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Developing Asustainable Approach to Effective Materials Management in Construction Sites in Aba Abia State

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ABSTRACT

Construction materials management is critical to the success of any building project. Time and cost overruns, poor quality of work and so on can be traced to ineffective materials management. This study aims at Assessing materials management measures and methods for project timely delivery and advocate for new sustainable approaches to improve efficiency in the production process. The objectives are to highlight these measures and identify factor hindering the efficiency of the process and devise new approach to material management. A well structured questionnaire was administered to (48) professionals in various construction firms. The data was analysed using percentages and relative importance index using the 5 – point likert scale. The findings, revealed poor scheduling of materials RII = 0.72, use of skilled workers RII = 0.74, providing adequate buffer stock RII = 0.73 and proper procurement RII = 0.73 as major measures to ensure efficiency while the new approaches advanced include using CCTV RII = 0.85, detailed scheduling RII = 0.72 and use of appropriate software to avoid manual errors RII = 0.70 it was further revealed that inaccurate estimate contributed to factors militating against efficient materials management. Recommendations include use of CCTV in monitoring worker and minimize theft, use appropriate software to reduce manual errors and embracing technologies such as use of drones for large construction projects etc. training and re-training of both the professionals and artisans should always be in the front burner of every firm's policy. All these will enhance efficiency in materials management.

Introduction

The construction industry is characterized with complexity due to its fragmented and multi-faced nature.In this digital era ,digitalization play a key role in sustainable materials management in the construction industry.Integrated Management systems,such as big data and ioT are key to sustainable construction management(kang,and mo ,2024) The several parties ranging from clients ,contractors, stakeholders, shareholders and regulators make it complex. (Babalola, Oluwatuyi, Akinloye and Aiyeiwalehinmi, 2015) and Walker (2015) opined that ,today the construction industry have become highly complex due to technological developments, globalization, uncertain economic conditions, social pressure, political instability and so on.It is an industry that generates tons of raw materials yearly producing around 40 %of worlds carbondioxide.(Grybauskas and Ghobakhloo 2022)

Ashwini (2013) explains that construction materials constitutes a major cost of may be 50% of total cost, so that it is important for contractor to consider that timely availability of materials is potential cause of successful completion of project construction materials management is a key to success of a construction project. Materials management can be described as a system of planning and controlling all the efforts necessary to ensure the correct quality and quantity of materials are properly specified in a timely manner and at a reasonable cost, and importantly are made available at the required point (Pated and Vyas, 2011).

Khyomesh (2011) explains that procurement process affects contractors profit margin negatively. In trying to cope with lowest bid contract and at the same time avoid construction cost overruns. Contractors use substandard elements, do shoddy jobs through the use of cheap inexperience labour

which often results in building collapse, abandoned project and so on. But researchers have continuously identified that effective material management can result in substantial savings in project cost. The goal of material management is to ensure that whenever any material is needed it is available and at a reasonable price.

