Mahindra & Mahindra

Warehouse Space Utilization and Validation Study

The Anylogic Conference 2024

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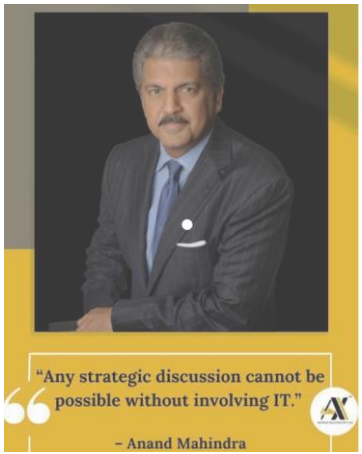
ADC Digital

OUR COMPANY



Mahindra & Mahindra is an Indian automobile manufacturing company headquartered in Mumbai, Maharashtra. It was established in 1945 Part of the Mahindra Group, M&M is one of the largest vehicle manufacturers by production in India.

Our Main Man is always Right !!

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 IT – Digital Manufacturing Team CoE

Presented:
Arun Kumar G.

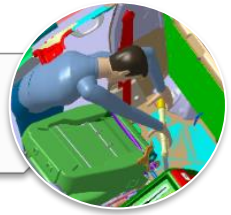
WHAT WE ARE WORKING ON

Product Design & Process Planning

- Manufacturing BOM

- Process Planning Solutions

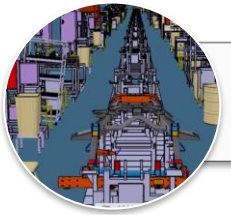
- Process Simulation



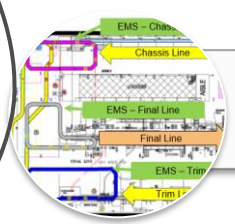
Digital Manufacturing

Production & Capacity Planning

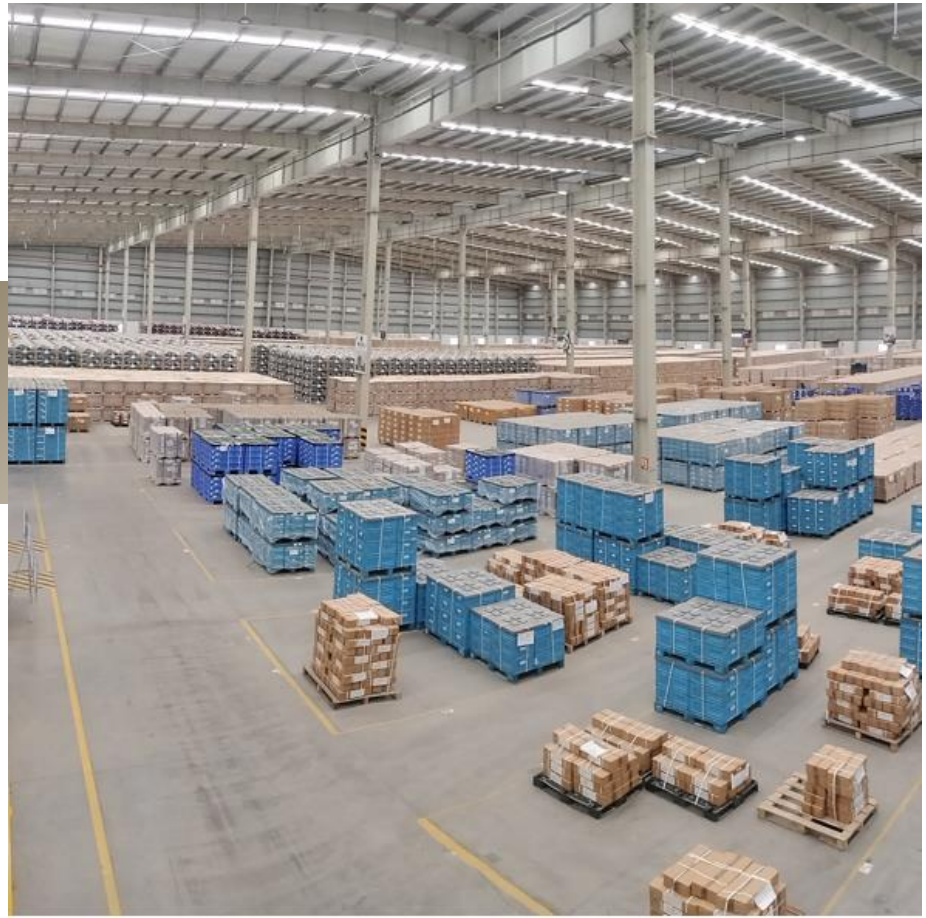
- Factory Layout Design



- Discrete Event Simulation



- Virtual Reality



About DSCM & Warehousing

Digital Supply Chain Management & Warehousing:

