IOSR Journal of Humanities And Social Science (IOSR-JHSS)
Volume 26, Issue 9, Series 7 (September. 2021) 21-29
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

Appraisal of the Factors that Affect the Material Management Strategies of Construction Works in Ekiti State Nigeria.

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ABSTRACT
Material management is an approach for planning, organizing, and controlling all those activities principally concerned with the flow of materials into an organisation. This research deals with the appraisal of the factors that affect the material management strategies of construction works in Ekiti state, Nigeria. A structured sixty (60) questionnaire was prepared and administered in accordance with the research design and data gathered were analysed. The analysis of the findings from the questionnaires revealed that sequence of materials delivery ranked first with RSI value of 0.823 (82.30%), availability of material in the local market ranked second with RSI value of 0.80 (80%) and lack of skilled negotiating procedures ranked third with RSI value of 0.770 (77%) followed by transportation for large quantities, poor communication between sites, improper handling on site/manual materials handling, workers' mistakes/misuse of specification, poor planning and co-ordination, material changes in type and specification during construction, dispute resolution strategies management of surplus materials, inadequate knowledge of it solution on materials management, unreliable supply from material suppliers, and inadequate waste management plan. Damage of material in storage ranked least with RSI value of 0.597 (59.70%) followed by delay in the especial manufacture of building materials and Excessive paperwork in ascending order. Conclusion and recommendations will be drawn based on the findings and suggestion for further modification made.

KEYWORDS: Appraisal, factors, material, management, strategies, construction

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Date of Submission: 10-09-2021 Date of Acceptance: 26-09-2021

I. INTRODUCTION

Material management is important because many issues come up on construction site like non-availability of material, inadequate storage, lack of proper handling, and late delivery of materials, e.t.c, which results in cost overrun and time overrun, and perhaps abandonment of construction project. It is apparent that effective and efficient material management will reduce the problem of unnecessary material wastage, scarcity of material, cost-overrun and time-overrun [1].

[2] and cited by [3] defined materials management functions include planning and taking off materials, vendor evaluation and selection, purchasing, expenditure, shipping, material receiving, warehousing and inventory and material distribution. Material management is a planned procedure that includes the purchasing, delivery, handling and minimization of waste with the aim of ensuring that project requirements are met. Further deduction by**[4, 5],** indicate that a sizeable number of contractors operating within the Nigerian construction industry do not engage in any form of quantitative construction planning, but rather prefer to depend on ''intuitive management' (acting on the basis of hunches or previous experience) for managing projects. If material management is a planning process as defined earlier, invariably the need for awareness in eradicating unacceptable practices in order to move the Nigerian construction industry forward is a vital necessity. Material management is an approach for planning, organising and controlling of those activities principally concerned with the flow of materials into an organisation. The scope of material management varies greatly from company to company and may include material planning and control, production planning, purchasing, inventory control,

in-plant materials movement and waste management. It is a business function for planning, purchasing, moving, storing material in a optimum way which help organisation to minimize the various costs like inventory, purchasing, material handling and distribution costs.

Material management definition is "the planning and controlling of all material and equipment so they are requested in advance, obtained at a reasonable cost and are available when needed." This definition includes not only materials that go directly into the product and the equipment to produce it, but also the spare parts needed for maintenance, in order to ensure uninterrupted operations [6]**.**

Material management differ among organizations that is from the producers and users. In some businesses, the material handling process might include sourcing, procuring, transporting, storing and all other aspects of material flow. In other organizations, particularly large construction companies or manufacturers – separate departments might exist for procurement, supply chain, logistics and other functions.

Direct materials are those that go directly into the product being sold, and therefore represent the cost and benefit of the product itself. These materials may include items such as wood, cement, pipes, glass, etc. Availability and quality of direct materials are vital for project success. Poor planning for direct materials can cause significant losses and repercussions to the business and indirect materials are those that are part of the process, but do not go into the product itself. These materials may include items such as equipment and spare parts, staples for staple guns, drill bits, etc. Their value to the product cannot be easily quantified, but their absence or breakdown will negatively impact the process and results.

The importance of the material management process is often overlooked, but its poor execution will have severe, negative consequences. To appreciate this, it helps to understand the weight of a material manager's responsibilities. The material manager must ensure the right materials, in the right quantities, at the right time and place, from the right source and at the right price [7].

