Consignment Inventory System and Obsolescence Management in the Drilling Fluid Firms in Nigeria

Dr Ahunanya, Valentine[1], Dr Ovharhe, Orugba Harry[2], Prof. Emenike, C. Gladys [3], Prof. Otto, Godly [4]

[1]Centre for Logistics and Transportation Studies, University of Port Harcourt
[2]School of Social Development & Occupational Therapy, University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State, Nigeria
[3]Centre for Logistics and Transportation Studies, University of Port Harcourt
[4]Centre for Logistics and Transportation Studies, University of Port Harcourt

Corresponding Author: Ovharhe, Orugba Harry
harryovharhe@yahoo.com

DOI: 10.56201/ijssmr.v8.no5.2022.pg1.17

ABSTRACT

This study investigated the consignment inventory system and obsolescence management in the drilling fluid firms in Nigeria. The study adopted cross sectional design and ex-post facto design. A total population of 9432 and sample size of 384 was determined using Taro Yamane Formula at 0.05 level of significance using purposive and proportionate stratified random sampling technique. The 384 copies of questionnaire were administered, only 317 was deem fit after processing, retriever, coding and cleansing. The Split Half method was employed to determine the reliability of the instrument with Spearman Prophesy approach. Four research questions and four hypotheses were raised which was tested with Pearson Product Moment Correlationand Partial Correlation because of the bivariateand multivariate functionrespectively via SPSS 25 version. From the findings, consignment inventory system positively correlates with the obsolescence management. Hence, it was revealed that the alternate hypotheses were accepted. In conclusion, the explanatory variable has positive significant influence response variable. From the findings, maximum stock level, re-order stock level and minimum stock level expresses strong correlates on reactive and proactive obsolescence management in the short term and long term. It could be recommended that re-order level should only be implemented and demonstrated by the top management of the drilling fluid companies because of its complexity towards balancing the ordering cost and holding cost.

***KEYWORDS**: Consignment Inventory System, maximum inventory level, re-order inventory level, minimum inventory level,proactive obsolescence management, reactive obsolescence management*

1. Introduction

Drilling Fluid firms render mud engineering services to Operating companies (Oil Exploration Companies) and such services include provision of drilling chemicals and additives, develop Mud programs and monitor behaviour of these fluids or Mud if you like to ensure successful drilling of a well within stipulated time for hydro-carbon production (Priniotakis & Argyropoulos, 2018). Drilling fluid is another name for drilling mud and used interchangeably in the industry. Blending of these chemicals and additives to proffer solutions to Drilling operations is the responsibility of drilling fluids firms. Drilling fluids/Mud provide primary well control of subsurface pressures by a combination of density and any additional pressure acting on the fluid column (annular or surface imposed). They are most often circulated down the drill string, out the bit and back up the annulus to the surface so that drill cuttings are removed from the wellbore (Shahzad, Syed, Faraz & Moin, 2020).

With the ever-rising level of competition amongst drilling fluid companies in Nigeria due to the emerging global issues of shifting from hydrocarbon to alternative sources of energy and now the impact of COVID-19 pandemic globally, there has become a sudden shift in paradigm, especially in the oil and gas industry. This change has totally affected drilling fluid industry inventory management practice and created a very huge competition amongst operators thereby calling for a very serious attention to what is called management of change in the industry (Pulungan, Nugroho, Maidah, Atmojo, Hardo & Pawenang, 2013). The need to achieve and maintain a sustainable competitive edge is imperative. Whether you are in retail, supply chain, or a manufacturer, ensuring that your inventory shelf life is active is key to business sustainability and profitability at this time (Muscatello, 2018). This is solely because the nature of business practice in the industry has become indeterministic, as no one organization is fully in control of the next turn of events. This therefore calls for a serious review of inventory management practices that can enable drilling fluid firms glide through the turbulent times as obsolete inventory can adversely impact on business sustainability (Acharya, 2020). Obsolete inventory is a term that refers to inventory that is at the end of its shelf life or prompted by change in technology. This inventory has not been sold or used for a long period of time and is not expected to be sold in the future. This type of inventory has to be written off and can cause large losses in a company. Obsolete inventory is also referred to as dead inventory or excess inventory. Obsolescence can present itself in two ways; the item in question is no longer suitable for current demand or is no longer available from the original manufacturer (Sandborn, 2020).

Ensuring that plans are in place to identify and mitigate against risk when products, parts, spares, equipment, skills (people), and software are to become obsolete is an integral part of proactive obsolescence management plan (Sandborn, 2020). A lack of understanding of the importance of proactive Obsolescence Management can have a major impact on firms of all sizes and in all sectors. Obsolescence affects all products and it impacts upon all stages of their life. The term product covers capital equipment, infrastructure, consumer durables, consumables and software products (International Institute of Obsolescence Management, 2020). Component obsolescence often leads to the need for expensive or unplanned replacement of products, parts, redesigns, and requalification, all of which could affect organization's competitive edge, profitability, and market reputation. Obsolescence is inevitable and it cannot be avoided, so obsolescence management is essential to achieve optimum cost-effectiveness throughout the life cycle of a product. Fine-tuning pro-active and reactive planning can minimize the impact of obsolescence and its potential high costs. Proactive strategic and tactical measures can be taken to mitigate many of the risks associated with obsolescence, thus reducing its impact on true life costs. Most of the stocks imported or exported into Africa are obsolete and the process or the decision of sending them to Africa or other underdeveloped parts of the world is worrisome (Pretorius and Pretorius, 2020).

