

BI in Inventory Management

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Introduction

I read an interesting quote by Jan Carlzon "...without information, people cannot take responsibility ...with information they cannot avoid taking it !"

In their efforts to become more competitive, Corporates in India are struggling to reduce their costs of operations. One of the areas targeted by them is the investment being made in working capital. Accounts Receivable and Inventories are two areas which are receiving considerable attention.

This article gives you a penetrating look at how Inventories and related data can be analysed in the domain of mid-sized Manufacturing Industries. In my previous article I had shared my thoughts on BI in the domain of Accounts Receivable.

General Scenario

Corporates use techniques like Kan-Ban, JIT (just in time) etc. for Inventory Management. Long before organized manufacturing started and even in current times, there is one person who does the perfect inventory management. And that person does not need any advanced Japanese techniques or ERP's for doing so. That person is the humble housewife! Have you ever seen three months supply of vegetables in the kitchen, or six months supply of grain? Have you ever faced a situation where on a day you get only chapattis to eat and no vegetable, and on another day vice-versa? All things are managed so well in the kitchen, that by the time we come from office we have a hot dinner ready ! And God save the retailer who charges excess rates or creates an artificial shortage. Governments fall if the housewife's requirements are not met...remember the onion shortage !

My guess is that if we had scientifically studied the techniques of the humble housewife, we would not be in such a mess! But as they say 'ghar ki murgi dal barabar'.

The Cost of High Inventory

Let say that you have a turnover of 1000 crores, with a profit margin after tax of 100 crores (10%). If you have locked up say 200 crores in inventory and if your opportunity cost of capital is 20%, then you are losing 40 crores, and this is equivalent to the profit earning capacity of 400 crores of turnover! Massive loss!

Proper inventory management begins of course with having a proper manufacturing plan (based on a sales and dispatch plan), correct Bill of Materials, a MRP Process and an established supply chain which can delivery just in time. I have heard some executives say that they cannot have any inventory problems. They say that they the above processes (MRP etc) are in place, and therefore their inventory must be right. (I am reminded of a comedy movie called 'If it's Tuesday, it must be Belgium!').

This is not necessarily true. As the saying goes, proof of the pudding is in the eating. It is essential to find out whether all these processes are working well by examining the inventory at a point of time. This article discusses some analytical reports which can help you doing so.

BI for Inventory

So how does one go about generating a reporting solution for Inventories which is analytical and actionable? What should the report contain? ... so that the management can find what they are looking for, rather than keep searching the myriad permutations which a typical BI report tends to give. In the following paragraphs I share some of my thoughts in this matter. My experience has mainly been in mid-sized manufacturing companies, but the general principles are applicable in any situation.

You can analyze inventory by building 'Intelligent Dimensions' on the raw data which an ERP provides. To build some analytical reports let's take the following raw data from ERP viz:

- Inventory balance at the end of a period along with value
- Summary of item wise and transaction type wise data of receipts and issues during the month.
- Item master containing attributes like business unit, the sbu, the location, warehouse project with the appropriate descriptions etc.

The inventory balance data would be by dimensions of sbu, business unit, location, warehouse etc., and the transaction data would summarized by the same dimensions. Needless to say the arithmetic accuracy of this data should be checked to ensure that the previous month's inventory balance plus the current month's summary of transactions is equal to the current month's inventory balance. This data would be stored in a database in set of tables with each record tagged with the as-on-date and/or the month to which the transactions belong. Multiple months' data will be stored in the same table to permit trend analysis.

In our practice we are using MS-SQL Server as the relational database. Business rules are applied using sql / stored procedures fired via MS-Access macro mechanism. User interface for entering user defined dimensions etc. is done using MS-Access forms. The report visualization is done using MS-Excel Pivot Tables and Pivot Graphs. This combination of technologies provides an extremely cost effective analytical framework. Here instead of purchasing new solutions, you can leverage your existing investment in MS-Office etc.

