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INVENTORY MANAGEMENT – A CASE STUDY OF OIL AND GAS EXPLORATION SERVICE PROVIDER COMPANY

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Abstract

The upstream oil and gas exploration service providers need keep inventory of the equipment and services used in the drilling, evaluation, completion, production, and intervention of oil and natural gas wells. This will lead to high inventory levels and blocked working capital of the company. This case describes the Asset/Inventory function of the oil and gas service provider the company and the concepts get rid of redundant and excessive inventory. It also describes some of the inventory classification tools to optimize the inventory. Inventory Optimization through Classification describes the various dimensions of inventory and different analysis tools for classifying inventory. The report discussed about the ABC, FSN, and HML analysis done on about 5600 items from three branch plant of the company. Last six months transaction data were collected from three branch plant warehouses. The new method to Re-Classify of these items in three different categories (Very Important, Important, and Less Important) by combining ABC, FSN, and HML analysis were proposed.

Keywords:
Inventory;
ABC Analysis;
Oil and Gas;
Virtual Warehouse;
ERP System.

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1. Introduction

Inventory is necessary but it also affects the economic health of the company. The company under study provides equipment and services used in the drilling, evaluation, completion, production, and intervention of oil and natural gas wells to independent oil and natural gas producing companies worldwide. It primarily offers artificial lift systems, which include progressing cavity pumps, reciprocating rod lift systems, gas lift systems, hydraulic lift systems, plunger lift systems, and hybrid lift systems, as well as wellhead systems and production optimization. The company also designs and manufactures drilling jars, rotating control devices, and other pressure-control equipment used in drilling oil and natural gas wells; and provides a selection of in-house or third-party manufactured equipment for the drilling, completion, and work over of oil and natural gas wells for operators and drilling contractors. In addition, it offers a line of completion tools and sand screens; Wireline and evaluation services; re-entry, fishing, and thru-tubing services; pipeline and specialty services; and drilling and well construction services. Further, it provides chemical technology and services comprising fracturing technologies, production chemical systems, and capillary injection technology and services, as well as operates land drilling rigs.

To provide the mentioned services at right time and places, the company has to maintain huge amount of inventory. To manage its inventory, it has ERP system in place. The process flow for the access /issue to a particular tools or equipments is shown below. The diagram shows that, for a particular tooling or equipment to be delivered to drilling site, it has to be done through ERP system.

Most of the business functions in upstream oil and gas sector are driven by the firm contracts. These contracts include the clauses like take or pay/supply or pay. So, any companies which enter in to these kinds of contracts have to either face high inventory cost or high penalty cost. Being a service provider company in upstream oil and gas sector and having a presence in more than 100 countries, Weatherford International Ltd. maintains its inventories in different warehouses located across the globe.

To improve its inventory level and operations, the company has implemented ERP system. With the help of ERP, company could able to connect all its function across the globe. With this connectivity between regions help the company to establish a virtual warehouse for managing its inventory.

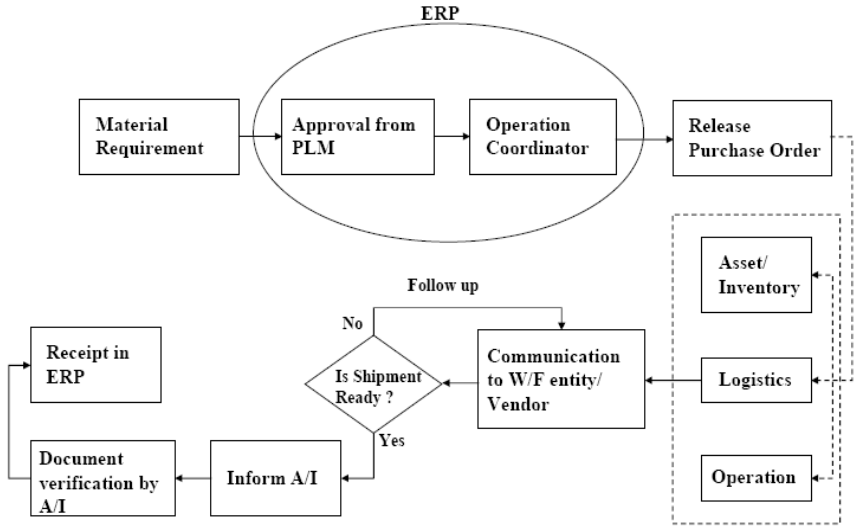

Figure 1Process Flow of Inventory in ERP system

Virtual warehouse (VW) is a business model targeted at reducing cost, optimizing inventory and providing high quality customer service. The basic concept of VW has focus on a single-location consolidated stock rather than multi-location distributed stock of virtual inventory approach. The basic approach of VW is shown in Figure.

