

Re-engineering Materials Management System in the Oil and Gas Service Industry

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ABSTRACT— *Profit is the main motive behind every business and if the material flow in an industry is not well managed, then the company will keep acquiring materials and services at higher costs which can lead to low productivity, huge overheads and low profit. This study therefore examined the effect of Materials Management on the profitability of Nigerian Oil and Gas Service firms using the case of Integrated Corrosion Science Co. Ltd. Data was collected through relevant publications and interview with key individuals in the company. The results showed that there was substantial increase in the company's profitability as a result of efficient management of materials, which was achieved by efficient coordination and full accountability for quality, delivery and cost by the materials related department, improved inventory management system, good relationship with vendors, and state-of-the-art facilities/ICT. In this study the Economic Production Quantity Model was used in the re-engineering of the company's materials management.*

Keywords— Materials, Management, profit, Inventory.

1. INTRODUCTION

Materials Management is simply defined as a concept that integrates all the activities of planning, scheduling and controlling materials from design through production and including delivery to the customer. It therefore establishes full responsibility over the material flow system with full accountability for quality, delivery and cost (Sharma, 2000).

Materials Management is all about purchasing mix and covers all operation management functions from procurement of raw materials through the production processes to the final delivery of the end products. It brings together under one management responsibility for determining the manufacturing requirement, scheduling the manufacturing processes and procuring, storing and dispensing materials (Wild, 1995; Ondiek, 2009; Asaolu et al., 2012).

The primary role of a material manager is to ensure that he/she streamlined the issue/demand/sales of the company as to enable him/her to be aware of when the management is short of goods and will not go to the extent of making use of their buffer stock.

A lot of research has been conducted on the management of material flow and management in many organizations. Years ago in Israel, Levy and Ronen (1989) conducted a research on the purchasing policies in science-based Japanese industries and established that caution must be exercised in cutting raw materials inventory levels. They applied an analytical model to meet with the requirements of science-based industry. They tried to distinguish between the “Big Just in Time” – the philosophy and strategy of the Just in Time (JIT) which can be applied in all types of industry in Japan, and the “Small JIT” – the Scheduling mechanism.

Ogbadu (2009) analyzed how business firms can achieve high productivity through effective materials management. He identified some problems of material management which if corrected, can lead to high profit.

Fearon et al. (1988) in their study viewed the introduction of computers as a great boost to the adoption of Materials Management, as materials functions has many common databases.

Ramakrishna, 2005; Ogbadu, 2009; Ondiek, 2009; Asaolu et al., 2012 in their studies, have shown that materials account for more than fifty percent of the annual turnover in the manufacturing firms. This shows clearly that priority should be given to Materials Management in manufacturing firms in order to achieve significant cost saving, improvement in production efficiency, and increase in profitability and competitiveness.

Asaolu et al. (2012) conducted a detailed study on Materials Management as an effective tool for optimizing profitability in the Nigerian Food and Beverage Manufacturing Industry.

Khanna (2005) highlighted some of the benefits companies will derive from adequate Materials Management to include:

- Good Inventory management practice for achieving minimum inventory carrying costs.
- Adaptation of scientific methods of cost reduction.
- Minimum stock/sales ratio.
- Less material in 'move' i.e., works in process.
- A systematic record keeping.
- Maximum inventory turnover ratio.
- Reduced losses due to obsolescence, surplus, deterioration and scraps.
- Lower materials handling cost.
- Shorter lead times.
- Better 'Management Information System' (MIS).
- Better customer satisfaction.
- Better relations with the material suppliers.

Ineffective management of materials can lead to purchasing errors, materials shortages and inventory irregularities. This in turn can cause production delays that lead to missed delivery dates. Late placement of purchase orders can also have the same impact. If the company tries to correct these problems with rush purchase orders, then they are creating room for increased costs of materials. This is because they will try to do last minute sourcing from the first available vendor with materials in stock, and costly, expedited freight arrangements.

The disruption of production schedules due to materials shortages, or incorrect materials can have other implications such as underutilization of labour resources and reduced quality standard of products.

Previously, the company used in this study has been using the manual method of material management in which the flow of material is tracked manually by the material/store manager. This he does with the use of inventory/scheduling notebooks which are used to record all sales and purchases made in the company. The material manager directs and coordinates all aspects of the Materials Management function including the planning, procurement, storage and distributing of raw materials, equipment, machinery, services, and supplies in the organization. He is also responsible and accountable for achieving financial objectives for inventory and purchase price standards. All these tasks were performed manually.