Intelligent Dimensions in Inventory

Using the above data, let's develop the following reports which can give us deep insights into the health of our inventories :

- Inventory Analysis
- Inventory Aging Analysis
- Inventory Velocity Analysis
- Inventory Variance Analysis
- Inventory Holding Cost Analysis

Various dimensions both natural and intelligent should be built into these reports, so that problem areas can be quickly spotted.

As discussed in my earlier articles, natural dimensions are ones which come directly from the ERP databases e.g. item code and name, location code and name, warehouse, projects, time dimension viz year-month etc.

Intelligent dimensions are the ones which can be generated by applying business rules. These dimensions help you to see 'what you need to see'. They can filter out all the clutter and help you to concentrate on what is important.

In the following paragraphs, I shall briefly describe the reports and also describe some of the intelligent dimensions which we can be built in this domain :

1

Inventory Analysis Report

In a typical manufacturing concern there are likely to be 30 to 40 thousand items in inventory. Finding the problematic item would be proverbial finding of a needle in a haystack. The intelligent dimensions which can be built are traditionally the ABC Analysis (inventory analysis based on value), the FSN Analysis (inventory analysis based on consumption) and the inventory turns (how quickly the inventory is turning).

- ABC analysis helps you to concentrate of the high value items. The 'A' class items are generally just 5% in terms of numbers and 80% in terms of value. I have also observed that the B & C class items may be low value, but may occupy a lot of store space. And any inefficient use of spaces has a huge opportunity cost. Hence here try to get a dimension of space utilization also.
- FSN analysis helps you to identify the slow and non-moving inventory so that you can concentrate on the slow and non moving items.
- Inventory Turns analysis helps to find how quickly the inventory has turned around. The higher the turns, the more efficiently the inventory has been managed. This should be calculated at the item level.

Now the best part of the report – combine the ABC, FSN and the Inventory Turns dimension into one single report and imagine the power of this report. Figure 1 below shows a sample report which we had developed for one of our clients .

ABC CLASS	FSN CLASS	Iss Val	Value	Cons
A-Class	A-VeryFast	366,214,790	34,443,906	171
	B-Fast	62,188,122	25,267,237	309
	C-Slow	1,349,056	4,969,936	57
	D-NonMove	0	60,000,363	588
A-Class Total		519,851,968	124,981,336	1,065
B-Class	A-VeryFast	108,212,527	1,200,235	86
	B-Fast	66,527,772	7,505,264	588
	C-Slow	21,936,688	11,716,061	1,200
	D-NonMove	0	25,695,488	2,033
B-Class Total		196,677,087	20,427,048	3,907
C-Class	A-VeryFast	11,178,648	20,494	13
	B-Fast	21,890,758	249,846	962
	C-Slow	12,190,838	2,020,758	2,479
	D-NonMove	0	3,144,332	3,038
C-Class Total		45,260,244	4,424,236	6,692
D-Class/Stock	A-VeryFast	4,139,279,049	0	1,040
	B-Fast	369,704,056	0	5,762
	C-Slow	184,239,467	0	14,674
	D-NonMove	0	0	388
D-Class/Stock Total		4,793,222,572	0	17,864
Grand Total		10,309,331,831	173,314,680	20,426

Figure-1

The adjoining Figure 1 is an Excel Pivot table report taking data from an SQL Server database. It shows the inventory of a typical manufacturing concern. At a high level summary level, it shows that there are 33,426 items in the inventory, worth a total of 173.31 million, having a total consumption of 5907 million. The A dimensions shows that there are 1,156 items, worth 124.35 million. When the FSN_Class dimension is dragged and dropped, it shows that within A-Class there are 588 items which are Non-Moving. AHA! – some information, but not yet actionable.

Let's do some more investigation, in Figure 2 below.

In the adjoining Figure 2 I have dragged and dropped the Buyer dimension before the ABC Class. The report now shows that in the purview of Buyer -1 there are 11 A Class items, of which there are 9 Non-Moving items.

Let's do some more investigation, in Figure 2 below. Double clicking on the cell F10, will open another screen which shows the details of the 9 items.