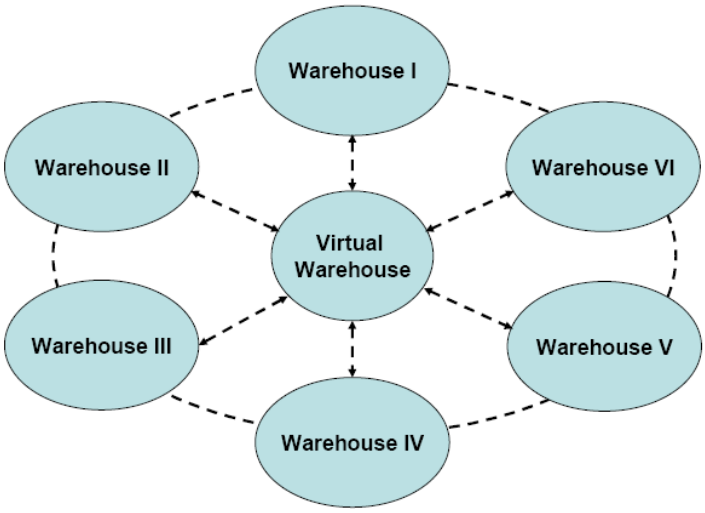

Figure 2VirtualWarehouse

In the company, each region is having more than one warehouse located in different country within that region. Each project office put their excess/unused material on virtual warehouse every month with the help of ERP.

Now, when the demand for a particular item comes from a site/rig, the operation coordinator checks the availability in country warehouse through ERP. If the item is not available in a country warehouse, the operation coordinator can check the availability of that particular item in other country/regional warehouse (Virtual Warehouse) through ERP. Thus, the time will be saved and the ordering and procurement lead time can be minimized. Also, it will reduce the redundant/ unnecessary inventory.

2. Research Method

Inventory Optimization through Classification describes the various dimensions of inventory and different analysis tools for classifying inventory. We haveused various inventory classification methods like ABC, FSN, and HML analysis done on about 5600 items from three branch plant of the company. Last six months transaction data were collected from three branch plant warehouses. Moreover, we have proposed a Re-Classification method of these items in three different categories (Very Important, Important, and Less Important) by combining ABC, FSN, and HML analysis. The 256 different categories of an item were generated by combination of four dimensions of inventory. The inventory management section of the company was recommended to identify some typical categories and set guidelines and policies to monitor it.

3. Results and Analysis

Inventories can be classified into categories on the basis of a number of criteria or dimensions. These can be consumption value, procurement lead time, consumption pattern, variability in lead time, seasonality of materials, perishability, location of vendors, number of vendors, criticality, cost of shortage, unit value, ordering cost, bulk, stocking level etc.

Techniques of selective inventory control like ABC analysis, which takes into account annual consumption value; VED analysis, which takes into account criticality of the items; FSN analysis, which takes into account movement of materials etc., are being used in industry. We

have collected last six months data from the three branch plant warehouse (BP -I, BP - II, and BP - III**)** and carried out ABC, FSN, and HML analysis. We have also visited the two warehouses: Patal Ganga and Panvel.

3.1 ABC Analysis

The ABC inventory control technique is based on the premise that a small portion of the items or styles in inventory typically represents the bulk of the dollar value of usage from inventory. "Dollar value of usage" is determined by multiplying the quantity of each item sold or issued for production by the unit value of the particular stock items. Percentage relationship for a typical inventory would be somewhat as follows:

"A" items – 10% of items represent 80% of value

"B" items—35% of items represent 15% of value

"C" items—55% of items represent 5% of value

Table 1 below shows the summery of ABC analysis for these three branch plant.

Table -1 Summary of ABC Analysis

Category	**% of Total Amount**	**% of Total Items**		
		BP – I	**BP – II**	**BP – III**
A	80	2.74	0.89	0.01
B	15	4.37	0.98	0.01
C	5	92.94	98.14	0.98

3.2 FSN Analysis

This analysis relates the demand for material and stock moving patterns. It defines stock/inventory in to three classes: Fast, Slow and Non-moving items. For the company under study, we have defined the criteria for FSN analysis based on Inventory Turn factor (I.T.). The Inventory Turn is calculated as follows:

Inventory Turn = Usage Inventory Quantity/Average Inventory

We have analyzed past six months consolidated data. So, if an item having inventory turn six or more than six, then that item has moved from warehouse on average once in every month. These

items will be termed as F category. Similarly criteria were decided for S and N category of items. The Table 2 below shows the criteria for three categories of items.