- Team responsible for manage and optimize flow of goods, info across the entire supply chain.
- Also focuses on Planning, Sourcing, Delivering & Warehousing

Warehousing:

- Ensure adequate space for types of product
- Keeping track of stock level for each part
- Ensuring Avg Daily Demand meet
- Forecasting required space as per foreseen parts volume

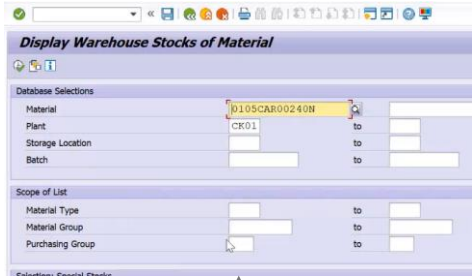
Why Do Simulation ?

- Faster Change Management
- Reduce Operational Cost

ADC Digital

Project in details

CURRENT PRACTICE



01

Query In SAP

Part extract via warehouse and plant location code

02

CleanUp The Data

Item ID and part count data extracted

03

Excel Macro

Warehouse count is mapped with respect to Item ID.

04

Space Calculation

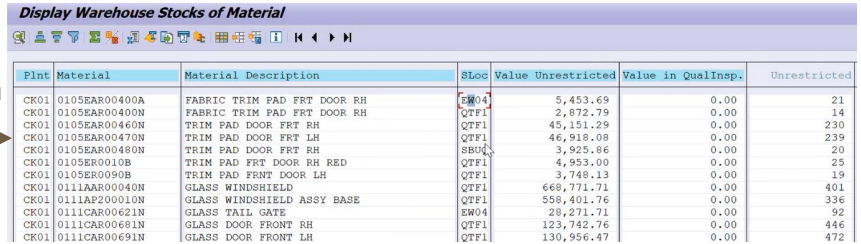
Based on predefined type of storage, Space consumed by each part is calculated against part ADD.

05

Summary

Individual parts space cumulated against initial available space for overall volume consumption.

	Floor	HBR	KLT	Total
	F25	F25	F25	F25
Volume (lacs/annum)	5.0			4.2
BEV (lacs/annum)	0.6			0.2
Unit (positions/bins)		15650	9142	
Space Required-sq mt	**9407**	**9547**	**585**	**19538**
WH Space req in sq mtr				**23361**
Empty returns sqmt	1142			1142
Non Moving sqmt	6000			6000
Vendor Aid sqmt/ SAM	1000			1000
MTBD	2500			2500
Strategic Inventory	3000			3000
Imports	1500			1500
Battery Parts	3000			3000
Total Sqmt	**27548**	**9547**	**585**	**37679**
				14000
		G+5		**51679**
			381	**556070**



Plnt	Material	Material Description	SLoc	Value Unrestricted	Value in QualInsp.	Unrestricted
CK01	0105EAR00400A	FABRIC TRIM PAD FRT DOOR RH	EW04	5,453.69	0.00	21
CK01	0105EAR00400N	FABRIC TRIM PAD FRT DOOR RH	QTF1	2,872.79	0.00	14
CK01	0105EAR00460N	TRIM PAD DOOR FRT RH	QTF1	45,151.29	0.00	230
CK01	0105EAR00470N	TRIM PAD DOOR FRT LH	QTF1	46,918.08	0.00	239
CK01	0105EAR00480N	TRIM PAD DOOR FRT RH	SBU1	3,925.86	0.00	20
CK01	0105ER0010B	TRIM PAD FRT DOOR RH RED	QTF1	4,953.00	0.00	25
CK01	0105ER0090B	TRIM PAD FRNT DOOR LH	QTF1	3,748.13	0.00	19
CK01	0111AAR00040N	GLASS WINDSHIELD	QTF1	668,771.71	0.00	401
CK01	0111AP200010N	GLASS WINDSHIELD ASSY BASE	QTF1	558,401.76	0.00	336
CK01	0111CAR00621N	GLASS TAIL GATE	EW04	28,271.71	0.00	92
CK01	0111CAR00681N	GLASS DOOR FRONT RH	QTF1	123,742.76	0.00	446
CK01	0111CAR00691N	GLASS DOOR FRONT LH	QTF1	130,956.47	0.00	472