The International Electro-technical Commission (IEC, 62402:2019) standard states that: "The objective of obsolescence in inventory management system is to ensure that obsolescence is managed as an integral part of all design, development, production, and in-service support to minimize cost and its impact on the product lifecycle Mohammed, 2018). Companies and industries with fast-moving, short shelf life products are very different from those with repair parts for long-lasting equipment. Inventory could become obsolete in three months to three or more years in the extremes, depending on the industry. Gaining awareness of your inventory movement, as well as checking with your Quality Control Department is needed to decide on the acceptable definitions for your business (Pretorius & Pretorius, 2020). The path from valid inventory to obsolete inventory usually passes through the phases of slow-moving, to excess, to obsolete for both raw materials and finished goods. The key to managing inventory level is to have visibility to inventory trends. Usage or sales trends are important indicators of potential inventory issues. The trends should be evaluated monthly or quarterly, depending on the industry (Ovharhe, 2022b).

The following analysis relies heavily on report from your inventory system. Standard reports are not always readily available, be prepared to have custom reports made for this analysis. More sophisticated inventory systems have several calculations to assist in managing inventory (re-order point and EOQ) but for smaller companies with less sophisticated systems, custom inventory reports will be needed (Akinsanya & Akinsanya, 2019). The burden of file maintenance can be an obstacle in using advanced inventory calculations to keep inventory at the correct levels. The parameters used in advanced calculations need to be looked at frequently, as supply and demand changes quickly. A company reviewing inventory factors/parameters of thousands of Stock Keeping Units (SKU) manually can be extremely cumbersome. In many cases, time restrictions can leave these system calculations incomplete and inaccurate. Whatever system you rely on, proper maintenance of data to ensure the validity of the analysis will be required. To identify slow-moving inventory, reports that compare quantity on hand (QOH) vs. usage/sales (which includes both production usage and sales) are required. Reviews of slow-moving inventory should be done religiously every month (Skidelky, 2020).

It is important to catch issues as early as possible to avoid an excessive inventory categorization (Saygın, 2020). This is the reason drilling fluids firms embraced Consignment inventory system (CIS) in the early 2010s through ISO 9001: 2010 where the board, management and staff committed to effective implementation of communication, training and employee involvement that consistently meets customers and other stakeholders' requirement's and expectations (Zunic, Delalić, Hodžić & Beširević, 2020). Concerns have been raised that conveners of Drilling fluid firms to have been hindered by the lack of knowledge on Consignment Inventory System, ineffective maximum re-order level, minimum inventory level and re-order inventory level. Based on the on-going, this study tends to bridge the gap that exist in Consignment Inventory System and obsolescence management within the drilling fluid industry in the Southern region of Nigeria in compliance with the current global paradigm shift (Azeddine & Mohammed, 2017).

1.2. Statement of the Problem

The impact of current realities in the industry due to emerging global issues of COVID-19 pandemic, global lockdown, isolation, social distancing and shifting from hydrocarbon to alternative sources of energy, has brought about a very serious change in the inventory management practice amongst drilling fluid firms in Nigeria, with a huge threat to the management of shelf life of inventories. The choice of how much inventory to keep for maintaining business sustainability has become very unpredictable owing to project demands and supply chain lead time, and pressure for survival has also changed the thinking pattern of top management of these organisations. One thing that becomes the inevitable is the adoption of an inventory management practice that is robust enough to manage product shelf life and at the same time guarantee product availability at all times. Consignment inventory system method has been identified as such a broad hearted method to keep the organization competitive at such trying times. This inventory method therefore has its focus mainly on product availability in the right quantity hence the need to examine its relationship with obsolescence management. In all cases, effective demand forecasting and inventory management processes can prevent this happening.

The antecedents and challenge of obsolete stock obviously leads to poor demand, forecasting, and replacement policy. Many drilling fluid firms use enterprise resource planning (ERP) or warehouse management systems (WMS) to manage their stock. Whilst these platforms will have some basic forecasting and purchasing functionality, most lack the sophistication to track stock as it moves through its product lifecycle or alert users when they have excess stock to prevent inventory obsolescence (Zunic *et al*,. 2020). Many users resort to excel spreadsheets, but these can be time-consuming to create and keep-up-to-date and can lead to inaccuracies.

Consignment inventory system is considered as among the most popular strategies that help the drilling fluid industries to create and sustain their prevention of loss via obsolescence management. Theoretically, available literature reveal that the research conducted in exploring the effects of Consignment Inventory system (CIS) and obsolescence management (OM) metrics show confusing and mixed findings. Some of the studies report a significant relationship between Consignment Inventory System and obsolescence management on stock level and lot size methods (Alexandre & Jean-Marie, 2021). Whereas Priniotakis and Argyropoulos (2018) discusses the importance of forecasting demand and uses the Root Mean Square Error (RMSE) as an effective measure of the forecast error, which later becomes a basic driver for inventory management and reported a negative relationship between safety, reorder inventory System and prevention of loss (Yunusa, 2021).

Therefore, this study attempts to extend the literature by further investigating the Consignment Inventory System and obsolescence management relationship within the context of drilling fluid firms in Nigeria in the phase of the current global realities.

