

PROJECT

Demand Forecast - Arconic

Inventory Control - VTI

Final Report ISEN 615(Production and Inventory Control)

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2.VTI – Inventory Control

2.1. Instruction of Visual Basic Application for VTI

This section guides you to use a self-coded VBA program for managing an inventory system of VTI firm based on existing data of customer requirement and stocks of products. The VBA program in this work is named VTIPB2019V2. It is composed of two linked files, which are a Microsoft Excel file of inventory with customer requirement database and VBA file in the same folder. An easiness of this self-created program is that an automatic popup window will show up after you do double click on the VBA program icon. A user can see inventory database of the product item immediately when the item number are selected from the listbox on the main control panel. Then the user can manipulate data directly without looking at the Excel file. Input values, such as penalty cost, interest cost, item cost and Alpha can be put in each input boxes of related parameters. Output data that are calculated by the above-mentioned inventory control method relying on formulas in Excel file can be shown automatically without opening the Excel file. However, you can open the Excel file by clicking the “manage Excel file” button on the control panel. After that, you need to press “Alt + F8” and enter to go back the main control panel of VTIPB2019V2 software after you completed managing the data in that Excel file. Before you close the program, you need to click “save” button to save your database into the Excel file. Otherwise, those modified data in the Excel file would be lost from the database. The following instruction explains the function of command buttons with concise procedure of using the VBA VTIPB2019V2. Figure 4 shows a feature of VTIPB2019V2 control panel before it is logged in. Most control buttons, except for Log Out and Exit program, are inactive as shown in Figure 4.

The screenshot displays the 'VTI of Texas' control panel. At the top, a title bar shows 'UserForm1' and a close button. Below the title bar is a blue header with the text 'VTI of Texas'. A menu bar contains several buttons: 'Log In' (yellow), 'Start' (green), 'Log Out' (grey), 'Clear Inventory Data' (grey), 'Open Excel File' (grey), 'Close Excel File' (grey), 'Manage Excel File' (grey), and 'Exit Program' (grey). The main area is divided into three sections: 'Inventory Data' (light blue background), 'Input Data' (light orange background), and 'Output Data' (light pink background). The 'Inventory Data' section contains eight input fields arranged in two rows: 'Item Number' (with a dropdown arrow), 'Board Size', 'Board Description', 'Vendor', 'Lead Time', 'Pieces/Bundle', 'Pieces/Truck', and 'Layout Space Limit'. The 'Input Data' section contains several buttons: 'Add Input OK' (yellow), 'Clear Input & Output Data on Panel' (grey), 'Next' (grey), 'Delete Input of Current Item Number in Excel' (grey), 'Back' (grey), and 'Delete All Input from Excel' (red). It also has three checkboxes: 'K value', 'c value', and 'I value', and three input fields: 'Alpha', 'etc.(If use)', and '# of Truck used'. The 'Output Data' section contains seven input fields: 'Demand Rate (Lamda)', 'Optimal quantities of order', 'Re-order point', 'Qty of bundles of this item/truck/trip', 'h value', 'Re-order quantities', and 'Maintain Safety Stock', and a 'Plot Graphs' button (yellow).

Figure 4 - The control panel before logging in

1. Log In: When the Log In button is pressed, the user will be asked to put the password into a blank box. If you put enter the right password: "VTI", you are allowed to access the main control panel of the VBA VTIPB2019V2.
2. Log Out: Log Out button is to enable the control panel until the user click on the Log In.
3. Start: The user needs to click on the Start to activate all control buttons and these control buttons will allow you to select the item number in next step.
4. Item Number Select: After the user clicked the start button, item numbers in the listbox are allowed to be selected. The user can select each item number for which product type you want to either see or enter the value of input parameters. You can also see inventory data of product items and descriptions (see Figure 5 as an example when Item number 4008 is selected). Input data and related variables are in active and you can then put the input value in the white box by clicking the check boxes of K, c, I, Alpha and other essential variables. Outputs of calculated parameters are shown as well.