ADC Digital

Why Change to Simulation

- ❖Completely depended on Excel macro
- ❖More Lead time for change and new setup validation
- ❖Volume handling and Complexity issue
- ❖Data Integrity and errors
- ❖Collaboration challenge with real time data
- ❖Unavailable of multiple options approach

Problem Statement & Objective

- Goal: To conceptualize and evaluate required warehouse space for the demand storage

- Objective:
- Validate the storage space required from the spreadsheet data
- Model should suggest the space available or additional required for storage based on storage type
- Model should suggest best storage type to optimize the space consumption for each part and improve the KPI's
- Statistics Analysis of Warehouse behavior for fluctuating inward and outward part flow.

- Overview:
- The main parameter to alter the storage space consumption along with part counts are, "storage type" and "type of storage boxes"
- Categorize the storage products to type of storage based on parameters like height, box type, stack limit
- Calculate the stack limit for storage products based on Type of storage boxes" like below

Corrugated Box	only 2 stacks
Metal Pallet	uptil 2.7mtr
Plastic Bin	uptil 1mtr
PP Box	uptil 2.7mtr
Stand	uptil 2.7mtr
Trolley	No Stack

Major Inputs & Approach

- Understanding the conventional method of approach from SAP data export based on plant and Warehouse code.
- Parameters and constraint logic in spreadsheet data
- Segregate/add the details required for Anylogic model
- Warehouse details like 2D layout, No of docks, types of storages
- Warehouse resources details like standard pallets size, High Bay Racks pocket dimension
- Total warehouse space and actual space available for storage details
- Individual parts Average Daily Demand, Inventory norms, box dimension, type of storage, stack limits, parts per box details

Calculations and Model logic

Display Warehouse Stocks of Material

Plnt	Material	Material Description	SLoc	Value Unrestricted	Value in QualInsp.	Unrestricted
CK01	0105EAR00400A	FABRIC TRIM PAD FRT DOOR RH	EW04	5,453.69	0.00	21
CK01	0105EAR00400N	FABRIC TRIM PAD FRT DOOR RH	QTF1	2,872.79	0.00	14
CK01	0105EAR00460N	TRIM PAD DOOR FRT RH	QTF1	45,151.29	0.00	230
CK01	0105EAR00470N	TRIM PAD DOOR FRT LH	QTF1	46,918.08	0.00	239
CK01	0105EAR00480N	TRIM PAD DOOR FRT RH	SBU1	3,925.86	0.00	20
CK01	0105ER0010B	TRIM PAD FRT DOOR RH RED	QTF1	4,953.00	0.00	25
CK01	0105ER0090B	TRIM PAD FRNT DOOR LH	QTF1	3,748.13	0.00	19
CK01	0111AAR00040N	GLASS WINDSHIELD	QTF1	668,771.71	0.00	401
CK01	0111AP200010N	GLASS WINDSHIELD ASSY BASE	QTF1	558,401.76	0.00	336
CK01	0111CAR00621N	GLASS TAIL GATE	EW04	28,271.71	0.00	92
CK01	0111CAR00681N	GLASS DOOR FRONT RH	QTF1	123,742.76	0.00	446
CK01	0111CAR00691N	GLASS DOOR FRONT LH	QTF1	130,956.47	0.00	472

Import the cleaned up and added field data into Anylogic model

Export the data from SAP with various variables

part_id	name	length	width	height	storage_method	no_of_stack	stock
1	0002AAR00190N_COVER ASSY JACK HANDLE	0.65	0.45	0.18	1	6	271
2	0002BU300021N_TOOL BAG PVC U301	0.38	0.22	0.17	1	6	271
3	0002DAR00061N_FIRE EXTINGUISHER	0.2	0.3	0.38	1	3	903
4	0309CAU00040N_UBE VAC RESVR TO MOD	0.5	0.38	0.3	1	4	91
5	0309FAU00261N_ASSEMBLY DOC SDPF	1.2	1	0.9	1	2	91
6	0309FAU00570N_ASSEMBLY CATALYTIC CONVERTOR	0.83	0.65	0.33	2	1	91
7	0309FAU00971N_CATALYST DE-OXIDATION ASSEM...	0.83	0.65	0.33	2	1	91
8	0309FAU01011N_PARTICULATE FILTER ASSEMBLY	0.83	0.65	0.33	2	1	91
9	0309FAU01151N_CATALYST DE-OXIDATION ASSEM...	0.65	0.45	0.25	1	4	91
10	0111FR0140N_BACK PANEL SLIDING WINDOW ASSY	0.76	0.36	0.33	1	4	91

