

SAP IBP Simulation Project

Austin Hong | SAP IBP Certified | [Link to Excel File](#)



Project Overview

- ❑ Simulated an SAP Integrated Business Planning (IBP) solution using Excel
- ❑ Covers end-to-end processes from demand planning to supply planning and inventory management

Project Overview / Agenda

- | | | | |
|---|--|---|--|
| 1 | Forecast Accuracy KPIs
(MAPE, RMSE, Bias) | 4 | S&OP Metrics Dashboard |
| 2 | Safety Stock & Supply
Heuristics | 5 | ABC/XYZ Segmentation |
| 3 | Scenario Planning &
What-if Simulations | 6 | Inventory Replenishment &
Procurement Logic |

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Overview

- ❑ Location ID = Specifies location
 - ❑ West / East Region
 - ❑ Plant / Distribution Center
- ❑ Period ID = Respective week of Q3
 - ❑ W01 - W12
- ❑ Product ID = Specifies each product
 - ❑ Widget A
 - ❑ Widget B
 - ❑ Widget C
- ❑ Unit of Measure (UoM)
 - ❑ EA = Each
- ❑ Product Location = Signifies the product type as well as location at the time of sale
 - ❑ I.e. P100_LOC1
 - ❑ Widget A
 - ❑ Plant

Location ID	Region	Type	
LOC1	West	Plant	
LOC2	East	Distribution Center	

Period ID	Calendar Week Start
W01	2025-07-07
W02	2025-07-14
W03	2025-07-21
W04	2025-07-28
W05	2025-08-04
W06	2025-08-11
W07	2025-08-18
W08	2025-08-25
W09	2025-09-01
W10	2025-09-08
W11	2025-09-15
W12	2025-09-22

Product ID	Description	Base UoM
P100	Widget A	EA
P200	Widget B	EA
P300	Widget C	EA

Overview (Key Figures)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	Product_Location		Period ID	Sales Forecast		Actual Sales		Inventory Projection		Target Inventory		Planned Orders			
2		P100_LOC1	W01		118		111		40		60			88	
3		P100_LOC1	W02		108		101		41		60			77	
4		P100_LOC1	W03		94		92		42		60			62	
5		P100_LOC1	W04		87		82		48		60			49	
6		P100_LOC1	W05		100		96		47		60			63	
7		P100_LOC1	W06		118		117		52		60			76	
8		P100_LOC1	W07		98		91		56		60			52	
9		P100_LOC1	W08		102		91		60		60			52	
10		P100_LOC1	W09		90		77		68		60			32	
11		P100_LOC1	W10		90		85		69		60			31	
12		P100_LOC1	W11		103		102		78		60			35	
13		P100_LOC1	W12		115		104		70		60			55	
14		P200_LOC1	W01		116		113		43		60			83	
15		P200_LOC1	W02		86		75		50		60			46	
16		P200_LOC1	W03		100		86		47		60			63	
17		P200_LOC1	W04		88		77		40		60			58	
18		P200_LOC1	W05		118		112		31		60			97	
19		P200_LOC1	W06		97		86		26		60			81	
20		P200_LOC1	W07		83		71		25		60			68	
21		P200_LOC1	W08		104		97		18		60			96	
22		P200_LOC1	W09		93		79		25		60			78	
23		P200_LOC1	W10		88		86		26		60			72	
24		P200_LOC1	W11		105		92		17		60			98	
25		P200_LOC1	W12		81		81		16		60			75	
26		P300_LOC1	W01		115		106		46		60			79	
27		P300_LOC1	W02		93		85		44		60			59	
28		P300_LOC1	W03		110		99		34		60			86	
29		P300_LOC1	W04		94		83		35		60			69	
30		P300_LOC1	W05		87		76		32		60			65	
31		P300_LOC1	W06		93		81		32		60			71	
32		P300_LOC1	W07		102		94		40		60			72	
33		P300_LOC1	W08		119		107		46		60			83	
34		P300_LOC1	W09		100		86		43		60			67	
35		P300_LOC1	W10		95		83		35		60			70	
36		P300_LOC1	W11		97		97		27		60			80	
37		P300_LOC1	W12		103		95		17		60			96	

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Forecast Accuracy Tracking (MAPE)

