

JOURNAL 28 & 29



ENVIRONMENTAL TECHNOLOGY & SCIENCE JOURNAL (ETSJ)

VOLUME 11 | NUMBER 2 | DECEMBER, 2020 | ISSN 2006-0459

JOURNAL PAPER 28 & JOURNAL PAPER 29

28. Shittu, A. A., Suleiman, A. & Abel Tsado, A. J. (2020).

29. Shittu, A. A., Tsado, A. J., Salaudeen, H. T., Odine, L. C. & Ibrahim, S.

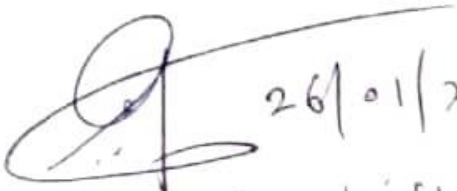


PUBLISHED BY
School of Environmental Technology
Federal University of Technology,
P.M.B. 65, Minna, Niger State, Nigeria.
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Environmental Technology & Science Journal

Vol. 11 Number 2

December 2020

 26/01/2021
Dr. A. A. Shiftn

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The Environmental Technology and Science Journal (ETSJ) is devoted to the publication of papers which advance knowledge of practical and theoretical issues that daily plague our society. The aim of the journal is to provide an avenue for the dissemination of academic research findings from various disciplines of the environment, engineering, pure and applied sciences, arts and social science which have materials that emphasize on environmental issues.

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Frequency of Publication

The journal is published twice a year in June and December

Subscription Details

The 2020 subscription rates for hardcopies of the journal including postage are:

Individual within Nigeria: N2,000 per copy and N1,000 for postage

Individual outside Nigeria including postage \$ 100

Institution within Nigeria: N5,000 per copy and N1,000 for postage

Institution outside Nigeria including postage: \$ 150

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Editorial

The outbreak of coronavirus virus (COVID-19) has not only interrupted world economies, but impacted negatively on the development of much needed infrastructure. However, in the midst of the COVID-19, the World Cities Day was celebrated on 31st October with this year's theme – valuing our communities and cities. The pandemic has further exposed our fragility most especially in the areas of health and education thereby making the call for R and D to be louder than ever before. It is on this note that I welcome you all to volume 11, number 2, December 2020 edition of Environmental Technology and Science Journal (ETSJ). There are eleven (11) articles that cut across topics from the built environment.

The 1st article by Saidu *et al.* examined the approaches for the implementation of e-procurement in building construction projects in FCTA, with a view to mitigating procurement fraud in the sector. The study recommended that both the Federal and State Governments should come up with policies and frameworks that will mandate FCTA construction projects to be procured through e-procurement platform.

Abu *et al.* in the 2nd paper mitigating strategies for high cost of construction projects in Nigeria advocated for the proper supervision and site management during the course of construction projects in order to reduce the shoddy work, mistakes, reworks and variations that might lead to high cost of construction projects.

According to Bashir, there are several risk management maturity (RMM) models that have defined maturity levels with corresponding capability attributes for each maturity level, however, there is a lack of clear strategies for highway contractors to attain higher levels of

RMM. In the 3rd paper, strategies for sustaining optimised risk management maturity level by highway contractors in Nigeria were developed. The study concluded that the adoption of the strategies will ultimately lead to better project delivery and more efficient utilisation of resources in the construction industry.

Preserving green spaces in parks and gardens in the physical landscape of urban built environment is an action that has been identified as a contributing factor to the sustainability of urban areas. Emechebe in the 4th paper assessed green space in urban built environment with a view to enhancing its sustainability. The study recommended creation of awareness on the need of the green spaces to users and also there should be provision of basic laws in the city that will protect the existence and suitability of the green spaces in the urban built environment.

Aka *et al.* in the 5th paper sought find out the underlying strategies that can be adopted for effective minimization of disputes in the Nigerian construction industry. The study concluded that adequate knowledge of contractual document before the start of a project, bringing up contract conditions that are fair to all parties and maintaining a good relationship between the clients, professionals and workers are the underlying strategies that can be adopted to overcome disputes in Nigerian construction projects.