UserForm1

VTI of Texas

Log In
Start
Log Out
Clear Inventory Data
Open Exel File
Close Exel File
Manage Exel File
Exit Program

Inventory Data

Item Number <div style="border: 1px solid black; padding: 2px;">40008</div>	Board Size <div style="border: 1px solid black; padding: 2px;">301/4"x97"</div>	Board Description <div style="border: 1px solid black; padding: 2px;">8'Plywood</div>	Vendor <div style="border: 1px solid black; padding: 2px;">Pacific Wood</div>
Lead Time <div style="border: 1px solid black; padding: 2px;">42</div>	Pieces/Bundle <div style="border: 1px solid black; padding: 2px;">40</div>	Pieces/Truck <div style="border: 1px solid black; padding: 2px;">978</div>	Layout Space Limit <div style="border: 1px solid black; padding: 2px;">850</div>

Input Data

Add Input OK
Clear Input & Output Data on Panel

☐ K value

150

☐ c value

10

☐ I value

0.2

Next
Delete Input of Current Item Number in Exel

☐ Alpha

0.9

☐ etc.(If use)

☐ # of Truck used

2.000

Back
Delete All Input from Exel

Output Data

Demand Rate (Lamda) <div style="border: 1px solid black; padding: 2px;">1807.292</div>	Optimal quantities of order <div style="border: 1px solid black; padding: 2px;">521.000</div>	Re-order point <div style="border: 1px solid black; padding: 2px;">0.288</div>	Qty of bundles of this item/truck/trip <div style="border: 1px solid black; padding: 2px;">4.000</div>
h value <div style="border: 1px solid black; padding: 2px;">2.000</div>	Re-order quantities <div style="border: 1px solid black; padding: 2px;">515.000</div>	Maintain Safety Stock <div style="border: 1px solid black; padding: 2px;">515.000</div>	Plot Graphs

Figure 5 - The Start button active

5. Clear Inventory Data: This button is for clearing product item data on the main panel only. You cannot delete item database by using this command button.

6. **Open Excel File:** This button is used if you want to look at the Excel file of inventory database during you work on the main panel. This command button does not allow you to edit database in the Excel file. The main panel still stay active on your computer screen.
7. **Close Excel File:** After you checked the data in the Excel file that you opened in Step 5, you can close that Excel file by clicking this command button. The main panel still stay active on your computer screen although you close the Excel file.
8. **Manage Excel file:** This command button connects the database Excel file which is included in the VBA VTIPB2019V2 folder. If you want to manage or edit the values of parameters that you input through Input Addition Button (explained in next step, you can click at the Manage Excel file button on the main panel.
9. **Exit Program:** This command button is used to exit the VTIPB2019V2 program.
10. **Add Input OK:** If you want to add input parameter values (K, c, l, Alpha and # of trucks used) into each row of the selected item number in the database Excel worksheet, this command button is only one way to send input value to the worksheet. The calculated result will show up in the output block. However, you should click on checkboxes to put values on the white boxes before pressing on Add Input button.
11. **Clear Input & Output Data:** This button allows you to clear up values on the main panel only.
12. **Delete Input of Current Item Number in Excel:** This button is directly used to delete input parameter values in each row of the selected item number in your Excel worksheet.
13. **Delete all Input in Excel:** Whenever you want to delete all input values from the database Excel file, you can hit this command button.
14. **Next and Back:** These two buttons are applicable for checking the next item and going back to the previously selected item numbers.
15. **Output Data Display:** This frame of the control panel displays output parameter values which are automatically calculated in the database Excel file as shown in Figure 5.
16. **Plot Graphs:** The user can plot and check statistical graphs by clicking this command button. A graph control panel will pop up as the second panel on the screen (example graph in Figure6)



Figure 6 - An example graph of EOQ versus Item number

2.2.Introduction to VTI calculation

We need to accommodate the 27 products of VTI into the database. The calculations of the safety stock, reorder point, reorder quantity will be dynamic calculated with every entry of weekly stock. The calculations are also made with respect to the customer requirement of not to stock out under any circumstance.

VTI calculations are made on the following assumptions:

- 1) The system should never stock out.
- 2) Lambda is calculated based on the average orders.
- 3) The weekly use chart is not updating automatically in the current chart, hence to be amended and then used.
- 4) The order rates of 90 days are used towards calculation of average demand.
- 5) Lead time provided are considered final.
- 6) Sum of in storage, on order, new order considered for lambda.
- 7) Cost functions assumed as shown in the spread sheet, this can be altered.

Data Cleaning:

The data is converted to column-based chart in order to make calculations and understanding easy. The focus is on calculations hence the Item#, board size, description, vendor details are obtained from the slides shared by the customer. The lead time is considered from previous data, at the same time we have provided with an option to edit or change the lead time per product. Starting with populating the charts of weekly use with values from the inventory list. We identified the calculations of the demand, maximum, minimum inventory conditions are calculated from the weekly use chart. The inputs for these are taken from the in storage, on order, and new order details provided in the spreadsheet. The weekly use will automatically be updated with an update in the data set. We have provided an option to enter new data into the database. However, the data with respect to in storage, on order and new order needs to take place in the same order and method currently followed at VTI. Excel is coded in order to calculate the max inventory demand automatically by considering data for the past 90 days (shown in Appendix 6 VTI - A).