Forecast Error	APE	MAPE
7	0.063063	0.078084
7	0.069307	
2	0.021739	
5	0.060976	
4	0.041667	
1	0.008547	
7	0.076923	
11	0.120879	
13	0.168831	
5	0.058824	
1	0.009804	
11	0.105769	
3	0.026549	
11	0.146667	
14	0.162791	
11	0.142857	
6	0.053571	
11	0.127907	
12	0.169014	
7	0.072165	
14	0.177215	

- Forecast Error = ABS(Sales Forecast - Actual Sales)
 - MAPE (Mean Absolute Percentage Error)
 - APE (Absolute Percentage Error)
- APE = Forecast Error / Actual Sales
- MAPE = AVERAGE(APE)
 - = 0.078
- On average, the Sales Forecast overshoot its estimates by 7.8%
 - Ideal = below 5%

1

Forecast Accuracy Tracking (RMSE)

Forecast Error		RMSE	RMSE
	7	49	8.3325
	7	49	
	2	4	
	5	25	
	4	16	
	1	1	
	7	49	
	11	121	
	13	169	
	5	25	
	1	1	
	11	121	
	3	9	
	11	121	
	14	196	
	11	121	
	6	36	
	11	121	
	12	144	
	7	49	
	14	196	

- ❑ Forecast Error = ABS(Sales Forecast - Actual Sales)
- ❑ RMSE = Root Mean Squared Error
 - ❑ Square the Forecast Error for each week
 - ❑ $\text{SQRT}(\text{RMSE}) = 8.33$
- ❑ According to RMSE, the forecast is off by 8.33% on average
- ❑ RMSE does not indicate the direction (over/under)

1

Bias Detection

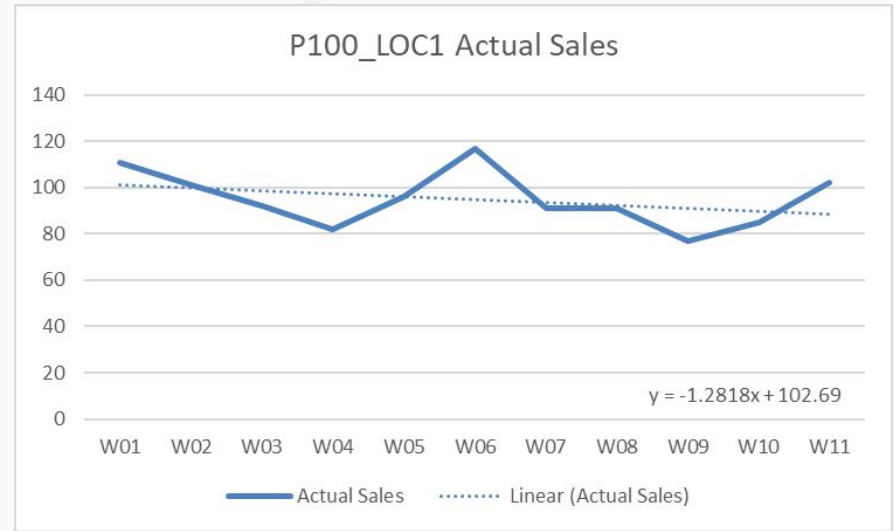
Forecast Error		P
	7	Bias
	7	6.958333
	2	
	5	
	4	
	1	
	7	
	11	
	13	
	5	
	1	
	11	
	3	
	11	
	14	
	11	
	6	
	11	
	12	
	7	
	14	

- ❑ Forecast Error = ABS(Sales Forecast - Actual Sales)
- ❑ Bias = AVERAGE(Bias)
 - ❑ = 6.96
- ❑ Positive Bias indicates an overestimation of Forecast Error
- ❑ Negative Bias indicates an underestimation of Forecast Error