The target of any construction firm is to improve its productivity and organisational efficiency. Unfortunately, Ola-Awo *et al.* argued in the 6th paper that the productivity of construction operatives in Nigeria has been established to be very low and various studies also established that motivation influences productivity. Hence, their paper assessed the motivational factors for improving

construction workers' productivity from the perspective of different stakeholders within Abuja. The paper recommended that management needs to review salaries, working conditions and other benefits to workers from time to time and organise training and re-training to maintain constant productivity improvement.

The 7th paper by Bako *et al.* examined the use of remote sensing technology in the detection of changes on land surface topography which is usually caused by human activities such as mining, building, road constructions, farming, borrow pits and others. The results showed that the topography of the study area has reduced in elevation by 13.55% as at June 2018 from what it used to be in the year 2000. This paper recommended that mining activity should be discouraged and the land reclaimed by the appropriate authority.

The growing demand for University education has led to the gradual elusion from residential housing needs of staff to the development of more academic facilities and no tangible plan has been made to provide housing for University staff. Therefore, Abdulkareem *et al.* in the 8th paper assessed the effectiveness of housing intervention strategies of Universities-based Cooperative Societies to the staff of Nigerian Universities in Southwest Nigeria. The paper suggested that Government at all levels need to encourage the sustainability of housing interventions of Cooperative Societies in Nigeria with a view to eliminating the housing problem of University staff.

The 9th paper by Shittu *et al.* evaluated the effects of material management on the delivery of building construction projects in Niger State with a view to improving the cost and time performance of construction projects. The study recommended that all relevant stakeholders should ensure total

implementation of the cost control techniques for improving material management in construction projects in order to avoid cost and time overrun.

Elimisiemon *et al.* in the 10th paper stated that several developed countries in Europe and North America are aware, widely accepted and adopted Building Information Modelling (BIM). However, developing countries like Nigeria are still using conventional construction practices. Hence, the paper assessed the current status of BIM awareness level and usage in Abuja and Kaduna. As the largest client, government's lack of demand contributed to the low level of usage. The study recommended among others that the Federal Government should make BIM compulsory for its projects that exceed certain threshold values in order to encourage the usage among construction professionals.

The final paper by Shittu *et al.* stated that studies have globally revealed that disputes are an endemic feature in the construction industry. When not properly resolved, they may escalate and ultimately require litigation proceedings. The paper therefore evaluated the effects of disputes on construction project delivery. It was thus recommended that parties to a contract should ensure that mechanism is put in place to effectively implement the identified strategies for controlling the effect of disputes so as to prevent ambiguity in the formulation of contract and contract administration.

As the world continue to battle COVID-19 pandemic, we should tarry a little and ponder about what Martin Luther King Jr. said "All mankind is tied together, all life is interrelated, and we are all caught in an inescapable network of mutuality, ned in a single garment of identity. Whatever affects one directly, affects all indirectly. For some strange reason I can never be what I ought to be until you are what you

ought to be. And you can never be what you ought to be until I am what I ought to be – this is the interrelated structure of reality”

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Let us do it again, peace!

R. A. Jimoh
Managing Editor

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Effects of Material Management on the Delivery of Building Construction Projects in Minna

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Received: 23/11/2020 Revised: 24/12/2020 Accepted: 31/12/2020

Studies revealed that improper materials management can affect the general performance of construction projects in respect to cost, time, quality and productivity. This study evaluated the effects of material management on the delivery of building construction projects in Niger State with a view to improving the cost and time performance of construction projects. Data were collected from professionals in four (4) Government Ministries in Minna who are in-charge of the execution of housing and construction projects with the use of questionnaire which was administered to 86 professionals. The study found that lack of proper work plan with relative importance index (RII) of 0.84 is the most important barrier to effective material management in building construction projects while the most significant impact of material management on the cost delivery of construction projects is better cash flow management with mean item score of 4.31. In a related development, planning the project budget with a mean item score of 4.61 is the most effective cost control technique for improving material management in construction projects. It was concluded that cost control techniques for improving material management in construction projects are effective and therefore, material management has a significant effect on the delivery of building construction projects. It was thus recommended that all relevant stakeholders should ensure total implementation of the cost control techniques for improving material management in construction projects in order to avoid cost and time overrun.