The material/store manager is also responsible for the final negotiation of all supply and manages all key supplier relationships, including external manufacturing partners. Directs and formulates procedures and policies to ensure that materials are available to support production schedules and customer service targets levels. He interacts with Sales/Marketing to understand product forecasts and demand and with the Quality Assurance on matters of vendor delivered quality and vendor rating systems.

The following are the inventory control records used by the material manager:

- Material requisition form
- Purchase requisition form
- Receiving report
- Perpetual Inventory record

For effective management of materials in the company, the following are required

- Production tracking and scheduling systems that provide the data needed for scheduling materials requirements.
- Data collection systems to support the scheduling systems and track materials movement and usage.

But none of these can compensate for the effects of inaccuracies or missing data. Hence the need for an inventory management system that performs the function of tracking of materials movement, ensure effective purchasing and inventory management as well, aid in product costing.

This study is aimed at analyzing the most effective method of managing the materials so as to enhance the coordination and control of various material activities which include purchasing/supply management activities, inventory management, receiving activities, stores and warehousing, in-plant materials handling, production planning, scheduling and control, traffic and transportation in typical oil service sector in Nigeria.

2. METHODOLOGY

In this study, the following steps were taken for data collection:

- 1) Interview was conducted on the management of materials so far by the company and enquiries made on the different strategies they implement to ensure full responsibility over the material flow system with full accountability for quality, delivery and cost.
- 2) The data collected was used to write a program that addresses the material flow of the company.
- 3) Recommendations were provided on the best Inventory system management software to employ for effective management of the inventories, sales, Purchases and payments made within and outside the company.

The model used in this work is the economic production quantity model because the demand of the materials in the company is gradual over a length of time at a finite rate (Sharma, 2011). This model was employed in this case because it was found that the amount of inventory usually ordered by the company is delivered by the vendor in several shipments over a period of time. Also, the rate of flow of materials and usage overlaps.

Other assumptions of the model include:

Demand is continuous and at a constant rate

The rate of receipt (R) of replenishment of inventory is greater than the rate of usage

The oil production set -up cost is fixed.

By employing T_p as the time period required to receive a batch amount of Q at a rate R, then the rate at which the stocks arrive is given by:

$$R = \frac{Q}{T_p} \quad (1)$$

During the production run time T_p , the inventory increases at the rate of R and simultaneously decreases at the rate of d. thus the inventory gradually builds up at the rate of R-d units during the runs and decreases at the rate of d between runs. Therefore the maximum inventory level reached at the end of T_p is expressed as:

$$I_{max} = \text{inventory accumulation rate} \times \text{production time} \\ = (R - d)T_p = (R - d)\frac{Q}{R} = \left(1 - \frac{d}{R}\right)Q \quad (2)$$

Since the minimum inventory level, $I_{min}=0$, therefore, the average inventory level would be:

$$\frac{Q}{2} \left(1 - \frac{d}{R}\right) \quad (3)$$

Thus the total annual carrying costs will be expressed as:

$$\text{Carrying cost } (C_c) = \frac{Q}{2} \left(1 - \frac{d}{R}\right) C_h \quad (4)$$

$$\text{Production set up costs} = \frac{D}{Q} \cdot C_0 \quad (5)$$

The total inventory cost per unit time is expressed as;

$$\text{TIC} = \frac{Q}{2} \left(1 - \frac{d}{R}\right) C_h + \frac{D}{Q} \cdot C_0 \quad (6)$$

Since the set up costs equals the C_c , it then means that the Economic batch quantity (EBQ) will be evaluated using the expression:

$$\text{EBQ} = \sqrt{\frac{2DC_0}{C_h} \left(\frac{R}{R-d}\right)} \quad (7)$$

The model above helps the company in the following ways:

- To determine the cost of holding any material in stock
- Determine how frequently supply should be made
- Helps to evaluate the ordering costs as well as carrying costs so as to reduce to the barest minimum, the problem of stock- out as well as excess inventory.

The program was written with the data collated from the company.

3. RESULTS AND DISCUSSION

The various data obtained from the company were combined to create inventory system management software.

The software which was designed in Microsoft Access takes input from users to determine the inventory level and the material flow. The Software Analysis also displays at a glance the purchases made, the orders received, the available materials, product cost comparison, product cost, product summary, purchase order etc.