1

Demand Trend Analysis: P100_LOC1

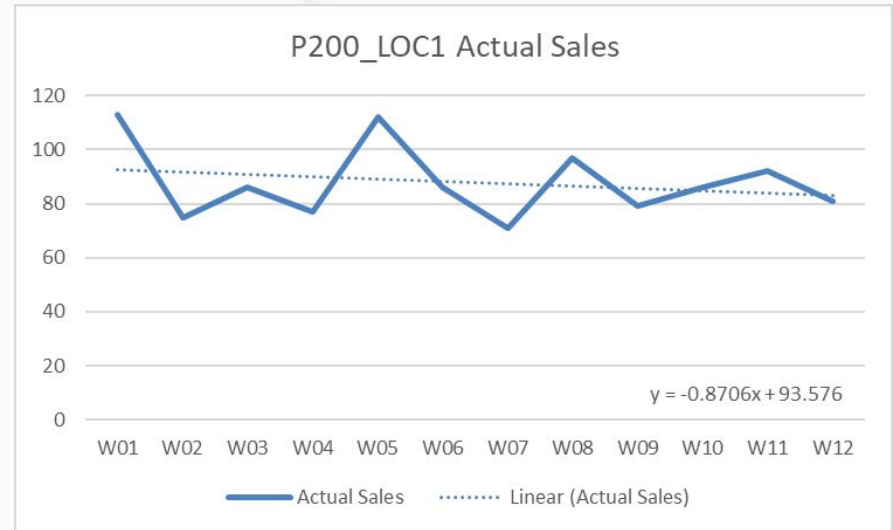
- ❑ X-Axis: Period ID
- ❑ Y-Axis: Actual Sales
- ❑ Slope = -1.28
- ❑ Actual Sales decline by an average of 1.28 EA per each week of Q3



1

Demand Trend Analysis: P200_LOC1

- ❑ X-Axis: Period ID
- ❑ Y-Axis: Actual Sales
- ❑ Slope = -0.8706
- ❑ Actual Sales decline by an average of -0.87 EA per each week of Q3

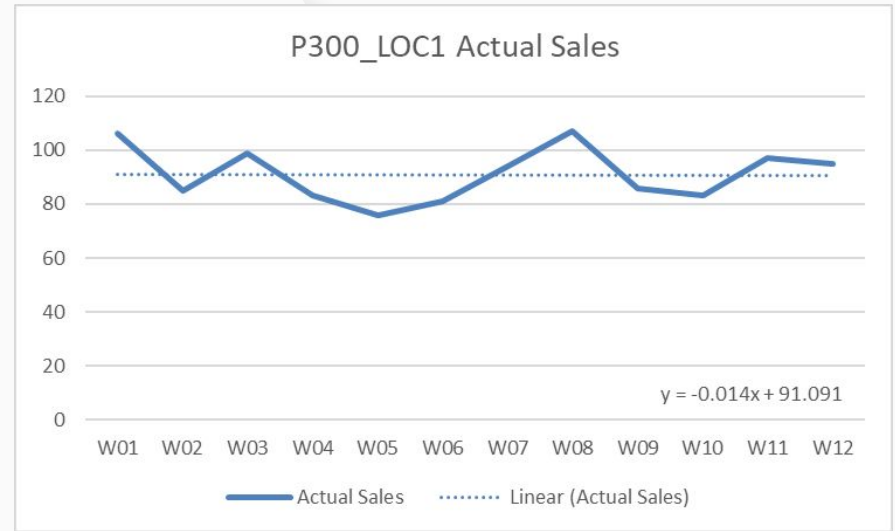


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1

Demand Trend Analysis: P300_LOC1

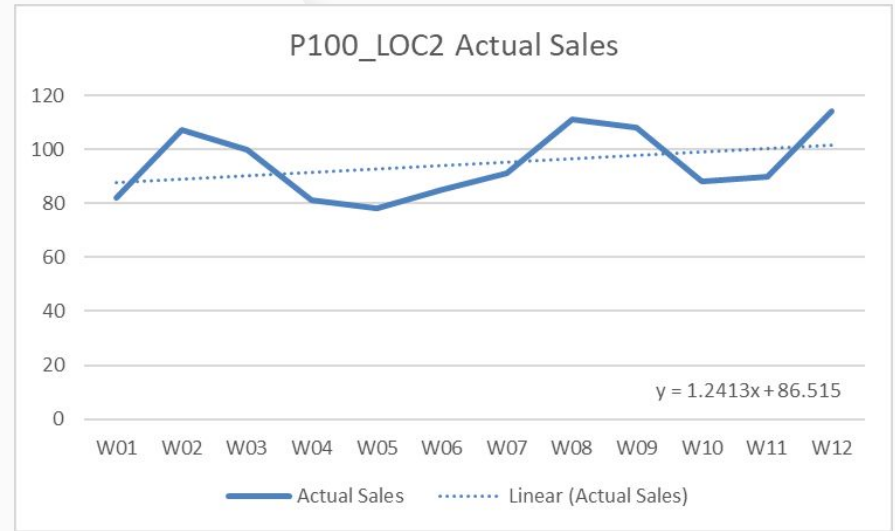
- ❑ X-Axis: Period ID
- ❑ Y-Axis: Actual Sales
- ❑ Slope = -0.014
- ❑ Actual Sales decline by an average of 0.014 EA per each week of Q3