ITEM_NUM	stk_qty	stk_val	
VLV-GAT-C2G070	6.00	90,000.00	GATE VALVES
VLV-BTF-C2G070	17.00	103,492.00	BUTTERFLY VALVES
SYS-WLD-B2G104	1.00	371,260.00	WATER LEAK DETECTION SY
PTH-PIP-C0G126	9,820.50	314,251.00	PIPES
PTH-PIP-B2G014	20,985.00	1,072,030.50	25MM GI CONDUIT
PTF-ASP-C2G070	3.00	1,331,525.00	SUPPLY & INSTALLATION OF
PPA-SPK-C2G120	196.00	94,080.00	CEILING SPEAKERS
CBL-SIG-B2G104	17,514.00	416,309.10	CABLE- C*1.5SQ MM SC/
CBL-ASP-C1H184	1,132.50	133,562.50	PERFORATED CABLE TRAYS

Figure-3

In the report there is also a dimension called 'turns class'. This dimension has been created by identifying the inventory turns at an item level. Inventory turns have been defined as total of consumption over a period divided by the stock at the end of the period. The higher the turns, the better is the inventory managed and lower is the investment in inventories. The user could drag down the inventory within the ABC class to see whether in A class there are items having low turns.

new_buyer	ABC CLASS	FSN CLASS	Qty Val	Value	Has
Buyer-1	A-Class	B-Fast	403,822	273,276	2
		D-NonMov	0	2,854,001	9
	A-Class Total		403,822	2,727,320	11
	B-Class	E-Fast	51,399	3,258	1
		C-Slow	6,620	10,344	1
		D-NonMov	0	50,536	3
	B-Class Total		58,019	72,132	5
	C-Class	A-VeryFast	954,339	1,870	1
		C-Slow	14,015	1,880	1
	C-Class Total		968,354	3,817	2
	D-ZeroStock	A-VeryFast	15,730,925	0	11
		E-Fast	5,575,711	0	45
		C-Slow	1,375,944	0	89
	D-ZeroStock Total		22,682,580	0	145
Buyer-1 Total			27,000,396	2,803,311	162
buyer-2	A-Class	D-NonMov	0	116,513	2
	A-Class Total		0	116,513	2
	B-Class	E-Fast	296,517	50,362	4
		C-Slow	248,061	104,768	13
		D-NonMov	0	175,854	20
	B-Class Total		544,578	332,725	37
	C-Class	E-Fast	386,002	2,316	2
		C-Slow	49,803	11,880	11
		D-NonMov	0	12,178	0
	C-Class Total		435,805	16,304	13
	D-ZeroStock	E-Fast	2,685,815	0	25
		C-Slow	646,936	0	75

Figure-2

In the adjoining Figure 3 all the 9 items which were non-moving for Buyer-1 are now identified. **The information is now actionable.**

The buyer can now take these item codes and study their purchasing and consumption patterns etc. in transaction level details in their ERP systems, and take the appropriate

2

Inventory Aging Report

Inventory Age could be an intelligent dimension transforming a run-of-the-mill stock balance report into an actionable report.

Inventory aging for those items for which stocks are not maintained batch wise, requires some programming. We can take an assumption of a FIFO (first in first out) basis of consumption. This means that the earliest purchases are consumed first. One could write some VB or VBA code which could allocate the stocks to the latest purchases so that the aging of inventory and its latest cost could be ascertained. This can be seen in the following report :

Inv. Value	AGE CLASS	General Total										
ORG. TYPE	SEGMENT1	Item Description	B: 01-60	C: 61-120	D: 121-180	E: 181-240	F: 241-300	G: 301-360	H: 361-420	I: 421-480	J: 481-540	General Total
COMMON	CAP		5,219	0	0	0	0	0	0	0	0	5,219
	FG		4,028,270	1,582,292	1,850,179	9,279,660	348,395	441,677	17,536,463			
	MSC		50,694,450	35,835,335	28,458,917	86,437,716	3,947,175	57,881,607	264,255,200			
	RM		27,485,268	17,122,288	7,020,605	7,757,736	916,277	21,531,156	81,841,287			
COMMON Total			82,213,207	54,539,913	36,348,700	103,472,072	5,211,836	79,854,440	363,638,169			
REGION			111,036	471,980	160,164	939,757	568,189	27,079,618	29,350,741			
SEU			25,530,821	15,941,440	2,375,306	3,475,080	3,256,646	117,411	56,896,704			
Grand Total			107,855,064	70,953,333	46,902,170	107,886,909	9,036,671	107,051,467	443,885,615			