[8] indicates that materials constitute about 60% of total project cost, and control 80% of the project schedule. Based on 5.5% profit of project cost, a 2% reduction in materials cost will increase profit by 21%. Availability of materials, improvement in labour productivity, and reduction in material surplus are advantages of having a material management system.

[9] iterate that the implementation and practice of ICT in material management will strongly ease unnecessary cost and increase productivity in any project. There is a need for information and communication technology (ICT) based on material management practice in the construction industry and interrelations of relevant participants in a construction process are considerable, and their management will have a direct impact on the success of the project in terms of time, cost, quality and morale.

Being aware of the importance of material management, several researchers have presented the application of lean concepts and techniques for efficient management of certain types of materials [10, 11] cited in [12]**.** These concepts and techniques include material management systems (MRS), just-in-time (JIT), Inventory Management, value-adding and waste removal. In further recognition of the importance of materials in the success of every project, this study evaluates material management practices with a view to documenting and appraising such practices to help in improving the Nigerian construction industry and aid stakeholders in fashioning out effective material management practice.

II. LITERATURE REVIEW

Material management is an approach for planning, organizing, and controlling all those activities principally concerned with the flow of materials into an organisation. It is a business function for planning, purchasing, moving, storing material in an optimum way which help organisation to minimise the various costs like inventory, purchasing, material handling and distribution costs.

The planning and control of the functions supporting the complete cycle (flow) of materials, and the associated flow of information. These functions include identification, cataloguing, standardization, need determination, scheduling, procurement, inspection, quality control, packaging, storage, inventory control, distribution, and disposal. Also called materials planning

The importance of proper management of material is highlighted by the fact that materials account for substantial portions of project cost and time [13]. [2] cited by [14**],** materials management is defined as a management system that is required in planning and controlling the quality and quantity of material, punctual equipment placement, good price and the right quantity as required. [15] and cited by [9]**,** materials management is defined as a coordinating function responsible for planning and controlling materials flow. In a detailed view, materials management is a planned procedure that comprises the purchasing, delivery, handling and minimisation of waste with the aim of ensuring that requirements are met [4] cited by [9], and materials wastage is any extra cost over and above the material used, plus their handling as contained in the estimated price for the job, [4]**.** [14] opined that, materials management can be defined as a process of planning, executing, and controlling the right source of materials with the exact quality, at the right time and place suitable for minimum cost construction process.

Material management can also be referred to as cost controlling because it minimizes the cost effect of material in project delivery. [14] opined that the objective of material cost control is to early detection of any possibility of cost variance form the budget (cost overrun) so that correction actions can be taken as anticipated. Similarly, [16] opined that the objective of material cost control is to have require materials as scheduled and planned. Construction professionals are recognizing the need to focus on the materials management process as a proactive, identifiable entity that has a significant impact on the cost of construction [17].

Materials management is defined as a coordinating function responsible for planning and controlling materials flow [15]. In a detailed view, materials management is a planned procedure that comprises the purchasing, delivery, handling and minimisation of waste with the aim of ensuring that requirements are met [4]. Materials management is an essential function that improves productivity in construction projects. Hence, the efficient use and management of material have an important influence on a company's profit and can avoid delay in construction [18].

Materials management functions include planning and taking off materials, vendor evaluation and selection, purchasing, expenditure, shipping, material receiving, warehousing and inventory, and material distribution [2]. Almost 60% of the total working capital of any industrial organisation consists of materials costs [19]. Materials management can only produce what it should with the right quantities of the right material at the right time [15]. Thus, any improper handling and managing of materials will cause a huge effect on the total project cost, time and quality. These are lean concepts and techniques used in material management, these concepts vary from one material to the other. [17] cited by [18] investigated a total concept for a material management system which combined and integrated the take-off, vendor evaluation, purchasing, expediting, warehousing and distribution functions of materials. The system resulted in improved labour productivity, reduced material surplus, etc. Also, [20] cited by [18] developed a computer management system that supplements contractors' material management capacity to improve the effectiveness and efficiency of material utilization and company profit. According to [14]**,** material cost control covers the control of ten (10) main steps in materials management, which are planning and scheduling, organization and personnel, procurement, delivery, quality assurance/quality control, storage and storage facilities, usage change order, monitoring and control, and other external factors. Material control covers related factors such as quality, quantity, acquisition, schedule and cost. It is indicated in a study [16] that project material cost has four indicators, which are purchasing cost, transportation cost, storage cost and excess (waste) material cost.