1

Demand Trend Analysis: P100_LOC2

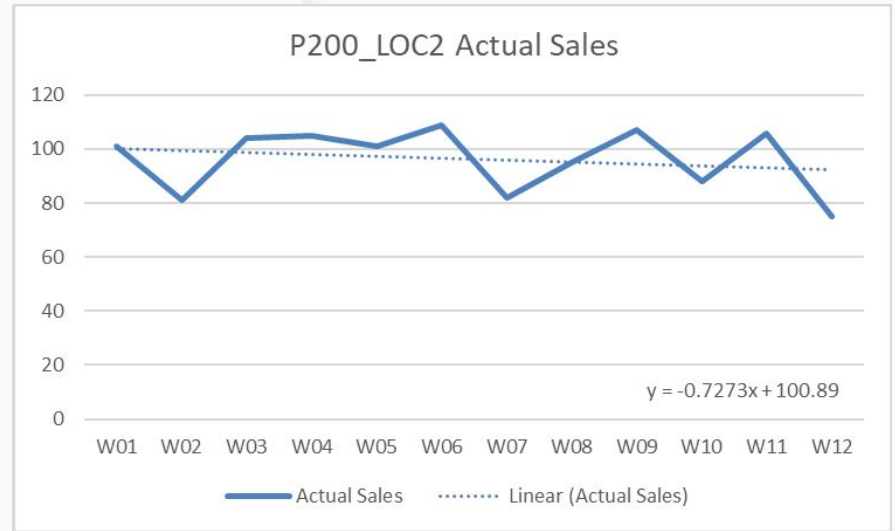
- ❑ X-Axis: Period ID
- ❑ Y-Axis: Actual Sales
- ❑ Slope = 1.2413
- ❑ Actual Sales increase by an average of 1.24 EA per each week of Q3



1

Demand Trend Analysis: P200_LOC2

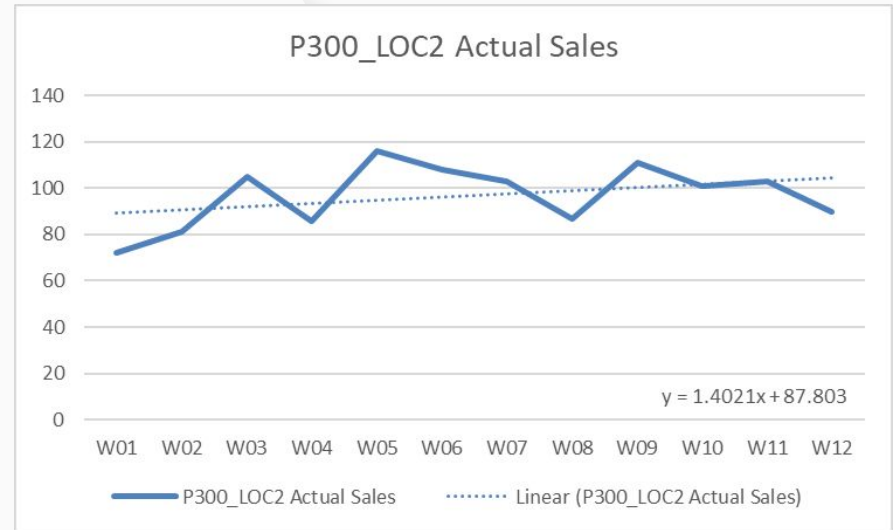
- ❑ X-Axis: Period ID
- ❑ Y-Axis: Actual Sales
- ❑ Slope = -0.727
- ❑ Actual Sales decline by an average of 0.727 EA per each week of Q3



1

Demand Trend Analysis: P300_LOC3

- ❑ X-Axis: Period ID
- ❑ Y-Axis: Actual Sales
- ❑ Slope = 1.402
- ❑ Actual Sales decline by an average of 1.402 EA per each week of Q3