Keywords: Construction Projects, Cost Control, Material Management.

Introduction

The success of a construction project depends upon having the right people with the right skills and equipment that are able to deliver the project on time and budget. In addition, Donyani and Flanagan (2009) reported that it is equally important to have the right materials in the right place at the right time, the cash flow and capital to adequately procure the labour and materials required. In spite of the fact that materials can represent anything from 30-70% of the cost of work on a project, yet material management has not received adequate attention from researchers (Donyani & Flanagan, 2009). Material management is the system for planning and controlling to ensure that the right quality and quantity of

materials and equipment are specified in a timely manner. Furthermore, materials should be obtained at a reasonable cost and be available for use when needed. Material management includes procurement, shop fabrication, logistics, supply chain management, production on site and field servicing. All of these items require special attention in order to achieve cost reduction through materials' waste reduction on site (Donyani & Flanagan, 2009).

Waste of construction materials on site refers to the difference between materials delivered to site and those that are actually used for construction work. Furthermore, waste can be defined as any losses produced by activities that generate direct or indirect

cost, but do not add value to the product (Ayegba, 2013). Rational management of materials to avoid waste is an important consideration for reducing construction cost and construction duration. Therefore, there is a need for efficient materials management in order to control productivity and cost in construction projects. Materials management is a process that coordinates planning, assessing the requirement sourcing, purchasing, storing, transporting, and controlling of materials, minimising the wastage and optimizing the productivity by reducing cost of materials in ways that are cost effective. So, materials management system attempts to ensure that the right quality and quantity of materials are appropriately selected, purchased, delivered, and handled on site in a timely manner and at a reasonable cost (Ayegba, 2013). Therefore, as a result of the complex nature of works undertaken by construction firms coupled with the need for effective material management on site, cost and time need to be effectively monitored and controlled if the anticipated profit margin will be realised for the contractor. This is required to ensure that projects are completed within the budgeted cost of the client. The prevailing availability of cash over short term has the potential to influence the stand taken by both clients and contractors in respect of management of project cost. To safeguard their primary objectives of survival, growth and profitability, contracting organisations should put in place an effective cost management system within the structure of their organisations for effective project delivery.

According to Sheriff *et al.* (2015), cost control of a project involves the measuring and controlling the cost records of a project and work progress, which also involves the comparison of actual progress with the planning. Sheriff *et al.* (2015) stressed further that a project control system should be established for each capital project. The scope and detail of the control system should be based on the size, complexity, and sensitivity and execution strategy of the specific project. Each project control system

should include a cost management process that estimates, monitors, predicts and reports project cost; a project scheduling management process that plans project activities, monitors completion of these activities, predicts timing of future activities and reports schedule status. Change management process that estimates the change impact, enable and documents the change decision, and integrate the change into the project scope of work to realise a cost effective way of executing works at building project sites. This can only be achieved through a well-defined system for planning and controlling to ensure that the right quality and quantity of materials and equipment are specified in a timely manner. It is in the light of this, it is imperative to undertake a research to evaluate the effect of material management on the delivery of building construction projects.

Kasim (2010) identified improper construction materials management as a factor affecting the general performance of construction projects in respect to construction time, quality, cost and overall construction productivity. Rivas (2011) reported that late delivery of construction materials, unavailability of materials before commencement of construction work, and the long distance of materials from the work location is the principal causes of materials related problems on construction sites. Management of materials among sub-contractors are an issue almost on each construction site; materials are sometimes needed to be lifted from one place to another on the site resulting in additional cost of manpower and machinery (Anwar *et al.*, 2015). Pauline (2014) also reported that difficulty to store materials on site due to limited space is another problem in connection with material management; sometime machineries cannot be adjusted on site due to acute space or mismanagement of site activities. Other problems identified in literature include: conflict among sub-contractors and difficulty to coordinate their materials, late delivery of ordered materials, cash flow problem to contractor due to delayed payments, rejection of materials due to non-

compliance to specification and improper health and safety procedure should injuries occur.