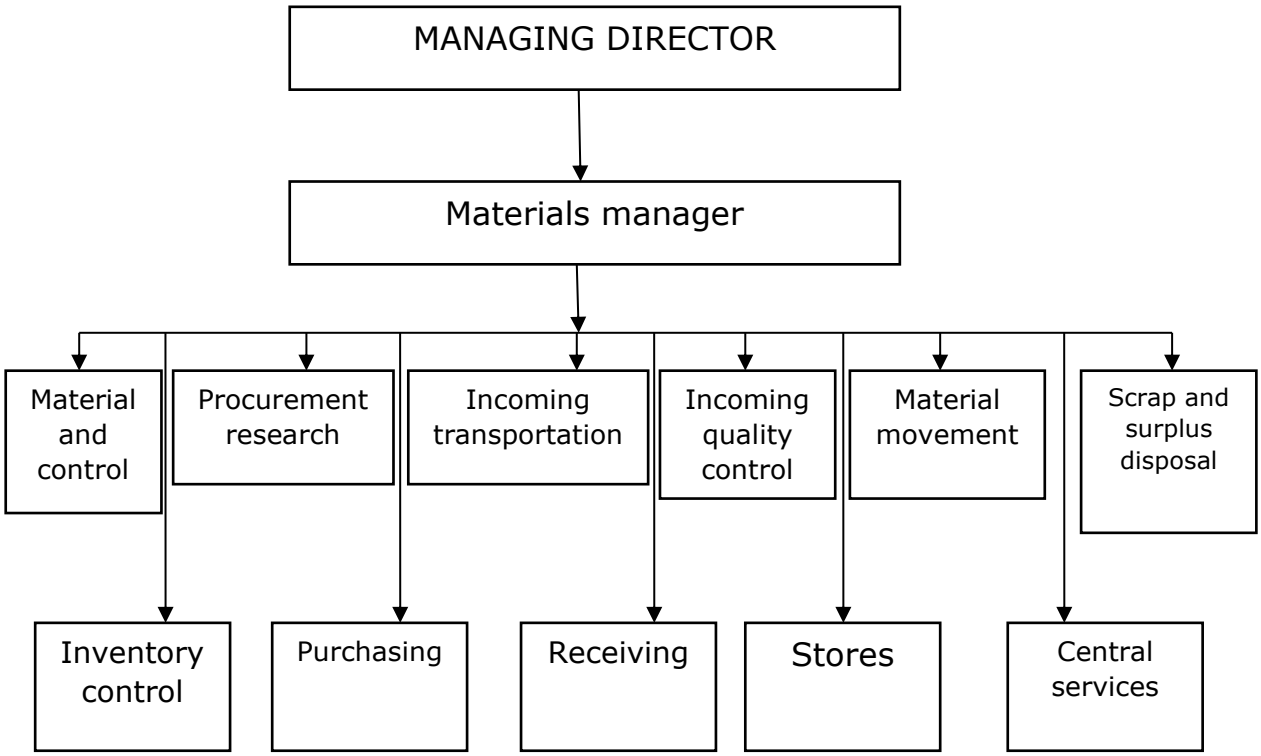
There are other issues that can arise with regards to materials Kelvin (2012) opined that materials may deteriorate during storage or be stolen, also extra expenses may be incurred if material required for particular activities are not available. The control of materials on construction sites is handled carelessly by planning and purchasing department, site supervisors and engineers as well as contractor's organization and this have been posing various problems to contractor in realizing reasonable profit margin (Bamidele, 2016).

Further, a study by Gulghane and Khandve, (2015) revealed that all these processes possesses high uncertainty, as they are interlinked with other series of activities with unknown variables. To this end, and against this background, this study is initiated to developing a sustainable approach to material management methods in Aba in order to improve the efficiency of the production process.

The aim of this study is to access the effectiveness of material management measures in Aba and develop new approaches. To achieve this the study shall concentrate on the following objectives;

i) To evaluate materials management measures used in construction sites in Aba.
ii) To evaluate factors affecting effective materials management.
iii) To develop new approaches that can enhance effectiveness in materials management.

Functional relationship for management materials in a construction firm



Functional relationship in management of materials
Source: Ayegba (2013)

The concept of material management has been a key issue when it comes to construction projects right from the time. From history, whenever anybody or family wants to build a house, the first step is to start moulding blocks and carefully stacking it at a corner of the site. Materials is key in executing a project.

Many definitions have been given to materials management and its methods. According to Kanimozhi and Latha (2014) materials management can be defined as a process for planning, executing and controlling field and offer activities in construction. Several methods and measures have been advanced for effective material management in construction. Also in this era of technology, there is need

to adopt cutting edge technology and techniques in materials management. Some of these will be explained.

Measures and Methods for Effective Materials Management

Use of integrated management approach. An Approach using cutting edge technology can positively influence materials management(abuhassain et al 2024)

Proper usage of material: Phu and Cho (2014) describes usage of materials as the flow component that provides for their movement and placement. Materials usage can be defined as the provision of proper handling techniques either manually or mechanically for the components held on site during construction process.

Use of Material Schedule for Contract: According to Kelvin (2013), it has been established that preparation of good material schedule helps in a long way in solving the problem of material handling on site. This is prepared at the control stage of the building contract. Project schedule should establish guidelines as to when and how projects can be executed.

Just-in-time Method (JIT)

JIT is a systematic concept consisting of JIP purchasing, JIT transportation and JIP production. These three elements combine and create a material handling system that avoids waste and minimizes inventory investment (Stock, 2001). Ocheoha (2013) affirmed the objectives of JIT, which is to reduce processing time, elimination of waste, have respect for people and cost minimization. JIT was first used in manufacturing described as a system that help in making appropriate order of material available to each operating unit at the right time in the right quantity.

Material Variance Analysis

This is the comparison of actual material usage against the estimate. It is also a means to track and examine the variability on material cost, quantity and wastage (Rahman, 1994).