Some of the techniques and concept which shall be explained are just-in-time, lean construction techniques, construction materials management software techniques, construction materials planning system techniques, material handling equipment selection advisor techniques, and construction materials exchange techniques. Material techniques is a way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value [21]. Previous research by [22, 23, 24, 25, 26, 27] recognizes that desired ends affect the means to achieve these ends, and that available means will affect realized ends. Maintaining an ideal inventory is key to an effective material management plan. A savvy material manager minimizes storage requirements and waste, while ensuring direct and indirect materials are available when needed. This means establishing re-ordering plans and projecting inventory levels to hold for work in progress and remedial needs. Failure as one of the effects of material management to achieve any of these the right materials, in the right quantities, at the right time and place, from the right source and at the right price has mention by [7]can result in operational disruptions, cost overruns and wasted materials, not to mention loss of profits, market share and professional reputation.

Construction materials constitute a major portion of the total cost in a construction project. It has been pointed out that the construction materials can constitute 50–60 per cent of the project cost [28]. Due to its role and major portion in construction projects, materials management has become a critical component and an essential function that improves productivity in construction projects [29]. Thus, it is necessary for construction companies to understand the effects of proper materials management towards the success of project execution [30]**.** Materials management is defined by Business Roundtable in Modern Management System as 'the planning and controlling of all necessary efforts to ensure that the correct quality and quantity of materials and equipment are appropriately specified in a timely manner are obtained at a reasonable cost, and are available when needed' [2, 30]. However, some defined it directly with a concept that involved integrating process whereby all procurements of materials are combined under one management function [31, 32]. Briefly, materials management can be defined as a planned process that consist of identifying, purchasing, delivering, handling, allocating of storage and minimizing wastes with the purpose of ensuring the availability of sufficient quantities of material for project needs [9, 30, 33].

The factors that affect the material management strategies in a construction work consists of seventeen (17) they include sequence of materials delivery, availability of material in the local market, material changes in type and specification during construction, damage of material in storage, delay in the especial manufacture of building materials, unreliable supply from material suppliers, poor planning and co-ordination, poor

communication between sites, inadequate waste management plan, transportation for large quantities, inadequate knowledge of it solution on materials management, improper handling on site/manual materials handling, workers' mistakes/misuse of specification and excessive paperwork, Management of surplus materials, dispute resolution strategies and lack of skilled negotiating procedures [1].

Problems identified with material management to include among others as delay in the delivery of materials, the lack of use of advanced planning techniques, material variances and computers. There is a need for an improved material management approach by contractors in a developing country [18].

III. METHODOLOGY

A total of sixty (60) structured questionnaires were developed to gather information from contracting organizations on material management strategies and administered on contractors in selected construction firms in Ekiti State in order to appraise the effectiveness of material management strategies used by them. The whole questionnaires were delivered by hand to the contractors on site and at their Head Offices.

Data were obtained from both the primary and secondary sources which include interview, questionnaire, textbooks journal publications and internet facilities. The data was analysed (i.e the mean and standard deviation), using statistical package for social society (SPSS). The statistical tools used for this study include percentage, mean, and relative significance index (RSI) to determine factors that affect the material management strategies of construction works in Ekiti state, Nigeria. The relative significance index ranking (RSI) was used for ranking of the factors studied. These methods had been used in construction research by authors such as, [34-38] among others. The Likert scale involving rating on interval scale of 5 and 1 developed for application in social sciences and management research for quantification of qualitative variable were used. It elicited information from the building construction professionals concerning the causes of rivalries among professionals in Nigeria construction industry. The responses of the items on the questionnaire were obtained on a 5-point scale ranging from 1 to 5. "Very High" were scored 5, "High" were scored 4, "Average" were scored 3, "Low" were scored 2 and "Very Low" were scored 1.

$$\boldsymbol{Relative\ Significance\ Index\ (RSI) = \frac{\sum \mu}{AN}}$$

Where μ is the weighting given to each factor by respondents.
A is the highest weight (i.e. 5 in this case); N is the total number of respondents = 60

IV. DATA ANALYSIS AND RESULTS

The data were presented using tables for clarification and better interpretation. The analysis tools included both descriptive and inferential statistics.