CONCEPTUAL FRAMEWORK

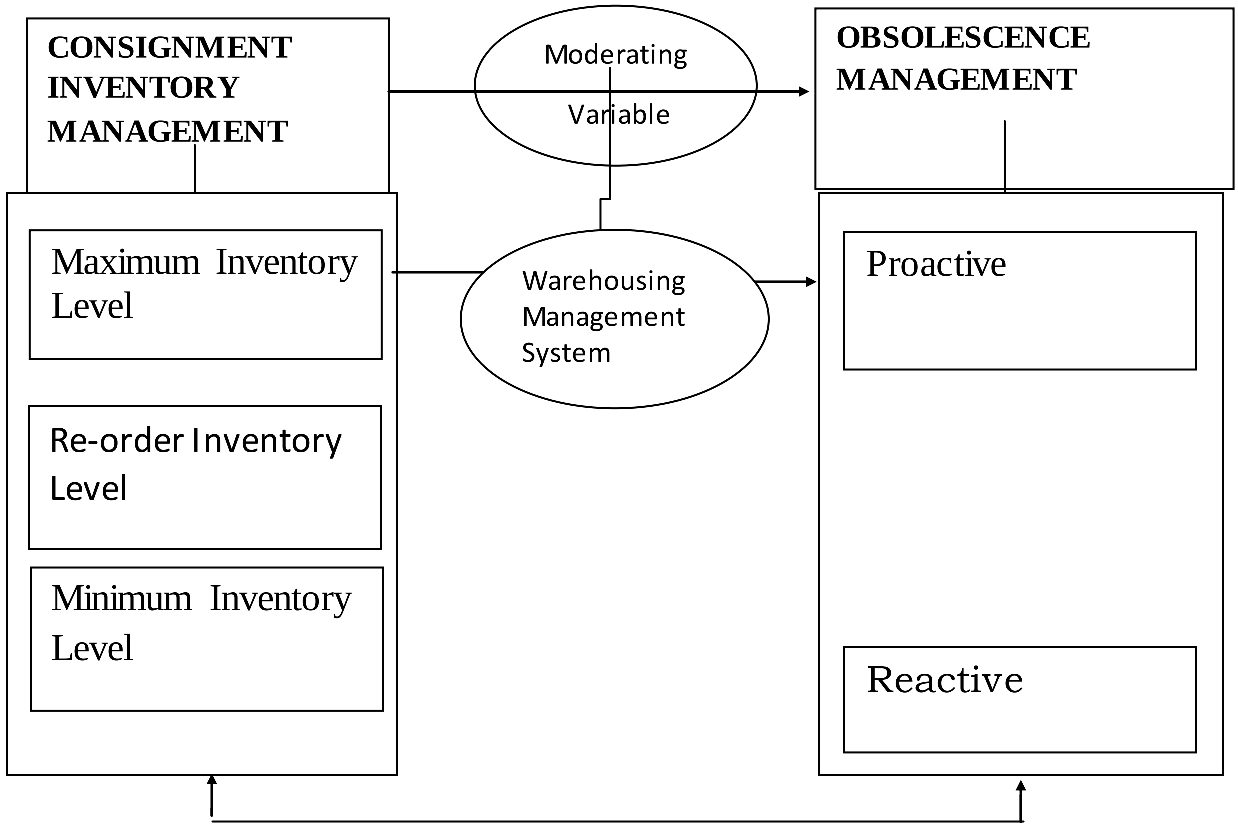

Figure: 1. Conceptual framework on consignment inventory system and obsolescence management in drilling fluid industry

SOURCE: *Researcher's Conceptualization, 2022*

1.3. Hypotheses

The following hypotheses stated in their null form were used for the study and will be tested at 0.05 alpha level.

- $H_{0i:}$ There is no significant relationship between maximum inventory level and obsolescence management in the drilling fluid firms.
- $H_{0ii:}$ There is no significant relationship between re-order inventory level and obsolescence management in the drilling fluid firms.
- $H_{0iii:}$ There is no relationship between minimum inventory level and obsolescence management in the drilling fluid firms.
- $H_{0iv:}$ Warehousing management does not significantly moderate the correlate between consignment inventory system and obsolescence management in the drilling fluid industry

2.1. Theoretical Framework

2.1.1. The ABC Theory of Obsolescence Management

The ABC theory as adopted by Ovharhe, Woko and Ezeocha, (2021) averred that certain ration of the assets in an average industrial plant may be obsolete. But in most cases the maintenance and reliability manager may not be aware of it. Everyone wants to avoid the situation of urgently needing a spare part that is not available anymore. There are some solutions and tools for obsolescence management that help to mitigate risks. Perhaps, ABC analysis is for enabling maintenance and reliability managers to approach obsolescence in a safe manner (Pretorius & Pretorius, 2020).

A = Active and planned obsolescence management

Having an active or proactive approach towards obsolescence management is of course highly beneficial for any maintenance and reliability manager. The more you plan and predict obsolescence in advance, the easier you will be able to control risks (Ovharhe, Okolo, Woko & Igbokwe, 2022).

B = Best practices for starting obsolescence management – the reality of (pro)active obsolescence management seems to be out of reach for the processes and material in drilling fluid firm facility, there are good hands-on methods that they can easily implement to lower risks. The opposite of a proactive approach to obsolescence management is, of course, a reactive one. This would mean simply reacting to occurring issues: Drilling fluid firm replace parts when they are defective, you check the availability of instrumentation when its phase-out is announced and you plan to implement a new automation system when the existing one fails (Azeddine & Mohammed, 2017).