Economic Order Quality of Materials (EOQ): This determines the amount of order that minimizes total variable cost required to order and holds inventory. If a firm places unnecessary orders, it will incur unneeded order cost. If a firm places too few orders, it must maintain large stock of goods or will have excessive carrying cost (Patil and Emitu, 2013).

Inventory Control of Materials on Site

Abdul – Rahman (1994) affirms that it involves taking note of the use and inventory of material on site and recordings ie the loadings and the off-loading, transit and handling of materials. When a construction material is delivered to a site it should be checked for damage quantity, quality and specification.

Use of Building Information Modeling (BIM)

Building Information Modeling (BIM) is an intelligent 3D model-based process that gives architecture, engineering and construction professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure. It helps in coordination and collaboration also helps in optimization of schedule and cost among other benefits (Poirier, et al 2015).

New Approaches for Materials Management

Use of Cutting – edge Technologies

The Digital twin concept: The Digital twin is a closed loop ,real time control system that updates with actual data for ongoing commissioning and enhancement.(wagar et al 2025).This gives information in real time ,making the processes seamless.

The labour input tracking model: the labour input tracking model also called building project monitoring model is an inbuilt part of a complete approach to automation of the whole building process with high technology known as computer integrated construction (CIC) (Navon and Goldschidit (2002).

Radio Frequency Identification (RFID): This is a technology used to determine or observe a mobile tag within the limit of the effect of the reader. RFID technology is used in industries in many countries for tracking inventories, preventing theft, tracking railway cargos (Yi Su 2010).

Use of Drones in Project Monitoring: Drones are unmanned aerial vehicles (UAVs) that are equipped with camera, geo- location sensors, infrared, sensor and more to capture precise details about an environment and physical site prior to and during construction (Hugh, 2018).

Use of CCTV (closed-Circuit Television): This is a system that allows you to keep an eye on what's going on in and around your business. It relates well will monitory of construction sites (State systems Inc 2019).

These cutting edge technology and more will bring efficiency in management of construction materials.

Methodology

This study assess the materials management methods and measures that can enhance its efficiency. New measures and methods were also advanced to enhance material management efficiency.

Questionnaire survey was used to obtain primary data for the analysis. Forty eight (48) questionnaires were randomly administered to building construction professionals handling projects in Aba Metropolis.

The data was analyzed using statistical method such as mean and percentage while relative importance was used in ranking. A Five-point linkert scale rating was used

1 - Not significant 2 – fairly 3 – moderately 4 – significant 5 – highly significant.

Where W is the weight given to each variable by the respondents and ranges from 1 to 5 A – the highest weight = 5, N – the total number of respondents.

A cut-off score of RII computed was determined by summing the weights and dividing by the total number of weighting items and highest weight respectively: (1 + 2 + 3 + 4 + 5) 1515 = 0.60. Thus, events that have RII that are higher than 0.60 are defined as important, those with RII equal to 0.6 are moderate, while those less than 0.60 are less important.

Results and Discussion

Table 1 show that 48 questionnaires were administered to the respondents out of which 40 were duly completed and returned representing 83%

Table 1

Distribution of Questionnaires

S/N	Questionnaires	Frequency (NO)	Percentage (%)
1	Returned	40	83%
2	Unreturned	8	17%
	Total	40	100%

Source: Field Survey (2026)

Table 2

Respondents Profile

	Option	Frequency (No)	Percentage (%)
Highest Educational Level	a) OND	2	5
	b) HND	4	10
	c) B.Sc	30	75
	d) MSC	4	10
	e) Ph.D	-	-
	Total	40	100%
Profession	a) Architect	12	30
	b) Builder	11	27.5
	c) Civil Eng.	15	37.5
	d) Quantity Surveyor	4	10
	Total	40	100%

Source: Field Survey (2026)

Table 2 shows the respondents profile, it can be observed that majority of the respondents with the highest frequency are B.Sc holders 75% while M.Sc is 10%, HND is10% and none has of Ph.D. It shows that the respondents are knowledgeable and have the ability of providing the professional requirement for achieving the aim of the research.