1

Safety Stock & Supply Plan Heuristic

Safety Stock		Planned Order Quantity		
15.68224		42.68224		
15.68224		55.68224		
11.89832		69.89832		
29.06686		67.06686		
22.76362		64.76362		
24.76833		54.76833		
13.33679		43.33679		
11.58922		54.58922		
21.06579		76.06579		
17.22651		73.22651		
9.668118		35.66812		
32.76542		72.76542		
32.26302		60.26302		
9.668118		67.66812		
29.98887		66.98887		
29.98887		52.98887		
34.22839		78.22839		
21.53445		54.53445		

- ❑ Safety Stock = $STDEV.S(\text{Last 3 Weeks of Actual Sales}) * 1.65$
 - ❑ 1.65 (service level factor) for 95% service level
 - ❑ Determines how much extra inventory to carry in the case of a demand spike or forecast error
- ❑ Planned Order Quantity = $MAX(0, \text{Forecast} + \text{Safety Stock} - \text{Inventory Projection})$
 - ❑ Quantifies how many units of planned supply you need to meet the forecast and keep enough buffer (safety stock) which will identify a Supply Gap

2

What-If Simulation

Adjusted Forecast	Adjusted Planned Order	Forecast Consumpt
129.8		7
118.8		7
103.4		2
95.7	63.38224	5
110	78.68224	4
129.8	89.69832	1
107.8	80.86686	7
112.2	74.96362	11
99	55.76833	13
99	43.33679	5
113.3	46.88922	1
126.5	77.56579	11
127.6	101.8265	3
94.6	54.26812	11
110	95.76542	14
96.8	89.06302	11
129.8	108.4681	6
106.7	110.6889	11
91.3	96.28887	12
114.4	130.6284	7
102.3	98.83445	14

□ Adjusted Forecast = (Sales Forecast)*(1 + Adjustment Rate)

- Determines the demand after a “what-if” scenario that causes a 10% increase in demand

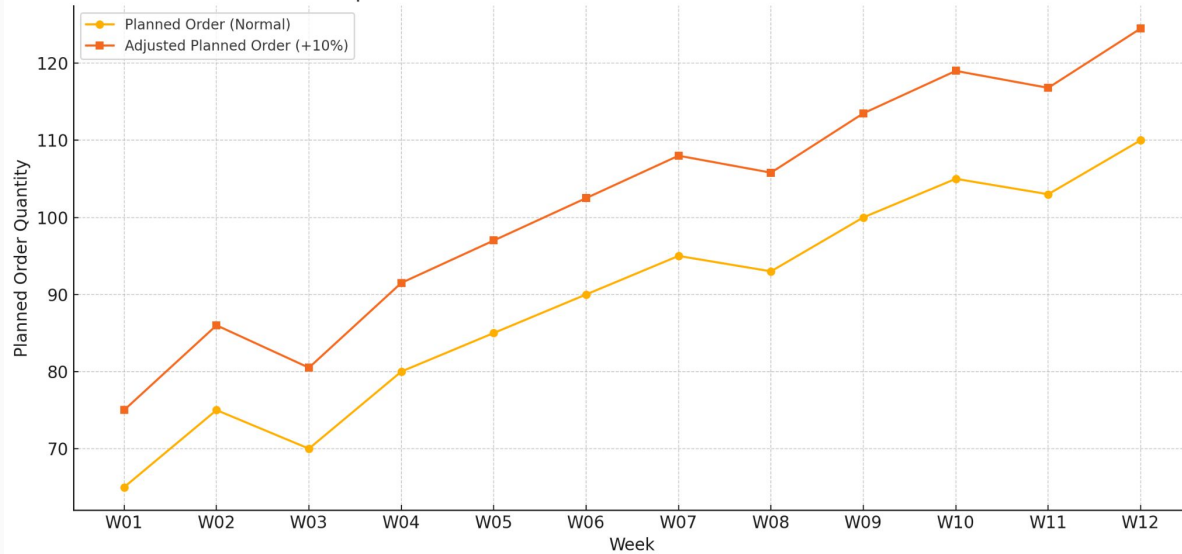
□ Adjusted Planned Order = MAX(0, Adjusted Forecast + Safety Stock - Inventory Projection)

- Determines how many units you need to fulfill the increased forecast and maintain safety stock