C = Construct your facility with an obsolescence management strategy – the future. If they are in the luxurious position of constructing a new facility or designing a new process, they will be able to pave the way for a highly efficient life cycle and obsolescence management. This means that starting from the scratch, they can decide if they wish to standardize your products and automation systems. They can define a set of standard suppliers and create an overall picture of your process that is as harmonic as possible. This will ease maintenance work in the future and lower any risks of unexpected obsolescence (Ovharhe, Woko & Igbokwe, 2021).

2.2 Proactive Obsolescence Management

Proactive measures should not only be adopted during the contracting phase but also while transiting to the operations and support phase. The project team should engage the contractors constantly to monitor any obsolescence issues. Establishing depot level maintenance capabilities (i.e. local repair capabilities) would help to alleviate the impact of obsolescence. Such measures would help to establish through-life support for the acquired system and achieve the maximum benefit for end users (Pretorius & Pretorius, 2020). These measures includes; create an obsolescence management plan, participate in technical advisory programmes organised by supplier, build strategic relationships with supplier and other users, develop local repair capabilities, leverage subsystem houses, develop and implement tools for obsolescence prediction and monitoring and establish appropriate contracts (Chibuike, Ovharhe & Amara, 2022).

Instead of helplessly waiting for your partner to notify you of impending obsolescence, a proactive obsolescence management strategy revolves around monitoring the component's lifecycle from the moment it is included in a bill of material until it is no longer needed. All of the disruptions associated with the current component shortage the struggle to source alternative components, inflated pricing, become moot. The major con involved with such a strategy, of course, is that it requires the investment of working capital to both purchase the inventory and create an environment suitable for long-term electronic component storage.

2.2.3.2. Reactive Obsolescence Management

A reactive approach to obsolescence management relies on taking action once a component event such as the release of a Product Discontinuance Notice (PDN) has already occurred, advising the management of an impending change in the component's lifecycle (Afolabi, Morakinyo & Olumide, 2017).

A reactive obsolescence management strategy, as the name implies, allows a team to "pivot" their supply chain to alter their approach to accumulating the critical components necessary to complete the lifecycle of their products. This can include quickly finding alternative component suppliers, alternative components that can be seamlessly substituted in designs at the point of assembly, or, should a product change notification (PCN) be issued in sufficient time, negotiating a last time buy. Each of these solutions, however, comes with various unknowns which have drastic consequences on their ability to succeed (Krolicki & Noel, 2020).

One of these variables comes in the form of product change notifications (PCNs). PCNs are not released in accordance with any set industry standard. While most component manufacturers do try their best to inform their customers of their intentions to discontinue a component, statistics indicate mixed results at best to do so. For many obsolescence management team, 12 months is the minimum amount of time required to pivot their supply chain assuming the current market has an available alternative product to pivot. During a component shortage, this is an unrealistic assumption at best (Romero, Rajkumar & Kelly, 2012).

2.2.4. Consignment Inventory System and Obsolescence Management

While one obsolescence management strategy should never be entirely disregarded for the other, it is important to realize that, in the face of a market shortage, a proactive strategy should take priority over a traditional reactive model (Ovharhe, Ahunanya, Woko & Igbokwe, 2022). And with partners such as Partstat making such strategies easier to implement than ever before, there is no reason not to consider proactive obsolescence management a cornerstone of your supply chain moving forward (Ahunanya, Ovharhe, Emenike & Otto, 2022)

Obsolescence is a significant cost driver and can impact products and equipment at all stages of the acquisition process. Early identification of obsolescence risk allows a wider range of options to be considered and consequently reduces the actual cost of resolution (Ovharhe & Igbokwe, 2021).

The rate of obsolescence is increasing and the financial and availability risks to equipment will continue to require careful management to reduce through life costs. There is clear evidence that a robust Obsolescence Management strategy can significantly reduce such costs and interruption to supply. When a part failure occurs, or a modification/change is required, a major problem can develop if the replacement part is no longer available from its original manufacturer, or any other approved sources. This can often result in the most expensive resolution (redesign) being the only option available. Consignment inventory system and obsolescence management strengthen the cord of rehabilitating consignee and consignor relationship factors even when one party in not fully competent with certain conditions (Ovharhe, 2022a; Ovharhe, 2022b).

Although electronics are most likely to be discontinued, obsolescence of non-electronic and commercial off-the-shelf (COTS) items also poses a significant problem to long life systems. In short, obsolescence is a threat to system supportability. It will not go away. It has been shown that the annual growth of End of Life documents, where manufacturers declare a part obsolete, increases significantly year on year by as much as 25% (Romero, Rajkumar & Kelly, 2012).

Obsolescence in long life projects and equipment is inevitable. Unforeseen obsolescence issues can happen quickly and could cost a significant amount of unplanned money to resolve and can have the impact of loss of equipment capability (production down time) and significant increase in support costs through life (Ovharhe & Okolo, 2022).

The principle aim of Obsolescence Management is to avoid the costly resolutions when an obsolescence issue occurs. Careful planning can minimize the impact of obsolescence and its potentially high costs. The objective of obsolescence management is to ensure that obsolescence is managed as an integral part of design, development, production and in-service support in order to minimize cost and its detrimental impact throughout the product life cycle (Ahunanya *et al*,, 2022).

3. Methodology

The study intends to adoptedcross sectional design and ex-post facto design. The expost cross sectional design and ex-post facto design helped to preformatted situation in the drilling fluid industry under study and analyze same with both quantitative and qualitative approach. This research was strategized on ex-post facto design; this is to show that sampletemplate of the study was not manipulated by the researcher. The total population of the study is nine hundred and ninety-nine staff (9432) comprising seven thousand, two hundred and one (7201) staff of Rivers State, six hundred and twenty-eight (628) staff of Delta State, two hundred and ninety-two (292) staff of EDO, three hundred and twenty-two (322) staff of Akwa-Ibom and nine hundred and eighty nine (989) staff of Lagos State. The population figures were generated from the corresponding information available in the selected drilling firms.