In view of the above, in the construction industry, it is observed that many contractors are facing the problem of exercising cost control on materials management during construction activities which automatically results in time and cost overrun in building projects. In order to address this problem, this study carried out an evaluation of the effects of materials management on the delivery of building construction projects in Niger State with a view to improving the cost and time performance of construction projects.

Literature Review

Barriers to Effective Material Management in the Construction Industry

Problems related to managing the flow of materials can be found in every organisation. The proficient management of materials acts as a key function in the successful completion of a project. The organising to materials is a very important and fundamental subject for every company and should be handled efficiently for the successful completion of a project. Consequences of material departures are: Time deviations, Quality deviations, Quantity deviations, Product deviations. Materials are vital in the procedures in every industry since unavailability of materials can impede production. Unavailability of materials is not the only phase that can cause problems. Excessive quantities of materials could also make serious problems for managers. Storage of materials can raise the costs of production and the overall cost of the project.

According to Donyani and Flanagan (2009), materials management can be divided into five categories. These are: measurement and specification, procurement and purchasing process where the order is transmitted to the supplier, delivery to site and logistics of checking the order, offloading, and storing on site, administrative and financial process of payment, and using the materials in

production on the job site and recovering the waste. In terms of purchasing and supply of materials, not matching materials with the existing purchase, purchasing wrong material type or non adequate management, lack of communication and relation between contractor and supply chain companies are the main obstacles to effective material management (Janyan & Janyan, 2019). Some other common problems hindering material management in construction sites are namely failure to order in time which delays the projects delivery at the wrong time which interrupts the work schedule, over ordering, wrong materials to order in direction of materials requiring on-work, theft of materials, and trouble handling of materials. In terms of logistics, the main problems are wrong time of materials arriving to the site or wrong quality, lack of information for materials arrival to the site or use work, missing materials, unavailability of storage space, and waste of labour for materials searching on site.

According to Kanim (2010), there are many issues which contribute to poor materials management in construction projects. Waste, transport difficulties, improper handling on site, misuse of the specification, lack of a proper work plan, inappropriate materials delivery and excessive paper work adversely affect materials management. All these issues lead to wastage and shortage of materials which result to delay in managing materials on construction sites. In addition to the above mentioned, some other issues relating to materials management are: receiving materials before they are required, causing more inventory cost and changes of deterioration in quality; not receiving materials at the time of requirement, causing loss of productivity; incorrect materials take off from drawings and design documents.

Impact of Poor Material Management on Cost and Time Delivery of Construction Projects

In construction industry, one of the common challenges people face is with their material management. Poor material management can lead to issues with the timeline for the entire project. According to Adafin et al.

(2010), construction material management is of central importance to the economic development of the construction industry. Ajayi *et al.* (2017) also identified material management as an integrated process of designing, constructing new structures or remodelling existing structures, using materials more efficiently with a great importance of contributing to construction industry's performance improvement as well as solving material waste management problems. Several authors have shown that material waste from the construction firm represent a relatively large percentage of the production costs (Saidu & Shakantu, 2016). The poor material management of materials leads to an increase in the total cost of building project (Amech & Itodo, 2013).

However, it is not ideal to commence a project without adequate supply of materials and effective planning of the materials required for project execution. This has the advantage of fostering a good relationship with the suppliers who should be selected due to the fulfilment of the standards required to meet the delivery time over a number of years (Adeyinka *et al.*, 2014). In the light of this, effective practice of material management plays a key role in the successful completion of a project. The impact of effective materials management practices on construction projects includes:

- i. **Environmental impact:** This includes the conservation of natural resources, reduction of energy consumption, conservation of landfill space and reduction of environmental impacts across the life cycle by decreasing the demand for virgin products (Van Ewijk & Stegemann, 2016).
- ii. **Economic impact:** It includes reduction in disposal costs and may reduce transportation of material costs which leads to reducing overall project costs, reduction in purchasing costs since non-virgin materials are often less expensive than virgin resources, make contractors to be more competitive with their bids at reduced costs and it creates employment opportunity and economic activities in the reuse and recycling industries (Beacon, 2008).
- iii. **Performance impact:** This includes reclamation of salvaged or reused materials which can perform as well as or better than virgin products in many applications, reduction in the overall costs of materials, better handling of materials, reduction in duplicated orders, materials will be on site when needed and in the quantities required. There will be improvements in labour productivity, improvements in project schedule, quality control, better field material control, better relations with suppliers, reduction in materials surplus, reduced storage of materials on site, labour savings, stock reduction, purchase savings and better cash flow management (Jensen, 2014).

Other impacts of material management practices that could benefit construction industry includes: reduce cost of materials, improvements in productivity, project will be constructed on time or than expected, purchase saving, providing adequate storage of material on site, improvements in project schedule, reduced materials wastage and better cash flow management (Albert, 2014). According to Patel and Vyas (2011), the benchmarking process prescribed for effective material management in construction projects includes: planning; purchasing; receiving; inspection; stocking and storage; issuing materials; and inventory control. In a related study, Panle and Satihuddin (2015) added that material management process should be initiated from the needs generated from the construction site. The information gathered from these needs is then conveyed to Stores Department and materials is thereafter ordered from the store. Lastly, Satihuddin (2015) reported that vendor selection can then be carried out for the least value and best items.

Effective Cost Control Techniques for Improving Materials Management in Construction Projects

Material control aims at eliminating and minimizing all kinds of wastes and losses, while the materials are being purchased, stored, handled, issued or consumed. A

number of techniques are used in planning, procuring and holding stage of material which help in exercising and effecting material cost control. At the same time, construction activities will generate big amount of the waste and it will cause difficulties in the industry. However, with the proper planning of material management, which is efficient and effective will help to reduce the waste of materials during construction project and within the site. This will in turn increase the profitability of the industry. The Nigerian construction industry continues to occupy an important position in the nation's economy even though it contributes less than the manufacturing or other service industries (Aibinu & Jagboro, 2002). The contribution of the construction industry to national economic growth necessitates improved efficiency in the industry by means of cost effectiveness and timeliness, and would certainly contribute to cost savings for the country as a whole. It is also common knowledge that the implementation of the construction project in the industry is usually accompanied with poor quality delivery and delivery time delay and cost increase as well as owner dissatisfaction (Hafez, 2011). Thus, the efficient use and management of material have an important influence on a company's profit and can delay project construction, (Abdul-Rahman & Alidrisiyi, 1994). Material management is a planned procedure that includes, the purchasing, delivery, handling and minimization of waste with the aim of ensuring that requirements are met (Illingworth & Thain, 2011).

According to Culvert (2010), a detailed material schedule and co-ordination of the requisition and order of material are important in ensuring material availability. Efficient material planning is a key to high productivity on site. Material planning embraces quantifying, ordering and scheduling productivity will suffer if the material planning process is not executed properly. Bell and Stukhart (2007) reported a total concept for a material management system (mms), which combined and

integrated the take-off, under evaluation, purchasing expediting and warehousing and distribution functions of material. The system resulted in improved labour productivity, manpower and cost saving. Al-Jibouri (2002) described a computer simulation model, which help to solve the problem of order and deliveries of materials in real life by keeping a predetermined list of order and delivery time of all the materials on site. The delivery of each kind of ineffective materials management for projects can result in significant cost blow-outs and delays in project completion. Such cost inefficiencies will negatively impact global competitiveness and owner operators and engineering, procurement and construction companies are trying to streamline work processes for their projects. Inaccurate materials information, such as incorrect bills of materials, inaccurate cycle counts, shipping errors, receiving errors and so on, will also affect the overall project life cycle and increase project cost. Having to deal with subcontractors outside of the materials management process impacts the overall project supply chain as there is an increased risk of data inconsistencies.