Table 3

Working Experience of Respondents

Years of Experience	Frequency (N)	Percentage (%)
0 – 5	10	25

6 – 10	15	37.5
11 – 15	10	25
16 – 20	2	5
20 years and above	3	7.5
Total	40	100

Source: Field Survey (2026)

Table 3 shows that (37.5%) of respondents have working experience of 6 – 10 years and the least percentage (5%) have a working experience of 16 – 20years. Also 25% of the respondents have working experience of 0 – 5 years. Therefore the respondents can be said to have adequate knowledge and experience in materials management of sites.

Table 4

Ranking of factors affecting effective materials management

Factors Affecting Effective Materials Management	Rank						
	1	2	3	4	5	RII	Rank
Inadequate space on site	10	10	10	10	0	0.50	7
Lack of proper inventory system	0	8	22	8	2	0.62	4
Delay in receiving materials on site	0	8	22	8	2	0.62	4
inadequate control of materials on site	8	16	12	4	0	0.46	9
Inadequate estimate of materials prior to order	0	8	10	16	6	0.7	1
Improper scheduling of materials to cover the entire contract duration	6	2	18	4	10	0.65	2
Inadequate buffer stock	0	8	20	6	6	0.65	2
Unpredictive transportation grid-lock	0	8	24	8	0	0.6	4
Lack of site planning	2	10	20	8	0	0.49	8
Inadequate fund for proper storage facilities	16	10	14	0	0	0.39	11
Negligence of duty of worker in charge of site for materials management responsibility	0	6	28	6	0	0.60	4
Untrained and un-cooperative workers	10	16	10	4	0	0.44	10
Bad site terrain	8	6	22	4	0	0.51	6

Table 4 shows the relative importance index RII as computed for the factors affecting effective materials management. From the ranking assigned to each of the factors, the most significant factor affecting material management is: inadequate estimate of materials prior to order (RII = 0.70) followed by improper scheduling of material to cover the entire contract duration and inadequate buffer stock (RII = 0.65), lack of proper inventory system and delay in receiving material on site, both having an (RII – 0.62) and 3rd in ranking, unpredictive transportation gridlock (RII = 0.6). This shows that estimation is key in material management among other factors. Kasim, et al., (2005) affirms this and recommended use of softwares in estimation to avoid manual errors softwares such as Microsoft project, PRIMAVERA, ERP etc. improper scheduling ranking 2nd. There is need to breakdown the building sequence into operational groups on stages; this makes scheduling easier. This was in tandem with Ngwu et al (2015) which stated that groups can be subdivided into elements which can be presented in terms of detailed quantities of materials. It will help in clarity in scheduling. Buffer stock are additional materials kept as a reserve in case where there is shortage of material or late arrival of materials. Provisions should be made for adequate buffer stock. Improvement in inventory system should be encouraged and efforts should be made to beat the unpredictive transportation griddle either by observing time that is more suitable or routers that are less busy. This study agrees with (Madhavi, et al., 2013) that suggested the need for improving transportation and new possibilities such as transportation order.

Table 5

Ranking of New approaches in enhancing effective material management

New approaches in Enhancing Effective Material Management	Frequency (NO)						
	1	2	3	4	5	RII	Rank
Use of Drones (unmanned aerial vehicle) for monitoring large sites etc	0	8	22	8	2	0.62	6
Use of global positioning system (GPS) tracking	0	0	10	10	20	0.85	1
Use of close-circuit television (CCTV) in monitoring site activities	0	0	6	20	14	0.84	2
Labour input tracking model	8	20	10	2	0	0.41	10
Radio frequency identification	8	8	20	4	0	0.50	9
Time-based contract	0	8	22	10	0	0.61	7
Project-based training for workers	5	5	10	12	8	0.67	5
Classification of firms as BIM-complaint and Non-BIM complaint	20	10	5	5	0	0.38	11
Use of only certified artisans and craftsmen duly registered	10	10	15	5	10	0.58	8
Use of software as MSP, prim AVERA, ERP, SAP, et to avoid manual error	0	10	5	20	5	0.70	4
Detailed scheduling	0	5	15	12	8	0.72	3

Table 5 presents new approaches that can enhance materials management. From the ranking use of GPS in tracking materials is one new approach. The RII = 0.85 which shows it is highly significant in monitoring and tracking of materials. Use of CCTV in monitoring site activities follows with (RII = 0.84) also highly significant closed circuit televisions should be placed in strategic places to capture activities on site, both entrance and exit points. Detailed scheduling rank 3rd with (RII = 0.72). This entails capturing all elements. This is a significant approach in materials management. This agrees with Chitkara (2009) which states the role of experiences in proper scheduling, similarly Ngwu et al (2015) affirms that detailed scheduling is important, emphasis need for coordination and making delivery of materials at scheduled times.