Table 1 Respondents' Gender

Gender	Frequency	Percent
Male	41	68.33
Female	19	31.67
Total	**60**	**100.0**

Table 1 showed respondents' gender. It showed that 68.33 (41) percent of the respondents are males and 31.67 percent (19) are females.

Table 2: Length of service

Duration	Midpoint (X)	Frequency (F)	Fx	Percent
1-5 years	3	8	24	13.33
6-10 years	8	24	192	40.00
11-15 years	13	15	195	25.00
16-20 years	18	9	162	15.00
21years and above	21	4	84	6.67
Total		**60**	**657**	**100.0**

Mean = ∑FX/∑F = 657/60 = 10.95

Table 2 showed the number of years of respondents' working experience in the construction industry. It showed that 40 percent (24) have between six and ten years working experience, 25 percent (15) have between eleven and fifteen years working experience, 15 percent have (9) between sixteen and twenty years working experience, 13.33 percent have (8) between one and five years working experience, and 6.67 percent (4) have above 20 years working experience. The result showed that 86.67 percent of the respondents have more than

five years working experience in the construction industry which gives an indication of credibility in their responses. The mean number of years of working experience of respondents is 10.95 years.

Table 3: Professional body

Professional body	Frequency	Percent
NIQS	13	21.67
NIOB	27	45.00
NIA	8	13.33
Others	12	20.00
Total	**60**	**100.0**

Table 3 showed the professional bodies that the respondents are associated with. It showed that 45 percent (27) are members of the Nigerian Institute of Builders (NIOB), 21.67 percent (13) are members of the Nigerian Institute of Quantity Surveyors (NIQS),
13.33 percent (8) are members of the Nigerian Institute of Architects (NIA), while 20 percent (12) belong to other related professional bodies such as Nigerian Society of Engineers and so on.

Table 4: Number of staff in the company

Staff	Frequency	Percent
<500	29	48.33
>500	31	51.67
Total	**60**	**100.0**

Table 4 showed the number of staff in respondents' organizations. 51.67 percent (31) have more than five hundred staff and 48.33 percent (29) have less than five hundred staff. This indicated a reasonable representation of small, medium and large-scale organizations
.

Table 4.5: Administrative position in the company

Position	Frequency	Percent
Senior management	15	25.00
Middle management	32	53.33
Junior management	13	21.67
Total	**60**	**100.0**

Table 4.5 showed respondents' managerial positions in their organizations. 25 percent (15) hold senior managerial positions, 53.33 (32) percent hold middle managerial positions, and 21.67 (13) percent hold junior managerial positions. The result revealed that 78.33 percent of the respondents hold middle and senior management offices. The management capabilities of the respondents are an indication of credible response
.

Table 6: Company's working experience in construction (in years)

Duration	Midpoint (X)	Frequency (F)	FX	Percent
<10	10	12	120	20.00
11-20	15.5	25	387.5	41.67
21-30	25.5	9	229.5	15.00
31-40	35.5	6	213	10.00
above 40	40	8	320	13.33
Total		**60**	**1270**	**100.0**

Mean = $\sum FX/\sum F$ = 1270/60 = 21.17

Table 6 showed the respondent company's involvement in the construction industry. It indicated that 80 percent (48) of the respondents' company has been in the construction industry for more than ten years; and 20 (12) percent for less than 10 years. The results revealed that majority of the respondents are key players in the construction industry. The mean number of respondent company's working experience in the construction industry is 21.17 years.

Table 7: Area(s) of specialization of the company

Specialization	Frequency	Percent
Building only	17	28.33
Civil Engineering only	10	16.67
Building and Civil Engineering	33	55.00
Total	60	100.0

Table 7 showed respondent company's area of specialization in the construction industry. The result showed that 55 percent (33) specialize in both building and civil engineering works, 28.33 percent (17) specialize in building works only and 16.67 percent (10) specialize in civil engineering works only.

Table 8: Personnel involved in material management practices

Personnel	Frequency	Percent
Site material manager	14	23.33
Quantity Surveyors	16	26.67
Project Manager	15	25.00
Engineer	10	16.67
Others	5	8.33
Total	60	100.0

Table 8 showed the personnel that are involved in management practices in respondents' firms. The results showed that 26.67 percent (16) of the personnel are quantity surveyors, 25 percent (15) are project managers, 23.33 percent (14) are site material managers, and 16.67 percent (10) are engineers, and 8.33 (5) percent is involved in other managerial work.