Material management is the system for planning and controlling to ensure that the right quality and quantity of material and equipment are specified in a timely manner. Materials should be obtained at a reasonable cost, and be available for use when needed. The cost of materials represents a large proportion of the cost. A good management system for materials management will lead to benefits for construction. Cash flow has become crucial for the survival of any business, if materials are purchased early. Capital may be tied up and interest charges incurred for the excess inventory of material. Material may deteriorate during storage or be stolen; also delays and extra expenses may be incurred if materials required for particular activities are not available. Modern methods of material management have been embraced by the manufacturers across a wide range of industry sectors outside of construction (Kaming *et al.*, 1997).

According to Sheriff *et al.* (2015), cost control is the processing of raw information received from projects, operating divisions, and special staff division and relating this information to various project cost estimates and schedules for the purpose of presentation of result in the form of reports to all levels of company management, the client and outside agencies. Also, cost control of a project involves the measuring and collecting the cost record of a project and work progress it involves the comparison of actual project with the planning the objective of cost control of a project is to gain the maximum profit within the designated period and satisfactory quality of work. In view of this, the application of cost control practice on site activities will bring about effective site materials management. The main cost control techniques that can be used to achieve this are: Planning the Budget; Keeping a Track of Cost; Effective Time Management; Project Change Control; and Use of Earned Value.

Research Methodology

This study adopted the quantitative research approach. This approach was adopted because it gives room for objective reasoning about an issue and reporting the outcome in numeric terms. In line with this, Kothari (2004) described a quantitative research to involve data generation in a quantitative form which can be subjected in a formal and rigid fashion to rigorous quantitative analysis. The use of structured questionnaire based on a five-point Likert Scale format was employed to collect data. Research population is generally a large collection of individuals or objects that is the main focus of a scientific query; it refers to the total number of the considerable population for the research (Morenikeji, 2006). In the light of this, the population for the study is comprised of registered professionals in government owned Ministries such as the Ministry of Works, Land and Housing; Niger State Housing Corporation, Niger State Geographic Information System Agency (NIGIS), and Niger State Urban Development Board in Niger State. The research population

according to the data obtained was 111 (one hundred and eleven) professionals. The sampling frame for this study covers professionals in these Ministries which involve Architects, Quantity Surveyors, Builders, Estate Surveyors, Town Planners, Electrical Engineers, Mechanical Engineers and Civil Engineers. The criteria for selecting these professionals are years of experience of at least 5 years and above and actively participating in ongoing projects. All the respondents met these criteria. The sample size for this study is 86 because according to Krejcie and Morgan's (1970) table, the sample size for a population size of 110 is 86. Since the nearest value to the population size (111) in Krejcie and Morgan's table was 110, then 86 was used as the sample size. The use of simple random sampling technique was adopted in order to make the sample representative of the population. Analysis of data collected was carried out using percentage, Relative Importance Index (RII) and Mean Item Score (MIS).

The formula for calculating RII and MIS for data analysis is expressed in Equations 1 and 2 as follows:

i. Relative Importance Index

Relative Importance Index is being ranked from 0.00 to 1.00 and they all have their decision rule as shown in Table 2. The formula for Relative Importance Index (RII) is as follows:

$$RII = \frac{\sum W}{A \times N} \quad (1)$$

Where: Σ = Summation, W = the weights of every one of the factors given by respondents and it was in the range of (1 - 5), (A=5) the largest value of weight (i.e. Highest factor) and finally N refers to the Total of number respondents.

ii. Mean Item Score

Mean Item Score is being ranked from 1.00 to 5.00 and they all have their decision rule as shown in Table 2. The formula for Mean item score (MIS) is as follows:

$$MIS = \frac{\sum W}{N} \quad (2)$$

Where: Σ = Summation, W = Weight, and N = Total
The decision rule adopted for the RII and MIS are summarised in Table 1.

Results and Discussion

The section presents the profile of respondents and also discusses the results of the analysis of data carried out.