Table -2 Criteria for FSN Analysis

Category	**Inventory Turn (I.T.)**
F	I.T>=6
S	6>I.T>=2
N	I.T<2

The inventory data from three branch plants were analyzed according to above criteria and the items were classified in F, S, and N category. The result is summarized in below Table 3.

Table -3 Summary of FSN Analysis

Category	**Inventory Turn (I.T.)**	**Number of Items in Each Category**		
		BP – I	**BP – II**	**BP – III**
F	I.T>=6	4	0	0
S	6>I.T>=2	55	12	4
N	I.T<2	2278	2242	998

3.3 HML Analysis

This analysis classifies the inventory in to three classes of items: High, Medium and Low based on their unit prices. The cutoff for different category is decided by the management. HML Analysis helps to

- Assess storage and security requirements
- To keep control over consumption at the departmental head level
- Determine the frequency of stock verification
- To evolve buying policies to control purchases
- To delegate authorities to different buyers to make petty cash purchases.

We have decided criteria (cutoff) for different category of items as follows:

Table -4 Criteria for HML Analysis

Category	Unit Cost (UC)
H	UC>=10000
M	10000>UC>=1000
L	UC<1000

The result of HML analysis for the three branch plant is shown in Table 5 below for three branch plant. We can see that the major portion of inventory items at three branch plants is classified as "L" category.

Table -5 Summary of HML Analysis

Category	Unit Cost (UC)	Number of Items in Each Category		
		BP – I	BP – II	BP – III
H	UC>=10000	12	11	14
M	10000>UC>=1000	276	312	108
L	UC<1000	2049	1931	880

3.3 Multicriteria ABC Analysis

The above mentioned techniques for selective inventory control like ABC, FSN, and HML has been discussed in the literature. However, these techniques alone are not useful in the industry and business operation due to variety of reasons like:

- Considers only one dimension of inventory.
- High variability in demand.
- Criticality of an item which require constant management attention.
- Contractual agreements between the businesses (Penalty Cost)
- Long procurement lead time for an item. (Affect Safety Stock).
- Perishable nature of an item which affect the inventory level and safety stock.

These reasons lead the industry to treat each item according to its characteristics. Also, it becomes very complex for an organization to ser different policy for each/ group of items. To

overcome these limitations we have used Multi-Criteria ABC analysis (Flores and Whybark, 1986).

In Multi-Criteria ABC analysis, we have combined the three analyses to generate other 27 category to classify the items. These 27 categories along with the number of items in each category are shown in Table 6 below.

Looking at these 27 categories, we have re-classified then in to three categories as (a) Very Important (A-class); (b) Important (B-class); and (c) Less Important (C-class). Again this classification is subjective in nature and depends on particular business (Operation). The above mentioned three categories are presented in Table 7.

Table -6 Summary of Multi-Criteria ABC Analysis

Category	**Number of Item (Branch Plant wise)**		
	BP – I	**BP – II**	**BP – III**
AFH	0	0	0
AFM	1	0	0
AFL	1	0	0
ASH	0	0	0
ASM	10	4	0
ASL	1	1	0
ANH	1	0	0
ANM	34	5	0
ANL	16	10	12
BFH	0	0	0
BFM	0	0	0
BFL	2	0	0
BSH	0	0	0
BSM	5	1	0
BSL	13	2	0
BNH	0	0	0
BNM	31	1	0
BNL	51	18	10

CFH	0	0	0
CFM	0	0	0
CFL	0	0	0
CSH	0	0	0
CSM	0	0	0
CSL	26	4	4
CNH	11	11	14
CNM	195	301	108
CNL	1939	1896	854

Table -7 Re Classification of Items

Category	**Sub Category**	**Number of Items in Each Category**		
		BP – I	**BP – II**	**BP – III**
Very Important (A-Class)	AFH, AFM, AFL, BFH	2	0	0
Important (B-Class)	ASH, ASM, ASL, BFM, BFL, BSH, CFH	13	5	0
Less Important (C-Class)	ANH, ANM, ANL, BSM, BSL, BNH, BNM, BNL, CFM, CFL, CSH, CSM, CSL, CNH, CNM, CNL	2322	2249	1002

The above re-classification of items gives some ideas to management where they need to attack to reduce their inventory. The analysis shows that in all the three branch plant, more than 90% of inventories are belong to Less Important (C-Class). To identify it's operational and business importance it is recommended to include some more dimensions of inventory in the analysis.

4. Conclusion

We have observed the operations of oil and gas exploration service Provider Company. Based on the operations and importance of services, various equipments and tooling inventory were analysed using inventory classification techniques. We have also proposed a re-classification method by combining the existing inventory classification techniques. Based on the proposed method, the inventory were classified in to three classes as "(a) Very Important (A-class); (b) Important (B-class); and (c) Less Important (C-class).

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