Purposive sampling and proportionate stratified random sampling technique was used to select only drilling firms that have interest on consignment inventory system and obsolescence management within the institution. Additionally, proportionate stratified random sampling technique was used to select reasonable percentages from each of the categories of staff from each of the drilling fluid firms' departments. While simple random sampling technique without replacement was used to select the potential respondents.

However, because it is not possible to cover the entire drilling firms and their departments, an accessible population was estimated to the total number of 9432 from the available records and there is a 95 % chance that the sample is distributed in the same way as the population (i.e. 0.05) confidence level.

We can determine the sample size by using Taro Yamane's (1967) formula as shown below:

$$n = \frac{N}{1 + N(e)^2}$$

Where, n = sample size sought
e = level of significance or (acceptable sampling error)
N = population

Applying the above formula:

$$n = \frac{9432}{1 + 9432\,(0.05)^2}$$

$$= \frac{9432}{1 + 9432\,(0.0025)}$$

$$= \frac{9432}{1 + 23.58}$$

$$= \frac{9432}{24.58}$$

$$= 384$$

A 60-item semi-structured questionnaire was used as instrument to collect data for the study drawn from Ahunanya (2022) thesis (Consignment Inventory System and Obsolescence Management in Drilling Fluid firms). The instrument was referred to as "Consignment inventory system and Obsolescence management Questionnaire" (CISOMQ). The "CISOMQ" was constructed by the researcher based on the specific purposes, research questions, hypotheses and information in literature. The questionnaire comprises of two sections, A and B. Section A generated socio-demographic data of the respondent's, which contain questions relating to respondents present class, age, gender, marital status, years spent in Drilling fluid industry, religion, and cluster-type. Sections B contained questions to elicit information on the Consignment inventory system and Obsolescence management in drilling firms. On section B, the part of the questionnaire was weigh polychotomous and modified four point Likert-scale response options of "Strongly Agree" (4 points), "Agree"(3 points) "Disagree" (2 points) and "Strongly Disagree" (1 point)". The respondents were required to tick (√) against each item as it best applied to him or her.

The reliability was determined using split half method with Spearman Brown Prophesy approach. The researcher assembled all the returned copies of the questionnaire, sort out the ones that are properly filled and separate them from the ones not properly filled (if any). The copies of questionnaire were coded for analysis using SPSS version IBM 25, and item-by-item, while sub-scale and overall analysis was implored in this study. Descriptive statistics of percentage mean and standard deviation with inferential statistics of Pearson Product Moment Correlation Co-efficient and Partial Correlations were used for data analysis.

4. Results and Discussions

From the copies of questionnaire distributed to the respondents, only 317 were fit for data analysis.

Test of Research Hypotheses

The study proceeds to test for research hypothesis in light of the Pearson product moment.

Test of Hypothesis one

Ho_1: There is no significant relationship between maximum inventory level and obsolescence management.

Table 4.1: Pearson Test for relationship between maximum level and obsolescence management

Correlations

		Maximum level	Obsolescence
Maximum level	Pearson Correlation	1	.928**
	Sig. (2-tailed)		.000
	N	317	317
Obsolescence	Pearson Correlation	.928**	1
	Sig. (2-tailed)	.000	
	N	317	317

**. Correlation is significant at the 0.05 level (2-tailed).
Source: *Author's Field Survey (2022) - SPSS version 25 output*

Using the output it can be observed that the Pearson correlation (PC) coefficient is 0.928 which shows a strong and positive orientation of the relationship between maximum level and obsolescence management. The significance value of 0.000 which is less than the 5% significance level ($p = 0.000 < 0.05$) leads to the rejection of the null hypothesis. This therefore reinforces the findings and on this basis, the null hypothesis is rejected while the alternate form of the hypothesis is accept therefore concluding that there is a significant relationship between maximum level and obsolescence management. In the tail of this, Priniotakis and Argyropoulos (2018) investigation revealed that inventory management has become one of the key elements of the supply chain management and can greatly affect the performance of a business. The textile industry is no exception. Azeddine and Mohammed (2017) examine how consignment inventory system of supply chain with robust control theory. Supply chain management (SCM) in the management of obsolete stock and prevention of loss has become a vital tool for organisations, which desire to improve performance and resilience.Ugboro and Obeng, (2010) in their research they found out that the half-hearted implementation of CIS is a major reason for its failure in most organisations. According to them, organisations are only willing to implement just those aspects of CIS which is supported by existing organisational culture.

Test of Hypothesis Two

Ho_2: There is no significant relationship between re-order inventory level and obsolescence management.