Calculations and model logic

- The Available space as per the layout dimensions of the warehouse

- Based on Type of storage

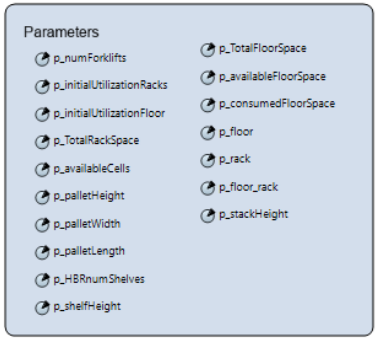
✓ Floor :
- stack limit :- 2700/part box height (mm)
- floor print:- length * breadth of part box(sq.mtrs)
- aisle factor:- 1.3
- consumed floor space:- (warehouse part stock/parts quantity per box/stack limit/floor print)*aisle factor

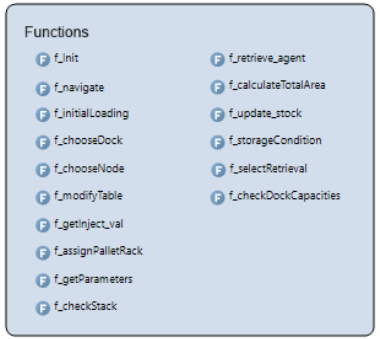
✓ High Bay Rack :
- stack limit:- <900(mm)
- standard pallet size:- 1200*1000*1000 (mm)
- part space print:- length*breadth*height of part box (sq.mtrs)
- parts per pallet:- standard pallet size/part space print
- factor:- 0.61
- consumed HBR space:- warehouse part stock/parts quantity per box/parts per pallet* HBR factor

✓ KLT :
- stack limit:- <900(mm)
- standard bin size:- 600*400*220 (mm)
- part space print:- length*breadth*height of part box (sq.mtrs)
- parts per bin:- standard bin size/part space print
- factor:- 0.0639
- consumed KLT space:- warehouse part stock/parts quantity per box/parts per bin* KLT factor

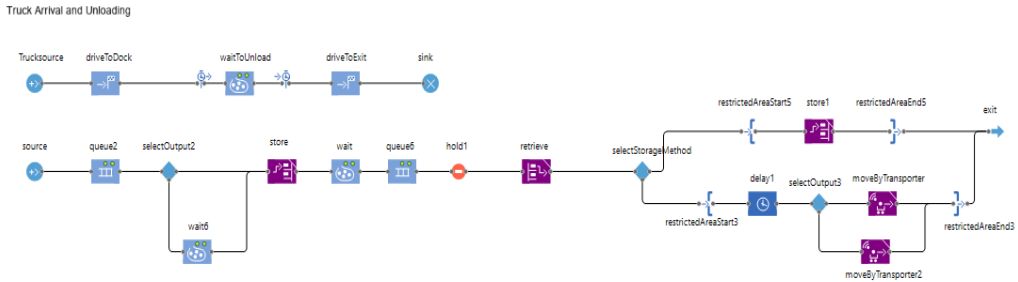
Calculations and model logic

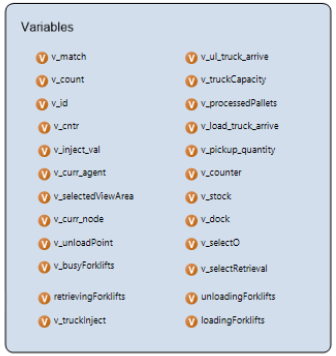
- Logical conditions:
- <u>When part fits both in HBR & KLT:</u>
  - Preferred to store based on less module/pockets to consume for the warehouse quantity
- overall consumed space:- Floor storage+ HBR storage+ KLT storage
- available space:- warehouse space- overall consumed space