Table 9: Factors that Affect the Material Management Strategies of Construction Works

S/N	FACTORS	1	2	3	4	5	TOTAL	TWV	RII	Rank
1	Sequence of materials delivery	5	3	1	22	29	60	247	0.823	1
2	Availability of material in the local market	3	5	5	23	24	60	240	0.800	2
3	Material changes in type and specification during construction	9	2	10	28	11	60	210	0.700	8
4	Damage of material in storage	10	12	13	19	6	60	179	0.597	16
5	Delay in the especial manufacture of building materials	9	11	9	22	9	60	191	0.637	15
6	Unreliable supply from material suppliers	8	9	10	21	12	60	200	0.667	12
7	Poor planning and co-ordination	9	9	4	12	26	50	217	0.723	7
8	Poor communication between sites	8	9	7	14	22	60	221	0.737	5
9	Inadequate waste management plan	6	10	13	23	8	60	197	0.657	13
10	Transportation for large quantities	6	8	1	28	17	60	222	0.740	4
11	Inadequate knowledge of IT solution on materials management	8	6	11	22	13	60	206	0.687	11
12	Improper handling on site/manual materials handling	5	7	10	18	20	60	221	0.737	5
13	Workers' mistakes/misuse of specification	7	5	10	17	21	60	220	0.733	6
14	Excessive paperwork	11	5	14	20	10	60	193	0.643	14
15	Management of surplus materials	9	6	8	23	14	60	207	0.690	10
16	Dispute resolution strategies	8	5	10	24	13	60	209	0.697	9
17	Lack of skilled negotiating procedures	10	2	13	19	16	60	229	0.770	3

Table 9 showed the relative significance index (RSI) of the factors that affect the material management strategies of construction works. The result revealed that sequence of materials delivery ranked first with RSI value of 0.823 (82.30%), availability of material in the local market ranked second with RSI value of 0.80 (80%) and lack of skilled negotiating procedures ranked third with RSI value of 0.770 (77%). Damage of

material in storage ranked least with RSI value of 0.597 (59.70%) followed by delay in the especial manufacture of building materials and Excessive paperwork in ascending order.

V. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The construction industry in Nigeria provides the infrastructure which is fundamental to the development of the country and since as much as 50-70% of the country's investments involve construction, the efficiency of investment programmes and the pace of economic growth depend on the efficiency and productivity of the construction industry. Despite its significant position within the national economy, its performance within the economy has been, and continues to be very poor [39].

This project has shown the importance attached to the material management strategies in the construction firms. At this stage, it is necessary to emphasise on the following conclusions:

1 Material management strategies are not perfectly known and practiced to the indigenous construction firms in Ekiti state.

2 It identifies major factors affecting material management strategies performed by the constructions to damage of material in storage when not used on time such as cement and paints, unreliable supply from material suppliers because of the high interest rate from the commercial banks and inadequate knowledge on information technology due to the epileptic power supply and understanding of it [40].

3 It also concludes and identifies the factors that mitigating to the successful usage of the identify material management strategies such as time factor, bad professional ethics, inadequate personnel welfare, Nigeria economy, environmental changes, autocratic boss and non-availability of professional training.

RECOMMENDATIONS

From the conclusions of this project the following recommendations are made:

1. Concerted efforts are required to widen the scope of formal training for the supervisory and crafts cadres without lowering the supply of top-level manpower, that is, construction firms should increase the training and retraining of their workers with the latest developments in material management strategies.
2. There is need to appoint and recruit more registered builder to manage the various aspect of material management such as material quality manager, project health and safety manager, etc.
3. The professional bodies should be encouraged to lay emphasis on the campaign on the need of material management strategies through campaign on waste control, and time factor.
4. Construction should take precaution in ensuring identified areas of potential threats to material management practice especially time factor and bad professional ethics. The solution to this is to ensure proper time management and professional ethics is inculcated in the material management practice [41].
5. Better attitudes through motivation which deals with both formal and informal approaches to encourage workers to do their best toward fulfilment of the material management strategies to improve material management strategies [42].

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