In the adjoining Figure 4 a pre-process has been run to age the inventory. For the report the stocks as on a particular date were taken and the Purchase order receipts of the previous two years were taken. A vba process was written to allocate the stocks to the later purchases. If sufficient quantity was not found in the receipts, the balance stock was considered to be from opening balance.

Users of the report said that the results were very surprising and unexpected.

Figure-4

The above report shows a bird's eye view of inventory in a typical manufacturing company. On the rows the report could be drilled down to the item level. On the columns the inventory aging is seen. The report was used by the company for making account provisions for old stocks.

3

Inventory Velocity Analysis

Inventory Velocity analysis is just a comparison of the receipts and issues of a given period. This is shown in the following report :

Value	subu	bu_group	subinventory_code	item_num	01-Opening	02-Receipts	03-Issues	04-Closing
	SBU-1	BU-01	Subinv-01		68,704,287	1,377,882,285	1,391,677,825	54,908,747
			Subinv-02		21,417,513	440,585,710	440,677,342	21,325,881
			Subinv-03		10	63,155,682	41,875,368	21,280,304
			Subinv-04		9,437,831	36,613,148	37,169,885	8,881,094
			Subinv-05		2	4,328,446	235,767	4,092,681
			Subinv-06		108,643	5,833,678	4,263,427	1,678,894
			Subinv-07		88,158	477,338		565,496
			Subinv-08		1,039,339	1,393,676	2,078,678	354,237
			Subinv-09		31,691	2,855,810	2,557,896	329,615
			Subinv-10		0	537,500	262,500	275,000
			Subinv-11		8,305	23,632,821	23,391,309	249,817
			Subinv-12		718,881	7,733	480,689	245,925
			Subinv-13		568,957	26,063,683	26,500,627	132,013
			Subinv-14		0	113,140		113,140
			Subinv-15		386,723	143,573,018	143,889,684	70,057
			Subinv-16		56,635			56,635

In the adjoining Figure 5 shows the opening balance, receipts, issues and closing balance of each sub-inventory. Within this the user can drill down to the individual items. A high level summary of inventory in such a compact manner shows gives a great degree of visibility in the inventory investments. This report can be summarized by sbu's, and within that individual product lines or warehouses etc. depending on how the inventory organization has been defined.

Figure-5

An intelligent dimension can be built to segregate the items where the stocks have increased and where they have decreased. The user can then directly go to those items where stocks have increased and go into the reasons of the same.

4

Inventory Variance Analysis

Comparing stocks at two points in time, and analysing the difference as caused by quantity changes and as caused by rate changes can show some very interesting results.

Item	RateChange	Current	Previous	Stock Var	Rate Var	Qty Var	Quantity	Curr Val	Prev Val	Unit Cost
PM	00-NoChange	89.97	87.31	2.66	2.96	73,073,556	254,265	73,819,171	2,440,566	220,202,694
	01-RateIncrease	79.77	66.33	13.43	12.45	7,222,629	4,863,206	2,369,294	2,349,263	177,965,686
	02-RateDecrease	77.85	79.12	1.27	1.63	62,824,938	7,883,066	44,841,670	2,173,730	169,226,375
	PM Total	81.41	78.50	2.90	3.55	116,575,955	3,184,248	115,291,707	6,301,601	567,524,666
PM	00-NoChange	13.72	13.24	0.48	2.53	5,862,455	0	5,862,455	2,171,429	29,802,204
	01-RateIncrease	19.20	22.89	3.69	19.24	1,715,629	600,276	1,107,353	860,537	16,902,731
	02-RateDecrease	23.36	46.41	17.05	73.01	26,805,527	23,425,635	3,379,892	518,756	12,115,767
	PM Total	16.47	20.77	4.29	26.06	31,052,352	23,817,359	6,234,693	3,570,724	58,820,703
INT	00-NoChange	79.99	82.86	2.86	3.70	39,975,207	490,719	39,484,488	1,847,537	155,792,910
	01-RateIncrease	72.42	82.05	10.37	14.32	194,342,469	362,087,045	267,744,576	13,859,516	1,003,745,116
	02-RateDecrease	97.44	82.26	15.19	15.59	2,332,526	44,136	2,376,662	756,753	73,741,294
	INT Total	83.36	82.04	1.32	6.61	1,063,462	2,040	1,065,000	795,062	49,473,142
Grand Total		89.49	83.02	6.47	7.99	88,897,834	396,941,321	424,296,236	27,671,192	1,908,097,311