3

What-If Simulation

Comparison of Planned Orders: Normal vs. +10% Scenario



3

S&OP Metrics Dashboard

Forecast Error %	Inventory Coverage Ratio		
-0.05932			
-0.06481			
-0.02128			
-0.05747	0.467462		
-0.04	0.406285		
-0.00847	0.400313		
-0.07143	0.440713		
-0.10784	0.480909		
-0.14444	0.592498		
-0.05556	0.66772		
-0.00971	0.680692		
-0.09565	0.514457		
-0.02586	0.322759		
-0.12791	0.52264		
-0.14	0.354008		
-0.125	0.332604		
-0.05085	0.242817		
-0.1134	0.204742		
-0.14458	0.221261		
-0.06731	0.130219		
-0.15054	0.218275		

- ❑ Forecast Error % = (Actual Sales - Sales Forecast)/Sales Forecast
 - ❑ Negative value indicates over-forecasting
 - ❑ Positive value indicates under-forecasting
- ❑ Inventory Coverage Ratio= Inventory Projection / (Sales Forecast + Safety Stock)
 - ❑ >1.0 means you have more inventory than needed (excess stock)
 - ❑ =1.0 means you have just enough inventory to meet expected demand
 - ❑ <1.0 means you have insufficient inventory

4

S&OP Metrics Dashboard

	Week	Forecast Error %	Inventory Coverage R	Status	
1	W01	-5.0	0.43	● Low	
2	W02	-1.82	0.4	● Low	
3	W03	-2.86	0.42	● Low	
4	W04	-2.61	0.38	● Low	
5	W05	-1.67	0.37	● Low	
6	W06	-3.2	0.36	● Low	
7	W07	-0.77	0.34	● Low	
8	W08	-0.78	0.35	● Low	
9	W09	-0.74	0.33	● Low	
10	W10	-2.14	0.32	● Low	
11	W11	-1.45	0.33	● Low	
12	W12	-1.38	0.31	● Low	

4

ABC/XYZ Segmentation

- ❑ ABC Segmentation = Based on Total sales volume, and the Lettering provides Prioritization
 - ❑ A = Top ~70% of Sales
 - ❑ B = Next ~20% of Sales
 - ❑ C = Bottom ~10% of Sales
 - ❑ ** A-Items: Prioritized for availability, high service levels
 - ❑ ** C-Items: Minimize stock, low cost focus
- ❑ XYZ Segmentation = Based on demand variability
 - ❑ ** <0.5 = X (Low variability / stable demand)
 - ❑ ** $0.5-1.0$ = Y (Medium Variability)
 - ❑ ** > 1.0 = Z (High variability / erratic demand)
- ❑ CV (Coefficient of Variation) = measures relative demand variability
 - ❑ $STDEV.S / \text{Average}$

Product_L	Total_Sale	% of Total	ABC		ST DEV. S	Average Sales	CV	XYZ Segmentation
P100_LOC	1149	0.170273	A		11.81005	95.75	0.123343	X
P200_LOC	1055	0.156343	C		13.54762	87.91667	0.154096	X
P300_LOC	1092	0.161826	B		10.0905	91	0.110885	X
P100_LOC	1135	0.168198	A		12.78108	94.58333	0.13513	X
P200_LOC	1154	0.171014	A		11.72281	96.16667	0.121901	X
P300_LOC	1163	0.172347	A		13.41951	96.91667	0.138464	X

5

ABC/XYZ Segmentation

	ABC Class	X	Y	Z
1	A	P100_LOC1, P100_LOC2	P200_LOC1	-
2	B	-	P200_LOC2	P300_LOC1
3	C	-	-	P300_LOC3

5

Inventory Replenishment & Procurement Logic

I	J	K	L	M
Reorder Point	Inventory Replenishment Trigger			
20			Order	
19			Order	
18			Order	
12			Order	
13			Order	
8			Order	
4			Order	
0			No Action	
-8			No Action	
-9			No Action	
-18			No Action	
-10			No Action	
17			Order	
10			Order	
13			Order	
20			Order	
29			Order	
34			Order	
35			Order	
42			Order	
35			Order	

Reorder Point =

Target Inventory -
Inventory Projection

Replenishment Trigger

= IF(Reorder Point > 0,
“Order”, “No Action”)