Table 4.2: Pearson Test for relationship between re-order inventory level and obsolescence management

Correlations

		Re-order	Obsolescence
Re-order	Pearson Correlation	1	.879**
	Sig. (2-tailed)		.000
	N	317	317
Obsolescence	Pearson Correlation	.879**	1
	Sig. (2-tailed)	.000	
	N	317	317

**. Correlation is significant at the 0.05 level (2-tailed).

Source: *Author's Field Survey (2022)-SPSS version 25 output*

In the table, it can be observed that the Pearson correlation (PC) coefficient is 0.879 which shows strong and positive orientations of the relationship between re-order level and obsolescence management. The significance value of 0.000 which is less than the 5% significance level ($p = 0.000 < 0.05$) leads to the rejection of the null hypothesis. This therefore reinforces the findings and on this basis, the null hypothesis is rejected while the alternate form of the hypothesis is accept therefore concluding that there is a significant relationship between re-order level and obsolescence management. Prior to this, Alexandre and Jean-Marie (2021) discussed inventory management in supply chains consignment on pro-active and re-active obsolescence management. Stephen andJaydeep (2016) provide a useful summary of the major inventory management techniques based on a recent review of the literature in the field and interviews with management teachers and practitioners. Meyer and Pretorius (2017) propose a process to manage the problem of electronic component obsolescence from a military product support perspective. By assessing applicable literature as well as feedback and lessons learned from relevant support projects, a methodology for the management of component obsolescence is proposed. Romero, Rajkumar and Kelly (2012) examines obsolescence risk assessment process best practice on consignment inventory. A component becomes obsolete when it is no longer available from the original manufacturer to the original specification. Muscatello (2018) views the enterprise resource planning (ERP) systems to have been widely implemented by numerous firms throughout the industrial world. Inegbedion and Eze (2019) examined inventory management and organisational efficiency. The classical inventory management techniques were applied to an organisation's inventory system.

Test of Hypothesis Three

Ho3: There is no relationship between minimum inventory level, proactive obsolescence management and obsolescence management.

Table 4.3: Pearson Test for relationship between minimum inventory level and Obsolescence management

Correlations

		Minimum level	Obsolescence
Minimum level	Pearson Correlation	1	.888**
	Sig. (2-tailed)		.000
	N	317	317
Obsolescence	Pearson Correlation	.888**	1
	Sig. (2-tailed)	.000	
	N	317	317

**. Correlation is significant at the 0.05 level (2-tailed).
Source: *Author's Field Survey (2022)-SPSS version 25 output*

In the table, it can be observed that the Pearson correlation (PC) coefficient is 0.888 which shows a strong and positive orientation of the relationship between minimum level and obsolescence management. The significance value of 0.000 which is less than the 5% significance level (p = 0.000 < 0.05) leads to the rejection of the null hypothesis. This therefore reinforces the findings and on this basis, the null hypothesis is rejected while the alternate form of the hypothesis is accept therefore concluding that there is a significant relationship between minimum level and obsolescence management. Yinyeh (2013) explains managing inventories at Public Universities is one of the major challenges for higher educational institutions in Ghana. Muhayimana (2015) investigates inventory management techniques and its contribution on better management of manufacturing Companies in Rwanda Case Study. Shahzad, Syed, Faraz and Moin (2020) investigate inventory management through lean logistics and warehousing techniques on obsolete stock. Inventory is one of the eight deadly wastes in Lean. Saygın (2020) presents an analysis of the processes related to the obsolescence management of electronic components in a large scale defense industry company.

Test of Hypothesis Four

Ho4: Warehousing does not significantly moderate the relationship between consignment inventory system and obsolescence management of drilling fluid firms in Nigeria.

Table 4.4: Partial Correlation test for evaluating the moderating effect of Warehousing on consignment inventory system and obsolescence.

Correlations

Control Variables			Consignment inventory system	obsolescence
Warehousing	Consignment inventory system	Correlation	1.000	.716
		Significance (2-tailed)	.	.000
		Df	0	314

Obsolescence	Correlation	.716	1.000
	Significance (2-tailed)	.000	.
	Df	314	0

Source: *Author's Field Survey (2022)- SPSS version 25 output*

The study observes from the probability level of 0.000 that the control variable/moderating variable significantly moderates/controls the existent relationship between Warehousing and flexibility. The positive correlation value of 0.716 shows that an increase in the intensity of the moderating variable is likely to subsequently increase the existing relationship between consignment inventory system and obsolescence management by up to 71.6%.in the same vein, Haves (2020) analyzed inventory management levels and obsolescence management on loss prevention. Large retailers employ senior executives to manage multi-billion-dollar crime and loss issues. This paper examines some of the issues and trends confronted by these important managers, in order to inform current and future loss prevention managers. Some of the topics studied include the changing mission of loss prevention executives, loss prevention performance measures, current and future crime and loss issues, how loss prevention executives evaluate loss control technologies, and their sources of loss prevention best methods. Sarojit and Chitra (2017) the inventory level of materials constitutes the most significant part of current assets and working capital in any organisation. A small saving in the inventory will mirror a crucial edge in benefit of the organisation. Afolabi, Morakinyo and Olumide (2017) evaluation of the role of inventory management in logistics chain considering obsolete stock. The operation of inventory management determines the efficiency of storage of products. Zunic, Delalić, Hodžić and Beširević (2020) investigates Smart Warehouse Management System Concept with Implementation. This paper describes the concept of a smart WMS that is implemented in one of the largest distribution companies in Bosnia and Herzegovina. The system uses artificial intelligence and optimization algorithms to improve working process. The paper describes the complete warehouse workflow that includes stock planning, initial product placement, transfer from stock to pick zone, order picking process, transport and tracking (Ahunanya *et al.*, 2022).