Figure-6

The above report has been generated by comparing the stocks at as on two dates. The overall difference in quantities and value is shown in column H. This is further analyzed into Quantity and Rate variance. The users here wanted the comparison of the average rate at two points of time. An intelligent dimension on the rate variance was created which is shown in column B. It shows those items where there were no changes, where there was a rate increase and rate decrease. Under each of these categories, the user can drill down to the individual items. Another intelligent dimension named 'impact type' analyzed the impact of the rate change in high, medium and low. Using these dimensions the users were able to navigate very easily to those items where the rate change was high and which led to a high impact in stock values.

5 Inventory Holding Cost

How does one analyze how quickly inventory has been consumed after it was purchased ? This could give a very good indication of the entire procurement process. If the inventory was purchased and consumed after many days, it may mean that the organization is incurring a holding cost. For one of our customers we created an interest algorithm for measuring this performance. We treated each inventory account as a cash credit account. Each receipt from the date of receipt started attracting a positive interest cost at a specified percentage. Each issue from the inventory attracted a negative interest cost at the same percentage. If the number of days between receipt and issues was minimal, this calculation would lead to a very low interest cost, indicating an effective inventory management.

The results of such a calculation was very revealing as shown in the following report. The report can be seen at a summary level and then also drilled down to the item level if required.

Demo Company: Holding Cost Analysis (15%)					
1					
2	segment1	(All)		sub inv location	(All)
3	segment2	(All)		sub inv sbu	(All)
4	segment3	(All)		sub inv type	(All)
5	segment4	(All)			
6				21-Nov-02	
7			Data		
8	ORG TYPE	ORGANIZATION NAME	Inv Value	Int Loss	
9	COMMON	Org-1	74,577,247	6,692,077	
10		Org-2	219,940,107	23,493,591	
11		Org-3	2,869,940	87,428	
12		Org-4	105,555,086	12,164,492	
13		Org-5	3,383,218	168,478	
14		Org-6	320,128	31,180	
15		Org-7	2,993	280	
16		Org-8	17,185,002	3,407,502	
17	COMMON Total		423,833,722	46,045,028	
18	REGION	Org-9	5,000,381	767,426	
19		Org-10	4,196,991	432,369	
20		Org-11	0	641,006	
21		Org-12	14,325,049	1,583,303	
22		Org-13	9,362,706	1,224,045	
23	REGION Total		32,885,128	4,648,149	
24	SBU	Org-14	27,696,778	3,414,404	

Figure-7

Conclusion:

Inventory Analysis is a huge area, and a large number of analytical reports can be generated to identify inefficiencies in inventory management. The reports given above are a few examples of what can be done.

The BI solution described above will help you in not only analysing your inventory, but will also give you the benefit of person-independence and load-independence in reporting.

But please don't cut-paste this to your scenario. That would be pushing a solution to a problem. Each scenario is different, analyse yours and build suitable intelligent dimensions!

Best of Luck!

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About the Author:

Sanjay Shah (B.Com, CA) is the CEO of Prosys Infotech Private Limited, a Pune; India based company specializing in developing BI solutions. Prosys has developed BI solutions for various companies like Honeywell Automation India Ltd., Alfa Laval India Limited, Tata Auto Components Ltd., Kirloskar Group Corporate Office, Kansai Nerolac Paints Limited etc. He can be contacted at sanjay@prosysinfotech.com.