The program interface is shown below:

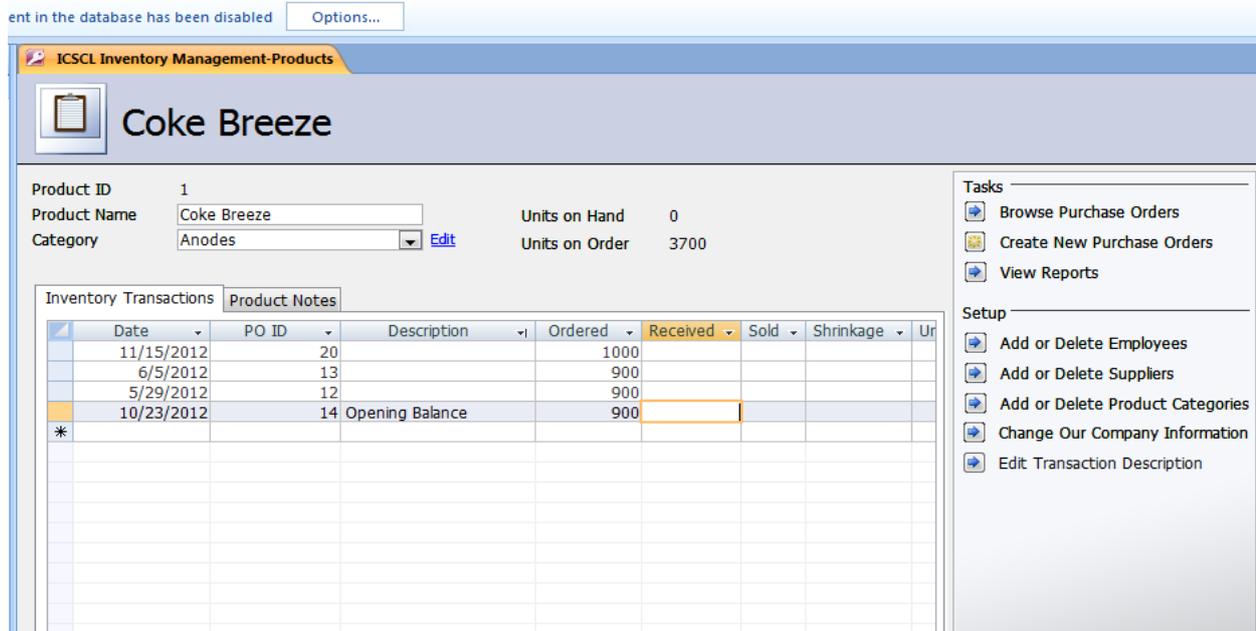


Fig 1 Software user interface

The program interface shows at a glance the product ID, product name, and category of product, available units of product, and units on order. It also shows the number of products received and date of receipt as well as the amount under shrinkage (ie those that have become obsolete). The right hand side shows the 'Tasks' and 'Setup'

The 'Tasks' menu consists of the following:

- a) Browse Purchase Orders in which all purchase orders can be called up at any time and viewed. Its interface is shown below:

