	1500	8	12000
Row 8	IJ 31100 4 WAY BODY	8	450	14	6300
Row 9	IJ 61100 COVER	9	1000	7	7000
Row 10	ELFS BODY	10	225	14	3150
Row 11	ELFS HS BODY	11	300	13	3900
Row 12	M 90 DIA COVER	12	1000	4	4000
Row 13	LW51200 MAIN RING	13	500	6	3000
Row 14	CLL 300X600 BODY	14	200	19	3800
Row 15	LT51236 B OP MAIN RING	15	200	18	3600
Row 16	LT51236 C/B COVER	16	500	8	4000

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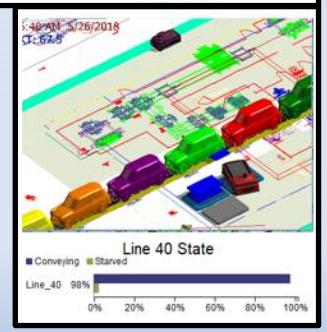
EV battery Inhouse Logistic supply

Purpose: Car assembly area logistic model requires EV battery pack delivery solution from warehouse to lineside delivery. Model required to identify optimum route, traffic congestion, and number of Tow truck requirement.

Simulation Model:

- ✓ Developed simulation model included vehicle sequence build, manual lineside transfer process, one way route constraints, number of other delivery MHE traffic, etc.
- ✓ Developed model consider option of delivery 1 or 2 pallet truck in one delivery. Change of warehouse footprint location at different location within warehouse as not location not decided due to not identified less congested traffic flow.
- ✓ Model 2 delivery solution not feasible due to MHE and Gangway width constraint so considered 1 pallet delivery in one go.
- ✓ Due to space constraint at lineside more time requires to install battery pack so considered 2 MHE delivery instead of 1 and warehouse storage location kept close to fitpoint.
- ✓ Model also designed for two way traffic flow considering associate & delivery MHE's and used 2 MHE for battery pack delivery

EV battery delivery model to identify number of tow truck requirement within current traffic flow scenario



Object (Seconds)	Idle	Blocked	Travel empty	Travel loaded	Offset travel empty	Offset travel loaded	Loading	Unloading	Standby	Utilization
MHE_Red	2222.126	7197.075	4016.053	40055.102	894.709	1425.38	9427.597	13236	7925.958	89.10%
MHE_Yellow	3963.426	6418.377	3640.213	39982.754	916.558	1377.96	9411.874	13178.531	7510.307	87.98%
TE_FuelTank	58563.973	3846.688	7451.336	7448.003	0	0	4530	4560	0	27.77%

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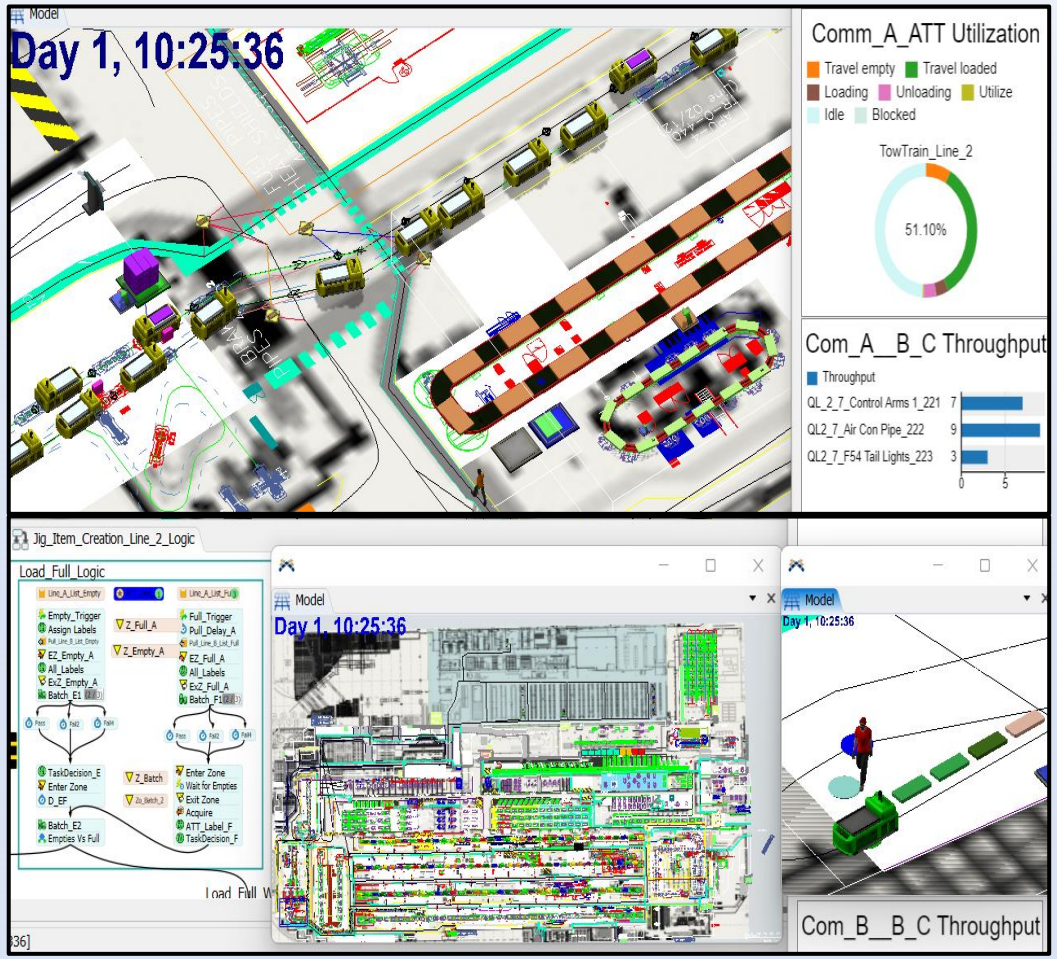
Car Assembly line sequence commodity Logistic Flow

Purpose: Large scale project is to implement IT driven auto train sequence commodity delivery solution. Model developed to perform mixed commodity sequence parts delivery at lineside with intermediate transfer stop. Intermediate transfer station considered as limitation of existing assembly plant space constraint. Model developed in two phase from warehouse to intermediate stop station auto train and from intermediate stop to lineside fitpoint manual delivery with the help of delivery associate.

Simulation Model:

- ✓ Considered 5 commodity for sequence delivery. All commodity has different take rate, different warehouse and fitpoint location, and different pallet factor.
- ✓ Model considered two as well as one way traffic flow as per existing traffic flow rule and delivery of full pallet and pick up of empty pallet in one delivery cycle.
- ✓ Simulation model identified major stoppage issue due shortage of parts at lineside. Lines stoppage is due to not able to cope up with 2 auto train so design for 3 auto train which fullfill the lineside parts requirement ontime.
- ✓ 3 auto train designed identified as must required for selected commodity.
- ✓ Two intermediate station associate does other manual lineside activity like manual pallet change over, empty return etc. when no auto train delivery at intermediate stop.
- ✓ Model analysis shows 3 tow train option has capacity to consider another commodity delivery.



Auto Train solution for delivering multiple commodity sequence pallet at lineside