The cost functions are randomly placed with certain logic based on the vendor variation, location, part type, lead time etc. This is just an assumption; hence we have provided the user to change the values of these functions as when required while running the program. If the costs are updated by the user, excel will automatically use that value for calculations and this latest value will be stored in the database. Suppose the user does not enter any cost function the previously assigned values for each Item will be used for the calculations.

We have done the calculations for VTI based on service level Type 1. We came to this decision to make sure the voice of customer were our customers wants us to make sure that the facility never runs out of inventory. The value of alpha for the estimation of how much quantity needs to be ordered (Q) and when the order needs to be placed (R) is kept at 90%, again this can be changed as per the interest of the user. The detailed calculation chart along with formulas of these are mentioned in the Appendix 7 VTI – B.

Working of the model:

- 1) Use the data base already developed and the inputs received from the user interface.
- 2) Updates the values in the spreadsheet.
- 3) Runs the macros as per the commands obtained from the user interface.
- 4) Stores the calculated values in the spreadsheet.
- 5) The final values of the order quantity, reorder quantity and the reorder point of the item selected by the user is matched in the spreadsheet and displayed (Figure 7).

These values are calculated in sheet 7

Item #	Board Size	Description	Vendor	Lead time in business days	Pieces/bundle	Pieces/truck	Bundles/truck	Layout Space Limitation	Mean	sigma	variance	Demand (lambda)	Setup cost (\$)	Item cost (\$)	Interest rate (%)	Holding cost (\$)	EOQ	Alpha	Re order
40000	3014"x37"	17Plywood	Pacific Wood	42	40	978	24	85	215.1538462	233.9493353	54732.2915	1807.292308	150	10	0.2	2	521	0.9	515
40003	3014"x12"	17Plywood	Pacific Wood	42	40	789	19	41	148.6666667	155.1010423	24056.33333	1248.8	150	10	0.2	2	433	0.9	347
40010	3014"x145"	27Plywood	Pacific Wood	42	40	661	16	72	382.4871795	452.5349578	204787.888	3212.892358	150	10	0.2	2	594	0.9	962
40011	4914"x37"	4x8 Plywood	Pacific Wood	42	40	818	15	25	91.1161339986	116.1339986	13448.99474	1880.4	150	10	0.2	2	319	0.9	230
40012	4914"x12"	4x10 Plywood	Pacific Wood	42	40	494	12	20	76.35897436	109.4996965	11990.18354	641.4153846	150	10	0.2	2	310	0.9	217
40013	4914"x145"	4x12 Plywood	Pacific Wood	42	40	412	10	20	79.23076923	113.7651	12942.49798	665.5384615	150	10	0.2	2	316	0.9	225
40102	45"x37"	4x8 MDF	Arauco	15	33	495	15	39	105.025641	116.4757682	13566.60459	315.0769231	80	5	0.2	1	225	0.9	254
40107	3014"x145"	12MDF	Arauco	15	33	530	16	29	163.9230769	201.4806226	40594.4413	491.7692308	80	5	0.2	1	281	0.9	422
40108	3014"x12"	17MDF	Arauco	15	33	614	18	19	68.41025641	77.13478222	5949.774529	205.2307692	80	5	0.2	1	181	0.9	167
40109	3014"x37"	17MDF	Arauco	15	33	781	23	39	104.7179487	139.4492831	19446.10256	314.1538462	80	5	0.2	1	224	0.9	283
40200	3014"x145"	12PB	Georgia-Pacific	6	34	476	14	652	1697.589744	2333.366077	5444597.248	2037.197692	100	1.5	0.2	0.3	1165	0.9	4688
40201	3014"x12"	10PB	Georgia-Pacific	6	34	578	17	652	1788.666667	2574.55417	6628329.175	2146.4	100	1.5	0.2	0.3	1196	0.9	5088
40202	3014"x37"	8PB	Georgia-Pacific	6	34	714	21	552	1170.641028	1651.374937	2727039.184	1404.769231	100	1.5	0.2	0.3	968	0.9	3287
40203	4914"x145"	4x12 PB	Georgia-Pacific	10	40	320	8	36	108.8974359	117.711913	13856.09447	217.7948718	100	1.5	0.2	0.3	381	0.9	280
40210	4914"x12"	4x10 PB	Georgia-Pacific	10	40	380	9	40	105.8974359	117.9227657	13905.77868	211.7948718	100	1.5	0.2	0.3	376	0.9	257
40211	4914"x37"	4x8 PB	Georgia-Pacific	10	40	480	12	60	159.9230769	167.5106257	28059.80972	319.8461538	100	1.5	0.2	0.3	462	0.9	375
40304	45"x12"	4x10 MDF	Arauco	15	33	396	12	19	99.46153846	143.3912289	20561.04453	298.3846154	80	5	0.2	1	218	0.9	283
40305	45"x145"	4x12 MDF	Arauco	15	33	328	9	19	131.0769231	146.8702228	21570.86236	393.2307692	80	5	0.2	1	251	0.9	319
41200	30"x144"	12SublindFSC	Roseburg	15	40	480	12	16	55.20512821	73.13890106	5349.430499	165.6153846	80	5	0.2	1	193	0.9	149
41201	30"x12"	10SublindFSC	Roseburg	15	40	560	14	16	69.84615385	93.44785725	8732.502024	209.5384615	80	5	0.2	1	183	0.9	190
41202	30"x37"	8SublindFSC	Roseburg	15	40	720	18	16	58.33333333	74.00011854	5476.017544	175	80	5	0.2	1	167	0.9	153
41203	45"x145"	4x12 SublindFSC	Roseburg	15	40	320	8	8	50.07692308	71.74897198	5147.914988	150.2307692	80	5	0.2	1	155	0.9	142
41210	45"x12"	4x10 SublindFSC	Roseburg	15	40	380	9	8	49.28205128	70.6186753	4986.997301	147.8461538	80	5	0.2	1	154	0.9	140
41211	45"x37"	4x8 SublindFSC	Roseburg	15	40	480	12	16	47.87179487	68.5915368	4704.79892	143.6153846	80	5	0.2	1	152	0.9	136
43004	3014"x37"	17RoseburgBoard	Roseburg	10	45	720	16	45	115.6052632	114.9997743	13224.94886	231.2195263	120	8	0.2	1.6	186	0.9	263
43005	3014"x12"	17RoseburgBoard	Roseburg	10	45	660	12	45	128.6923077	128.4258266	16489.21862	257.3846154	120	8	0.2	1.6	196	0.9	293
43006	3014"x145"	12RoseburgBoard	Roseburg	10	45	480	10	45	96.69230769	89.29464941	7973.534413	193.3846154	120	8	0.2	1.6	170	0.9	211