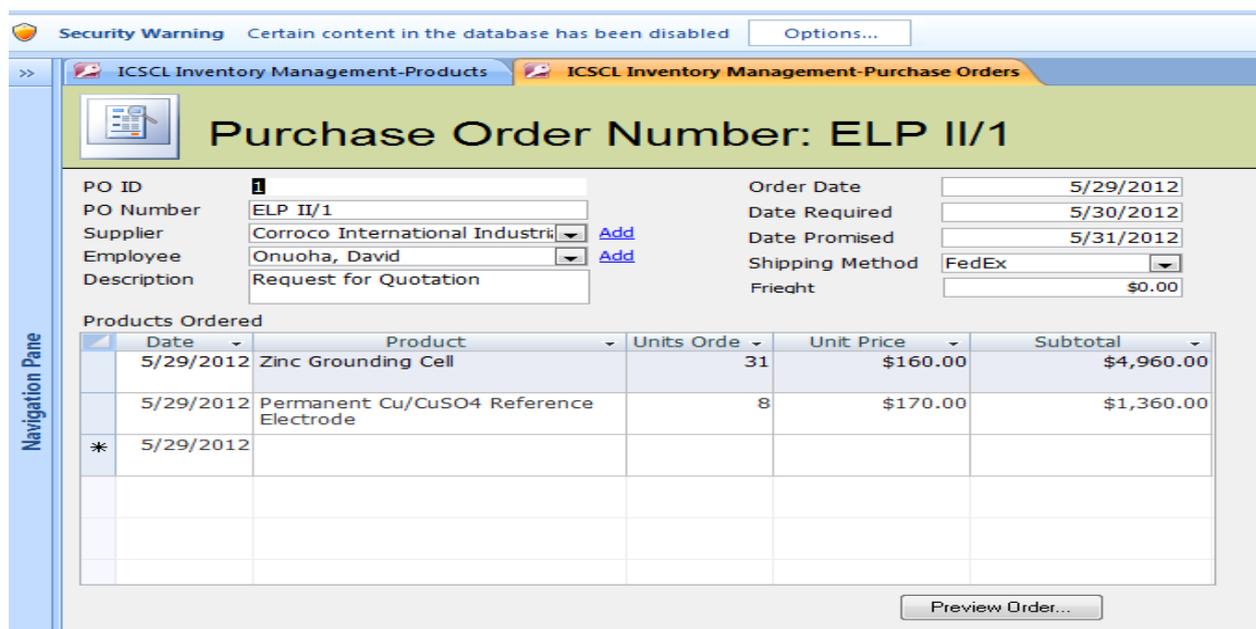


Fig 2 Interface for Purchase Order

b) Create New purchase order for creating new purchase orders

Date	Product	Units Orde	Unit Price	Subtotal
* 11/25/2012				

Fig 3 Interface for New Purchase Order

c) View Reports. The 'view reports' is of utmost importance as it displays the details of all the transactions made, the materials supplied, the materials ordered which are yet to be supplied etc. It displays the following:

- Product cost comparisons
- Product cost comparisons for order
- Product purchases by supplier
- Product sales
- Product summary
- Product transaction details
- Purchase orders

Select a Report to Edit, Open, Print, Email or Export

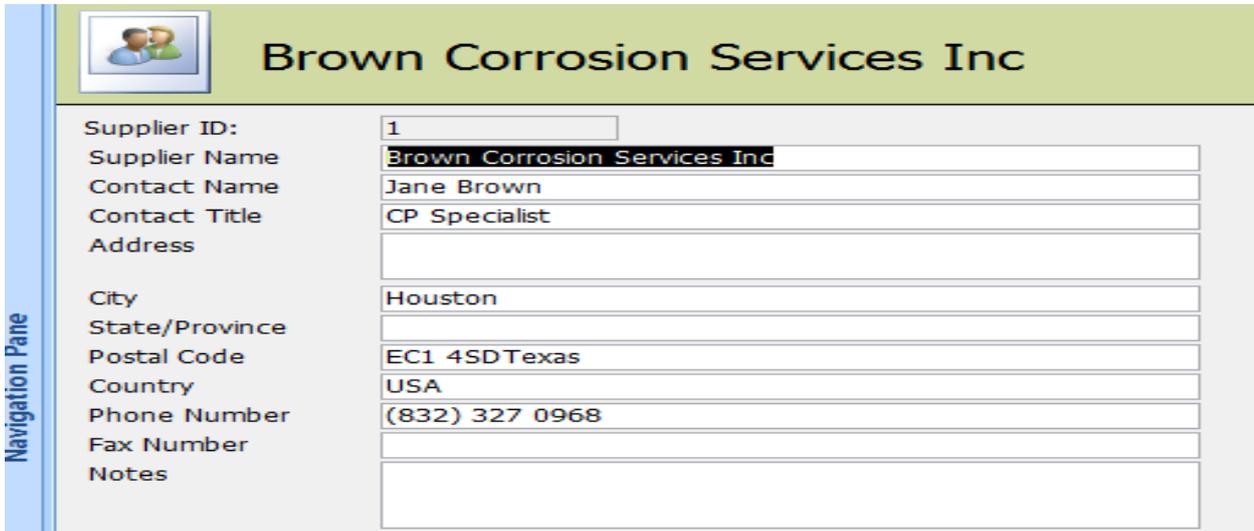
- Product Cost Comparisons
- Product Cost Comparisons for Order
- Product Purchases by Supplier
- Product Sales
- Product Summary**
- Product Transaction Detail
- Purchase Order

Edit Report List... Open Report Print Report Email Report Report to File

Fig 4 Interface for View Reports

The 'Setup' menu consists of the following:

- i Add or Delete Employees which is the column for adding and deleting any employee.
- ii Add or Delete suppliers in which the company can change any supplier's information at any time. This is shown below:



The screenshot shows a web application interface for 'Brown Corrosion Services Inc'. On the left is a vertical 'Navigation Pane'. The main area contains a form with the following fields and values:

Supplier ID:	1
Supplier Name	Brown Corrosion Services Inc
Contact Name	Jane Brown
Contact Title	CP Specialist
Address	
City	Houston
State/Province	
Postal Code	EC1 4SD Texas
Country	USA
Phone Number	(832) 327 0968
Fax Number	
Notes	

Fig 5 Interface for Add or Delete Suppliers

iii Add or Delete Product Categories. In the case of any change in any of the products ordered by and supplied to the company, this is where to effect the necessary changes.

iv Change our Company Information: To edit the company's info like change of name, address, etc, the face shown below is used.



