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Research Report: ZLC-2010-4
Improving Chemicals Supply Chain Management Through Traceability Technologies
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Improving Chemicals supply chain management through traceability technologies

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Summary:

This Thesis is a research on the impact of AutoID technologies, and in particular Barcodes, on warehousing processes at one upstream oil and gas service company. It looks to identify how improving chemical's inventory accuracy and visibility could benefit its operations.



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KEY INSIGHTS

1. Inaccuracies in low value but critical products can lead to costly job incidents.
2. Proper tracking of key inventory information helps to reduce slow-moving inventory, disposals and stock loss.
3. AutoID aligned with information systems provides powerful visibility to inventory beyond the warehouse.

Introduction

Historically, the company has managed materials identification at the warehouse level mostly manually. Examples include hand written tags, widely varying label types & sizes and engraved part numbers. The need of improving accuracy and time delivery of updated information, related to the status of disperse and increasing amount of materials drives the need to standardize and automate their identification and tracking

The materials used by the company can be classified in three large categories: *Tools*, *Spares* and *Chemical Products*. This research covers this last category of materials only.

By AutoID we understand the methods or technologies used to automatically detect or identify an item, capturing information about it and transferring it to a computer. MacFarlane & Sheffi (McFarlane & Sheffi, 2003) define AutoID as the one that involves the automated extraction of the identity of an object. Barcodes is one of the AutoID technologies used widely to tackle problems of accuracy and speed of transaction to a means of computer input. Even if they can be presented in different patterns, their main representation is a series of parallel lines that can be read with an optical scanner.

The inventory management has been under pressure to become more efficient by giving better availability and holding fewer inventories. Any inventory inaccuracy has a direct effect on these two performance measures (Wild, 2004). Having visibility to the inventory is a must to allow better company decision making, meaning by visibility, the timely

access to inventory items identity, location and status.

Warehousing challenges

The company ended 2009 with 134 products, worth \$5.4 million dollars, in its UK warehouse. During the same year \$11.0 million dollars worth of products were bought to run their operations. Two unconnected systems are used to manage the inventory. One is a local system used only at the warehouse level; it varies from local applications to personal spreadsheets. The second one is the global financial system.

During interviews, employees who in their day-to-day activity were responsible for or had to deal with chemical products, recognized there is not a single reliable source to get updated and accurate inventory information. The following statement made by one of the employees summarizes the status of current situation “the only way to know what the inventory level of a product is in the warehouse is going to there and do the count by myself”.

People interviewed agreed that at least it is required to track and have daily access to product identification, quantity and batch number. Other information that is useful to have available was: quality certifications, purchasing order number issued to buy the product, and history record. After the source raw data from the global financial system was cleaned (products where the AutoID was not applicable, and blank records were removed), 2,993 transactions related to products inventory remained for the analysis. These transactions were classified depending on the reasons for its creation and the impact of inaccuracies and/or lack of visibility of the inventory was analyzed to the light of the issues detected during the interviews.

An inventory count audit report was used to determine how accurate the global inventory system was with respect with the actual inventory at one of the two warehouses. The table and the graph below summarize the findings of the audit.

INVENTORY COUNT AUDIT RESULTS	
Number of Products	40
Total Expected Product Value (US\$ k)	1,148
Absolute Difference (US\$ k)	37
Accuracy of Inventory Value	96.80%
No. Products < 2% Diff. in Qty	13
Accuracy relative to # of Products	32.50%

Impact of AutoID technology

Savings estimated as a result of implementing an AutoID technology, as Barcodes, to capture data, are shown in the table below:

	MANUAL INPUT	USING BARCODES
Labor cost (US\$/min)	0.38	0.38
Recording time (min)	4.00	0.50
Transaction cost (US\$)	1.52	0.19
Savings (US\$)	-	1.33

With 2,993 transactions in one year, it represents savings in the range of \$4,000 dollars, equivalent to \$200,000 when the global operation is considered.