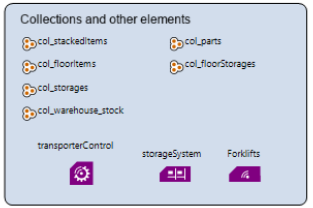




Logic Flowchart for Truck Arrival and Storing Parts

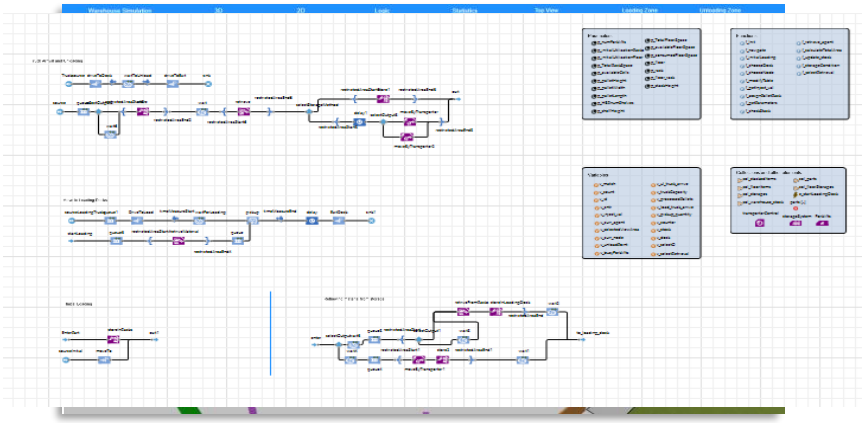


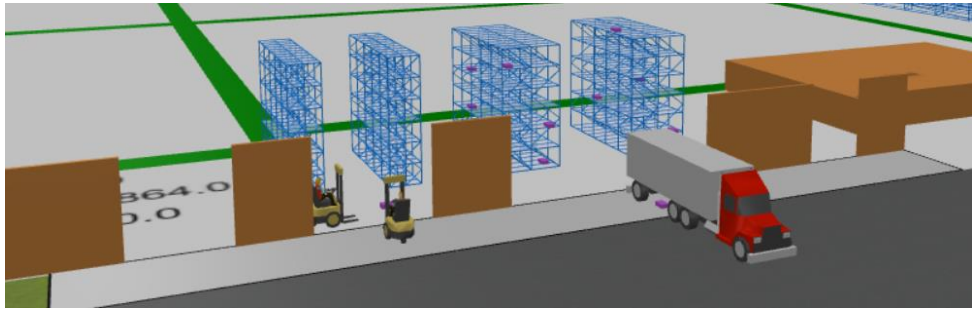


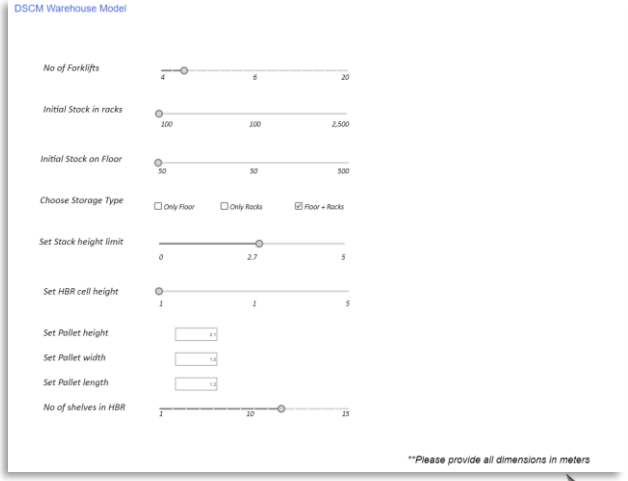


Key features in the model

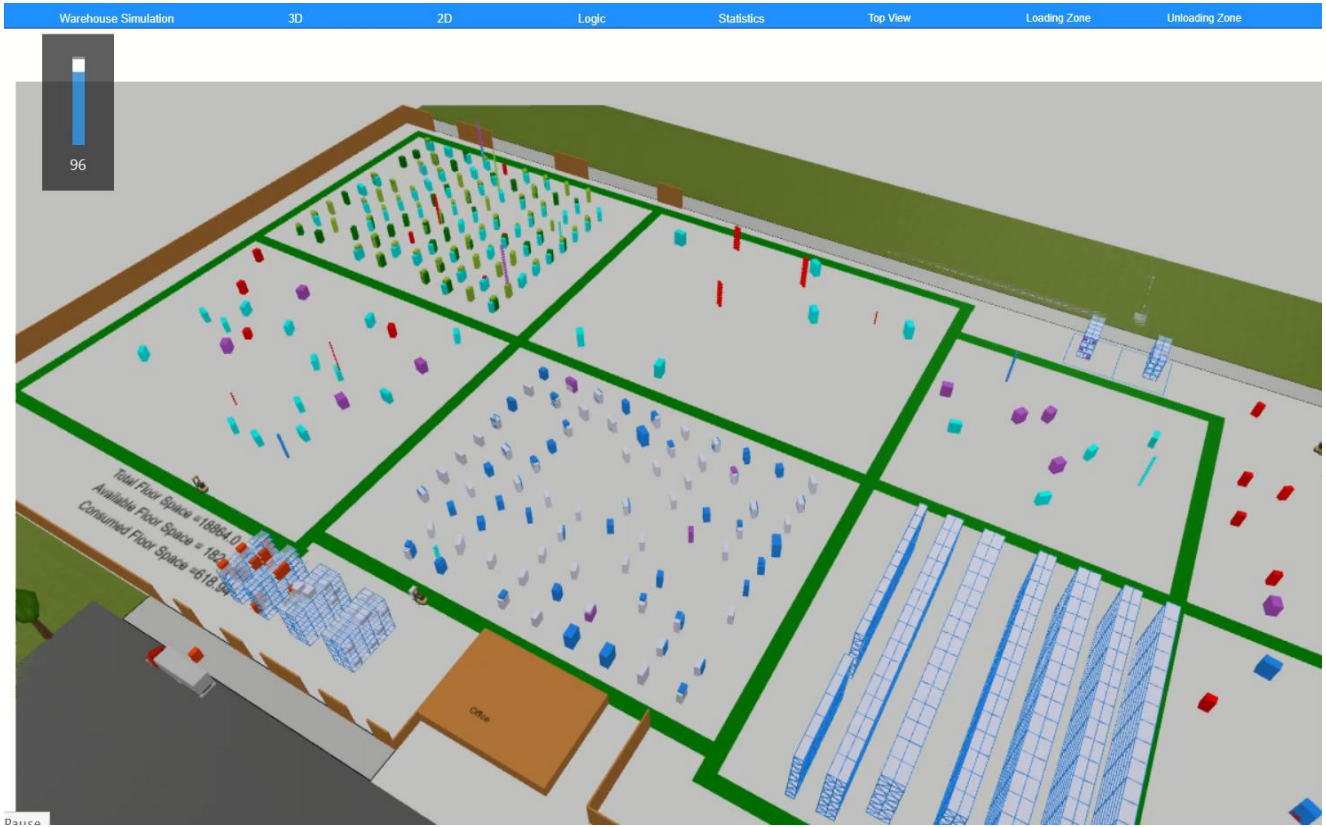
- Options to alter the key parameters like initial stock storage, type of storage, dimension of pocket size etc before model run as per requirement.
- For dynamic view, source parts are carried by truck and unloaded in dock followed by MHE's from dock to storage location.