Figure 7 - Excel final sheet

Improvements Possible:

- 1) Revised database management: by introducing automatic update for the in storage, on order and new order details. The order rates can be tracked and updated using simple bar code readers.
- 2) Multiple linking as per the method required for the user. For instance, if the user wants service level 2 at some point of time the tools can be formatted such a way that it calculates the type two level. This an additional column to store values and a temporary sheet that will be created by the macro to run the iterations.
- 3) The new calculations are based on our assumptions. If VTI wants to use the old formula chart then they can easily change the link given to the cells and the program will work just fine.

2.3.VTI - Maximization of Truck Utilization

We have formulated a linear programming model to calculate the optimum number of bundles of each item (for each vendor) to maximize the freight capacity utilization.

Weight of each item is calculated by multiplying the volume by the density of the material. The density details were obtained through standards available for each type of board and the volume was calculated based on the given data on size.

Assumptions:

The truck payload capacity is 55,000 tons/trailer (referred from standards).

There are two drops a day from each vendor. Each drop has 2 trailers.
Density of the material is taken from relevant standards.
Service level is taken as 90%.

Constraints:

Payload capacity of the truck.

Maximum number of bundles of each item that the truck can carry.

After Linear Programming - The Optimum Number of Bundles per truck per trip is

SUPPLIER	PRODUCT	BUNDLES/TRUCK/TRIP
Georgia Pacific	40200	3
	40201	3
	40202	3
	40209	4
	40210	1
	40211	1
PacificWood	40008	4
	40009	2
	40010	5
	40011	1
	40012	1
	40013	5
Arauco	40102	1
	40107	1
	40108	1
	40109	1
	40304	1
	40305	9
Roseburg	41200	1
	41201	1
	41202	1
	41209	1
	41210	1
	41211	1
	49004	1
	49005	1
	49006	1

Figure 8 – Trip data

The LP programming is given in appendix 8