The use of softwares such as Microsoft project, primavera to avoid manual error ranked 4th with (RII = 0.70) that shows it is significant project based training ranked 5th with (RII = 0.67) each project is unique in one way or the other. There should be training to equip workers this corroborates Kevin (2012) on the need for training of workers in project sites for effective delivery.

Table 6

Ranking of material management measures and methods

Methods and Measures for Material Management	frequency (NO)						
	1	2	3	4	5	RII	Rank
Methods							
Just-in-time method	0	2	16	20	2	0.68	4
Economic order quality (EOQ)	6	2	18	4	10	0.62	6
Materials variance analysis	6	4	10	10	10	0.67	5
Measures							
Employment of skilled craftsmen and operators	0	0	20	12	8	0.74	1
Proper storage of materials	2	8	8	14	8	0.69	3
Use of Building information modeling (BIM)	0	2	20	10	8	0.72	2
Proper usage of material	0	2	16	20	2	0.68	4

Purchase of standardized material	0	2	16	18	4	0.72	2
Purchase of materials from approved dealers	0	2	16	20	2	0.68	4

Table 6 enumerates various measures and methods of materials management. In the ranking of these measures and methods, employment of skilled craftsmen and operators ranked 1st, RII = 0.74. This shows it as a significant measure to ensure material management. Closely followed by use of Building Information Modeling (BIM) RII = 0.72. This is supported by a study by Poirer (2015) were findings demonstrated a 75% to 240% increase in productivity using BIM. Proper storage of materials had an RII = 0.69 which shows it is a significant measure, Kevin (2005) stated that materials may deteriorate during storage or be stolen also causing delay and extra expenses if proper storage is not taken care of proper usage of materials ranked 4th with just – in time method and purchase of standardized materials RII = 0.72. This is supported by Dixit, et al (2015) whose study stated that construction managers have to ensure procurement of right items in accordance to the requirement.

Discussion of Results

Findings from the study revealed that in construction projects in Aba, material management measures are low. A lot of wastages, time and cost overruns and poor quality of work is evident. There is low emphasis on skilled artisans as that area seems not to be well structured and organized. There is also improper scheduling as old use of bar chart is still common as only few firms and professionals have adopted software's such as MSP, primavera etc.

As stated by Chitkara (2009) scheduling is not a mere mechanical process. It needs experience. Also poor arrangement for buffer stock is lacking considering that the city has issues of traffic grid lock due to poor road network. This is collaborates Ngwu et al, (2015) which states the need to have adequate buffer stock in case of delay in receiving materials. Procurement of standardized material is also key. The study agrees with Madhavi et al (2013) that suggested the need for improving purchasing, transportation and introduction of new possibilities. Factors limiting effective materials management suggested that the most likely factor is inadequate estimation. Ngwu et al (2015) suggested that in the preparation of schedules, the building sequence could be broken down into operation groups of stages first, the sub-divided into elements or section to enable detailed quantities of materials. New approaches such as introducing technology was advance, finding shows that use of closed circuit television in site will help in monitoring activities in site. Both theft by workers and outsiders will be minimized. Also for large construction project, drones should be encouraged. Use of GPs for tracking of material and softwares to avoid manual errors should be emphasized.

Conclusion and Recommendation

This study has succinctly identified measures to ensure materials management for efficient project delivery. In busy cities like Aba, the poor road network causes a lot of traffic grid lock. This limits the movement of material and limits the number of trips a supplier can make. There should be an agreement with suppliers of materials that default to bring materials on schedule to forfeit a percentage of their pay. Most times quality and quantity are checked but time overrun is not.

Stakeholders in regulation and integrating artisan and craftsmen should ensure that only certificated and tested artisan and craftsmen are allowed to practice. Enforcement should also be taken seriously. The construction industry is slow in embracing technology. Use of softwares and technologies such as BIM, Unmanned utility vehicles, RFID etc should be embraced.

Standard organization of Nigeria (SON) seems to be overwhelmed by their mandate. Balkanization or creation of new regulatory body for construction materials should be established. Construction work is a team work professional bodies such as CORBON, COREN, ARCON should minimize superior contest and be professional always. Construction firms should take training and re-training of all workers as a policy to keep workers abreast of international standards and practice. Cash flow issues should be concluded prior to commencement of projects.

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