The screenshot shows a window titled 'ICSC Limited Inventory Management-My Company Information'. The main area is titled 'Edit Company Information' and contains the following text: 'Enter your company's name and address information here. You will save the information by closing the form.' Below this are several form fields with the following values:

Company Name	Integrated Corrosion Science Company Limited
Address	37 rumunduru Road
City	Port harcourt
State/Province	Rivers
Postal Code	
Country	Nigeria
Phone Number	08037108430
Email	icscl_ltd@yahoo.com

Fig 6 Interface for 'Change our company information'

As mentioned earlier, ineffective management of materials can lead to purchasing errors, materials shortages and inventory irregularities.

Also, in time past, the company used the manual method of material management in which the flow of material is tracked manually by the material/store manager. This he does with the use of inventory/scheduling notebooks which are used to record all sales and purchases made in the company. The manager, being human, is prone to mistakes and errors which could cost the company a lot. The program however, calculates and displays the product transaction details and the product summary in which the details of the number of products ordered as well as the number of products in stock is shown.

The following figures show the tracking of materials using the inventory management software;

Product Summary

Product Name	Number in Stock	Number on Order
Cathodic Protection System	0	8011
Coke Brease	0	3700
CP Solar Controller	0	3000
Deep Cycle Battery	0	1000
DMC 2000-001 (5c), Magneti	0	2
Permanent Cu/CuSO4 Refer	0	34
Surge Diverter	0	15
Zinc Grounding Cell	0	124

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Fig 7 Product Summary showing the number of products in stock and on order

Product Transaction Details

Product Name	Date	Transaction Description	Unit Price	# Ordered	# Received	# Sold	# Shrinkage
Coke Brease	5/29/2012		\$24.30	900			
	6/5/2012		\$17.65	900			
	10/23/2012	Opening Balance	\$21.20	900			
	11/15/2012		\$2.00	1000			
Zinc Grounding Cell	5/29/2012		\$243.00	31			
	5/29/2012		\$160.00	31			
	6/5/2012		\$240.00	31			
	6/8/2012		\$461.00	31			
Permanent Cu/CuSO4 Reference E	5/29/2012		\$74.25	8			
	5/29/2012		\$170.00	8			
	6/5/2012		\$147.50	8			
	6/8/2012		\$175.00	8			
Deep Cycle Battery	5/16/2012		\$131.04	504			
	6/14/2012		\$96.34	504			
CP Solar Controller	11/15/2012		\$6.00	3000			
Surge Diverter	6/11/2012		\$243.00	15			

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Fig 8 Product Transaction details showing the transaction details of individual products

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Product Cost Comparisons for Order

Product Name	Supplier Name	Ang Unit Price	Total Units	Subtotal
Coke Briquet	SI Power Company Limited	\$2.00	1000	\$2,000.00
	Stranco-Krachy Co, Inc	\$17.65	900	\$15,885.00
	SC QUADRO Srl	\$24.20	900	\$21,870.00
	Compro Companies, Inc	\$21.20	900	\$19,080.00
Zinc Grounding Cell	Corros International Industrial Co Ltd	\$160.00	21	\$4,960.00
	Stranco-Krachy Co, Inc	\$240.00	21	\$7,440.00
	SC QUADRO Srl	\$243.00	21	\$7,533.00
	Compro Companies, Inc	\$461.00	21	\$14,291.00
Permanent Cu/CuSO4 Reference Electrode	Corros International Industrial Co Ltd	\$170.00	9	\$1,260.00
	Stranco-Krachy Co, Inc	\$147.50	9	\$1,180.00
	SC QUADRO Srl	\$74.25	9	\$594.00
	Compro Companies, Inc	\$175.00	9	\$1,400.00
Deep Cycle Battery	Sebang Global Battery Co Ltd	\$95.24	504	\$46,555.36
	Starlight Power Technology Co Ltd	\$121.04	504	\$56,044.16
CP Solar Controller	SI Power Company Limited	\$6.00	3000	\$18,000.00

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Fig 9 Product cost of products showing the costs of individual products ordered

4. CONCLUSION

This study provides oil and gas companies as well as other industries in Nigeria with a solid reference which they can use as a guide to improve their productivity through effective materials management.

The result of the study simply shows that effective materials management is possible and attainable in our country. This can be achieved by developing suitable software which shows at a glance, the detailed material flow for increased productivity in industry as well as reduced cost. Material Managers and personnel involved in materials management should be trained on how to manage materials using the available software, e-support and manpower capacity development.

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