This is to simulate
when a location
should trigger a
replenishment for a
product

6

Inventory Replenishment & Procurement Logic

Vendor Lead Time (Weeks)	Week Index	Remaining Weeks	Procurement Trigger	Preferred Vendor	Alternative Vendor	Alt Vendor Lead Time
2	1	11	Yes	A	A (Alt)	1
2	2	10	Yes	A	A (Alt)	1
2	3	9	Yes	A	A (Alt)	1
2	4	8	Yes	A	A (Alt)	1
2	5	7	Yes	A	A (Alt)	1
2	6	6	Yes	A	A (Alt)	1
2	7	5	Yes	A	A (Alt)	1
2	8	4	No	A	A (Alt)	1
2	9	3	No	A	A (Alt)	1
2	10	2	No	A	A (Alt)	1
2	11	1	No	A	A (Alt)	1
2	12	0	No	A	A (Alt)	1
2	1	11	Yes	B	B (Alt)	1
2	2	10	Yes	B	B (Alt)	1
2	3	9	Yes	B	B (Alt)	1
2	4	8	Yes	B	B (Alt)	1
2	5	7	Yes	B	B (Alt)	1
2	6	6	Yes	B	B (Alt)	1
2	7	5	Yes	B	B (Alt)	1
2	8	4	Yes	B	B (Alt)	1
2	9	3	Yes	B	B (Alt)	1

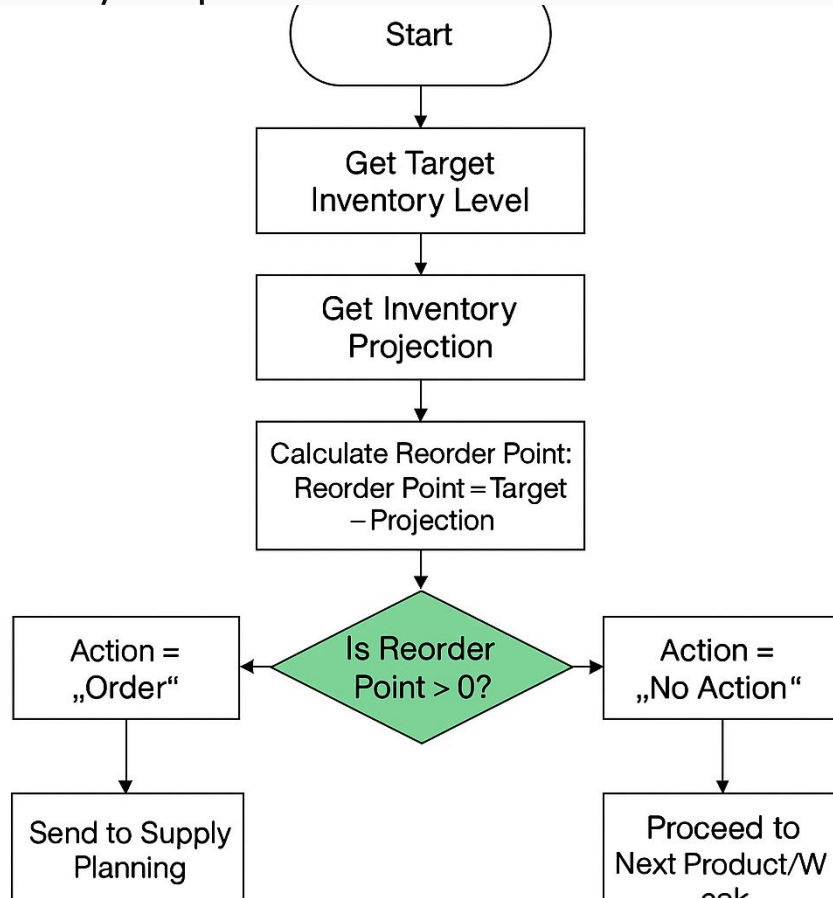
6

Inventory Replenishment & Procurement Logic

Rush Order Required			Use Alternative Vendor			Unit Cost		Rush Order Cost	Planning Status
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	No Action
No			No			10		0	No Action
No			No			10		0	No Action
No			No			10		0	No Action
No			No			10		0	No Action
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order
No			No			10		0	Normal Order

6

Inventory Replenishment & Procurement Logic



6

Thank you



Email: austinh@usc.edu

LinkedIn:
<https://www.linkedin.com/in/austinhong1/>

Project Link:
<https://github.com/austnhong/SAP-IBP-Simulation-Project>