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Consignment inventory system is the supervision of non-capitalized assets, or inventory, and stock items. As a component of supply chain management, inventory management supervises the flow of goods from manufacturers to warehouses and from these facilities to point of sale. Inventory management is a systematic approach to sourcing, storing, and selling inventory both raw materials (components) and finished goods (products). In drilling firms, inventory management means the right stock, at the right levels, in the right place, at the right time, and at the right cost as well as price as a part of supply chain, inventory management includes aspects such as controlling and overseeing purchases from suppliers as well as customers maintaining the storage of stock, controlling the amount of product for sale, and order fulfillment.. In conclusion the explanatory variable has positive significant influence response variable. From the findings, maximum stock level, re-order stock level and minimum stock level expresses strong correlates on reactive and proactive obsolescence management in the short term and long term.

5.2. Recommendations

Based on the findings and conclusions the following recommendations were made

1. Drilling fluid firms have to ensure that there is effective management of both the maximum level and re-order levels in the short-run because they are fundamental to the organisation'scontinued existence and prosperity, and the many risks that impact on day-to-day activities, and have a shorter time frame compared with longer-term.

2. To be able to manage the maximum levels in a better manner especially in the covid-19 pandemic period the drilling fluid firm should understand and apply warehousing A.B.C. model.

3. Re-order level should only be implemented and demonstrated by the top management of the drilling fluid companies because ofits complexity towards balancing the ordering cost and holding cost

4. Frequent training should be organized for those involved in decision-making risk with current knowledge driven strategies in the drilling fluid firm.

5.3. Contribution to Scholarship

This study has contributed to the existing knowledge as follows:

-Minimum level are clear visibility helps that Reduce costs, optimize fulfillment, provide better customer service and Prevent loss from theft, spoilage, and returns.

-Commitment to warehousing management principles and practice leads to firm prevention of loss and obsolete stock

-Re-order level balances the firm inventory carrying cost and processing cost enables the firm to be on the leading edge rather than the bleeding edge

-Client satisfaction depends on the effective implementation of pro-active and re-active obsolescence management policy.

REFERENCES

Afolabi, O. J., Morakinyo, K. O., &Olumide, O.(2017). Evaluation of the role of inventory management sin logistics chain of an organisation.*LOGI – Scientific Journal on Transport and Logistics*, 8(2),1-11. DOI:10.1515/logi-2017-0011

Ahunanya, V, Ovharhe, O. H., Emenike, C. G., & Otto, G. (2022a). Consignment inventory system and entrepreneurial success among micro warehousing firms. *International Journal of Social Science & Management Research.* 8(5), 18-28.DOI:10.56201/ijssmr.v8.no5.2022.pg18.28

Akinsanya, O., & Akinsanya, D. (2019). *Design and implementation of a computerized stock management system*.(A case study of Mide supermarket).Mide Digital Publishers

Alexandre, D., & Jean-Marie, P.(2021). Inventory management in supply chains.*Journal of Physics Conference Series*, 69(1), 67-72. DOI:10.1007/978-1-84996-017-5

Alina, S., Michael, F., & Alexander, K. (2017).Do entrepreneurs really earn less?*Springer Small Business Economics*, 49(2), 251-272

Anderson, B.(2012). *Building cars in Australia: Morris, Austin, BMC and Leyland 1950-1976*. Sydney: Halstead Press.

Azeddine, Z., & Mohammed, E.l. (2017). Inventory management of supply chain with robust control theory: literature review. *International Journal of Logistics Systems and Management*, 27(4), 45-64

Bertha, M. S., Ferry, J.,&Himadhani., M. (2020). Analysis of the uncertainty sources and SMEs' survival.*Policy for Innovative, Interventions and Entrepreneurship Journal*, 1(1), 1-27. https://doi.org/10.1080/08276331.2020.1764737

Chibuike, C. U., &Ovharhe, O. H. (2022). Emergence of risk culture and lean culture in Nigeria during pandemic and crisis era: Using confirmatory analysis. *International Journal of Multidisciplinary Research and Growth Evaluation*, 3(1), 263-271. DOI: https://doi.org/10.54660/anfo.2021.3.1.14

Chibuike, C. U., Ovharhe, O. H., &Abada, A. M. (2022). Synchronization of lean accounting alert and entrepreneurial sustainability among micro firms in Nigeria during pandemic and catastrophe: Using confirmatory factor analysis. *The International Journal of Business & Management*,10(1), 1- 13. https://doi.org/10.54660/anfo.2021.2.6.15

Evans, D. (2020).*Coronavirus shows that supply chains are outdated and unfit for modern manufacturing. Forbes. Retrieved May 21, 2020.*

Hayes, R. (2020). Loss prevention: Senior management views on current trends and issues. *Security Journal*, 16(2), 45-62. DOI:10.1057/palgrave.sj.8340129

Inegbedion, E. H., Sunday C., &Eze, S.C. (2019).Inventory management and organisational efficiency: stock market efficiency using different estimation techniques. *Journal of System Spectrum Research*, 5(3), 756-763. DOI: 10.32861/jssr.53.756.763

Krolicki, N. C., &Noel, R. (May 21, 2020).*Just-in-time' economy out of time as pandemic exposes fatal flaws. www.abc.net.au. May 1, 2020. Retrieved May 21, 2020.*

Meyer, L., &Pretorius, L. (2017).*A management approach to component obsolescence in the military electronic support environment*. University of Pretoria. DOI:10.7166/14-2-271

Mohammed, H. D. (2018). The effect of information technology on inventory management for the manufacturing companies in Mogadishu. European Journal of Logistics, Purchasing and Supply Chain Management, 6(3), 20- *Retrieved from https://www. eajournals.org/journals/european-journal-of-logistics-purchasing-and-supply-chain management-ejlpscm/vol-6-issue-3-june-2018/the-effect-of-information-technology-oninventorymanagement-for-the-manufacturing-companies-in-mogadishu/*

Muhayimana, V. (2015). Inventory management techniques and its contribution on better management of manufacturing Companies in Rwanda Case Study: Sulfa Rwanda Ltd. *European Journal of Academic Essays*, 2(6), 49-58

Muscatello, J. R. (2018). Enterprise resource planning (ERP) iimplementations: Theory and practice. *International Journal of Enterprise Information Systems*, 4(1), 63-83.