Company policy is to perform one Inventory Count every quarter. The counting activity takes three people and at least 3 days. Research studies report that a physical inventory carried out scanning Barcodes can be conducted 2 to 3 times faster than a manual inventory (Ekman, 1992). Savings of \$1,440 dollars are seen when AutoID is used to perform an inventory count audit. This represent \$900,000 dollars in global savings considering 4 inventory count audits per year in each country where the company operates.

The most common reasons to dispose of a chemical product are either because it has expired or the product does not pass quality assurance and quality control (QA/QC) tests. Today it requires searching into different sources to calculate the expiration date of a product in the shelves. Interconnecting and synchronizing the inventory systems will allow to know the expiration date, once the Barcode is scanned, for each batch and each product.

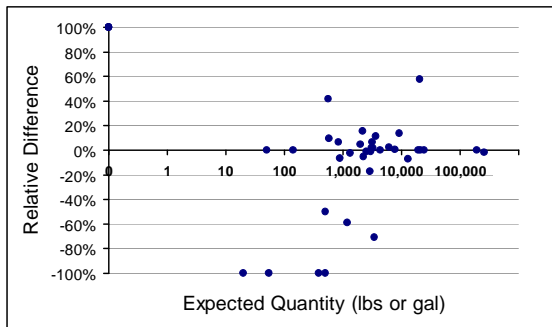
The inventory count audit reported the need for disposing one product worth \$18k. During 2009 about 15 products needed to be disposed. Early detection of slow-moving products and sharing the information, to the entire organization, can reduce disposals by 50%. This represents Global savings on the order of 3 million dollars a year.

Correct registration of products arriving and leaving the warehouse is critical to keep high Service Quality levels. Situations like being short of a critical product or using the wrong product leads to costly Service Quality incidents.

AutoID allows proper identification of a product and capture information faster and more accurately reducing the situation described herein and reduce

the chances of having Service Quality incidents that can cost between \$165,500 to \$316,000 dollars.

Finally, stock loss could be minimized using AutoID technologies. Unexplained absolute differences for about \$37 thousand dollars were found in the inventory counting audit. The graph below illustrates the differences in percentage for 40 products. The difference in percentage is plotted versus the expected quantity on the x-axis.



How to explain those product loss differences? The answer could be difficult to find out. Recording transactions using AutoID helps to filter problems categorized as Stock Loss, that frequently are simple keying errors at the time of registering product codes or quantities at receiving or shipping activities.

Conclusions

As of today, no AutoID technology is used across all company's field warehouses. The analysis has shown that the implementation of an AutoID technology on the warehousing activities will have the following benefits:

- Improvement on service delivery by reducing incidents caused due to inaccuracies in the product identification or poor tracking of inventory levels.
- Reduction of disposals by tracking batch number, ensuring older batches are used first and sharing on-hand information with other warehouses.
- Faster and easier identification of how much of product there is and where it is stored.
- Savings of 22 working days dedicated to capturing data. This time can be used to do more productive work.
- Increasing inventory count and reconciliation compliance from 25% to 75%, using the same

amount of time currently used to do an inventory count audit.

Recommendations

- Adopt Barcodes for inventory tracking technology at the warehouse level and as a Global Initiative
- It is critical to implement a common application that allows sharing information globally and provide visibility to the inventory to the entire organization.
- For products bought locally within each country is important to develop processes that ensure proper labeling following company's AutoID standards.
- Barcodes was identified as not being applicable to track *bulk* products, which represent about 35% of the annual expenditure. To track this type of inventory is required to look into a new AutoID technology.

Cited Sources

Ekman, S. (1992). Bar Coding. Fixed Asset Inventories. *Management Accounting*, pp 58-61.

McFarlane, & Sheffi. (2003). The Impact of Automatic Identification on Supply Chain Operations.

Wild, T. (2004). *Improving Inventory Record Accuracy*. Burlington, MA: Elsevier Ltd.