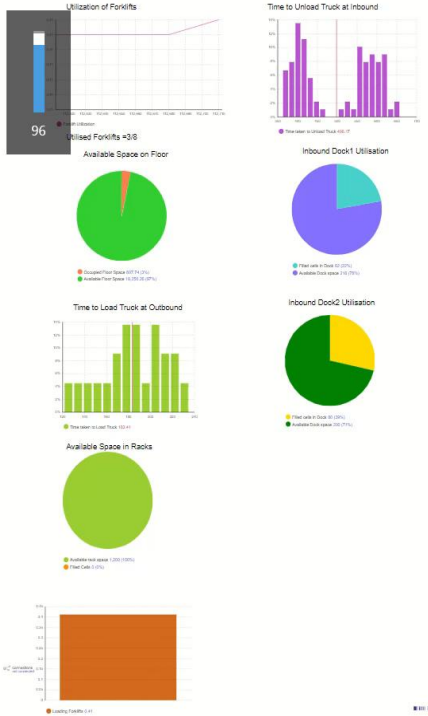






Anylogic model





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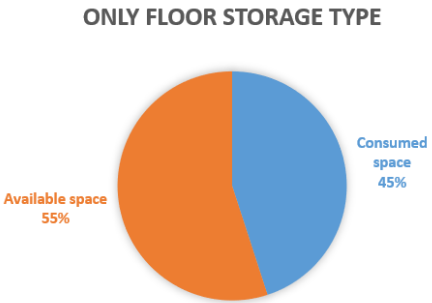
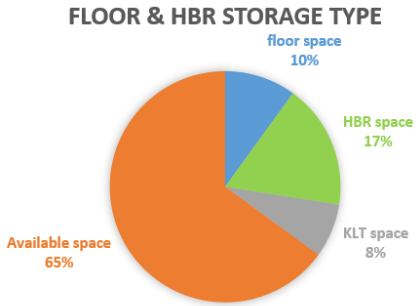
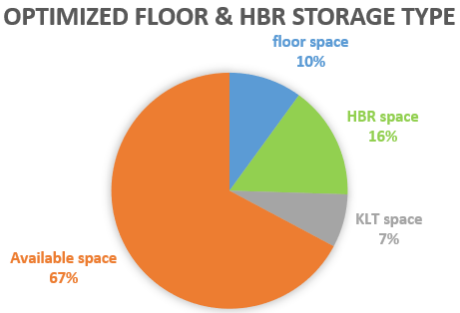
Output

Following were the space utilization observations for the current input at Warehouse



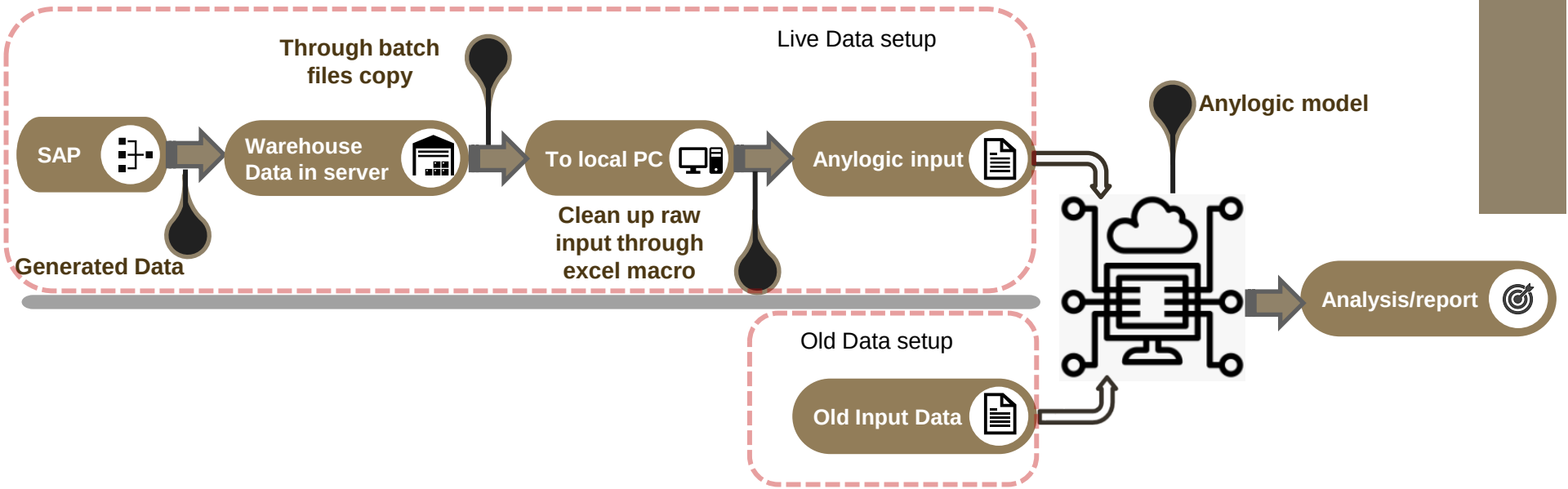




Business benefits

- Hassle free statistical analysis for warehouse storage planning, irrespective of part line items, warehouse location, resource parameters etc
- Easy comparison for available space & overall space consumed based on “type of storages”
- Accuracy in planning for effective space management
- In optimized option: restructured storage type data is exported back to DSCM team for validation with their master data

Future


Live Data setup
Through batch files copy
SAP
Warehouse Data in server
To local PC
Anylogic input
Anylogic model
Generated Data
Clean up raw input through excel macro
Analysis/report
Old Data setup
Old Input Data

ANY QUESTIONS