Ovharhe, O. H. (2022a). Sustainable development goals: Multicollinearity between therapeutic entrepreneurship and rehabilitation therapy among African nations. *International Journal of Small Business and Entrepreneurship Research*, 10(3),1-59.

Ovharhe, O. H. (2022b). Sustainable Development Goals: Therapeutic Entrepreneurship and Entrepreneurship Injelititis among West Africa Countries. *World Journal of Entrepreneurial Development Studies (WJEDS),* 7(1), 87-113. DOI: 10.56201/wjeds.

Ovharhe, O. H., Ahunanya, V., Woko, E. B. (2022). Consignment inventory system and entrepreneurial survival in Lagos State. *International Journal of Social Science & Management Research*.8(5),29-42. DOI: 10.56201/ijssmr.v8.no5.2022.pg29.42

Ovharhe, O. H., & Igbokwe, E. L. (2021). Analytical intervention of remote working correlates on risk culture and entrepreneurial adaptability in South-South Geopolitical Zone, Nigeria: Covid-19 Perspective. *Journal of Education and Practice, IISTE*, 12(3), 34-44,DOI: 10.7176/JEP/12-34-05

Ovharhe, O. H., & Okolo, B. S. (2022). Sustainable development goals: Lean entrepreneurship and Green entrepreneurship. *International Journal of Research and Scientific Innovation ISSN*: 2321-2705

Ovharhe, O. H., Okolo, B. S., Woko, E. B., & Igbokwe, L. (2022). Light entrepreneurship and customer funded business model. *International Journal of Social Science & Management Research*. 8(5), 87-106. DOI: 10.56201/ijssmr.v8.no5.2022.pg87.106

Ovharhe, O. H., Woko, E. B., & Ezeocha, V. U. (2021). Remote Working: Entrepreneurial risk and entrepreneurial survival in the micro firms in Niger-Delta, Nigeria (COVID19 Pandemic Prospects). *International Journal of Small Business and Entrepreneurship Research*, 9(4), 11-28. Available at SSRN: https://ssrn.com/abstract=3983482

Ovharhe, O. H., Woko, E. B., & Ogolo, T. M. (2021).Competitive risk strategy and entrepreneurial satisfaction among fast moving consuming goods in Nigeria during covid-19 pandemic using confirmatory factor analysis.*International Journal of Multidisciplinary Research and Growth Evaluation*, 2(6), 267-272.https://doi.org/10.54660/anfo.2021.3.1.14

Pretorius, L., & Pretorius, J. C. (2020).A management approach to component obsolescence in the military electronic support environment.*SDLC*, 2(2), 45-64.DOI:10.7166/14-2-271

Priniotakis, G., &Argyropoulos, P. (2018).Inventory management concepts and techniques.*IOP Conference Series Materials Science and Engineering*, 459(1), 012-060. DOI:10.1088/1757-899X/459/1/012060

Robert, P. G., Chao, M., Shanshan, Q., & Tae, J (2017).Entrepreneurial spawning and knowledge-based perspective: a meta-analysis. *Springer Small Business Economics,* 49(2),355-378

Roger, R.,Steven, K., & Matthew, M. (2016). Peace through entrepreneurship: Investing in a startup culture for security and development”. *Springer Small Business Economics,* 49(3), 717-720

Romero, F.J., Rajkumar R., & Kelly, S. (2012). Obsolescence risk assessment process best practice. *Journal of Physics Conference Series*, 34(1), 43-52. DOI:10.1088/1742-6596/364/1/012095

Sarojit, K. B., &Chitra, K. (2017). *Analysis of different inventory control techniques: A Case Study in a Retail Shop*. Jessore University of Science and Technology

Saygın, N. (2020). An obsolescence management framework for a defenceindustry. *Journal of Physics Conference Series*, 71(3), 85-91

Shahzad, N., Syed, M. M., Faraz, A., & Moin, A. (2020).Inventory management through lean logistics and warehousing techniques.*International Journal of Management Sciences and Business Research*, 5(10), 159-167

Skidelky, R. (2020).*The coronavirus pandemic shows why the West must transform its economic logic*. newstatesman. newstatesman.

Stephen, G., &Jaydeep, A. P. (2016). Review of modern inventory management techniques. *Journal of Physics Conference Series*. 64(4), 47-58

Yinyeh, M. O. (2013). *Inventory management system software for Public Universities in Ghana* (IMSSPUG). Ghana: University for Development Studies Publishing

Yunusa, A. (2021). Inventory management practices and performance of manufacturing firms in Kogi State.*Journal of Good Governance and Sustainable Development in Africa (JGGSDA)*, 6(3), 54-63

Zunic, E., Delalić, S., Hodžić, K., &Beširević, A. (2020).Smart warehouse management system concept with implementation.Conference: 2018 14th *Symposium on Neural Networks and Applications (NEU REL)*. DOI: 10.1109/NEUREL.2018.8587004