Response Rate

Eighty-six (86) copies of questionnaire were administered to the respondents during the course of the field work. Of these 86 copies, seventy (70) was correctly filled, returned and used for the analysis. This gives a response rate of 81.4%. Ankras (2007) had a response rate of 15.42% and expressed that the response rate normal for questionnaire surveys is 20 – 30%. In addition, 15.72% and 49.37% were the response rates in the studies of Agumba and Haupt (2014) and Shittu (2016) respectively. This therefore implies that the response rate in this study is adequate.

Barriers to Effective Materials Management

This section presents and discusses the RII results of the twenty (20) barriers to effective materials management. Table 2

reveals that *Lack of proper Work Plan, Transport Difficulties, Waste, Improper handling on Site, Inappropriate Material Delivery, Management of Surplus Materials, and Misuse of the Specification* with RII ranging from 0.81 – 0.84 are the most important barriers to effective materials management in building construction projects in Niger State. Other barriers to effective materials management in building construction projects in Niger State ranging between *Failure to order on Time* (RII = 0.81) and *Excessive paperwork* (RII = 0.72) are also important. On the average, the identified barriers to effective materials management in building construction projects in Niger State are important (average RII = 0.78). The findings here agree with that of Donyani and Flanagan (2009) where it was reported that these barriers identified can constitute a major obstacle in terms of purchasing and supply of materials not matching materials with the ordering purchase.

Table 1: Decision Rule for Data Analysis

SCALE	Cut-Off Point		Level of Importance	Interpretation	
	RII	MIS		Level of Significance	Level of Effectiveness
5	0.81 - 1.00	4.51 - 5.00	Very Important	Very Significant	Very Effective
4	0.61 - 0.80	3.51 - 4.50	Important	Significant	Effective
3	0.41 - 0.60	2.51 - 3.50	Fairly Important	Fairly Significant	Fairly Effective
2	0.21 - 0.40	1.51 - 2.50	Less Important	Less Significant	Less Effective
1	0.00 - 0.20	1.00 - 1.50	Least Important	Least Significant	Least Effective

Source: Adapted and Modified from Shittu *et al.* (2015)

Table 2: Barriers to Effective Materials Management in Construction Projects in Niger State

S/No.	Code	Barriers to Effective Materials Management	RII	Rank	Decision
1	B5	Lack of proper Work Plan	0.84	1st	Very Important
2	B2	Transport Difficulties	0.83	2nd	Very Important
3	B1	Waste	0.83	2nd	Very Important
4	B3	Improper handling on Site	0.83	2nd	Very Important
5	B6	Inappropriate Material Delivery	0.82	5th	Very Important
6	B20	Management of Surplus Materials	0.82	5th	Very Important
7	B4	Misuse of the Specification	0.81	7th	Very Important
8	B15	Failure to order on Time	0.80	8th	Important
9	B16	Lack of Communication	0.79	9th	Important
10	B14	Delivery at the Wrong Time	0.77	10th	Important
11	B18	Double handling of Materials	0.77	10th	Important
12	B12	Wrong Material	0.77	10th	Important
13	B8	Lack of Information	0.75	13th	Important
14	B17	Theft of Materials	0.74	14th	Important
15	B10	Subsequent design change	0.74	14th	Important
16	B13	Unavailability of Storage Space	0.73	16th	Important
17	B19	Not matching Materials	0.73	16th	Important
18	B9	Missing Material	0.73	16th	Important
19	B11	Over Ordering	0.73	16th	Important
20	B7	Excessive paperwork	0.72	20th	Important
<i>Average RII</i>			<i>0.78</i>		<i>Important</i>

Impact of Poor Material Management on the Cost and Time Delivery

The use of MIS was employed to examine the impact of poor material management on the cost and time delivery of construction projects based on the respondents' perception. The MIS results on the impact of poor material management on the cost and time delivery of construction projects are presented in Tables 3 and 4. Table 3 summarises the results of the impact of poor material management on the cost delivery of construction projects, while that of the impact of poor material management on the time delivery of construction projects is summarised in Table 4.

Table 3 reveals that the most significant impact of material management on the cost delivery of construction projects are *Better cash flow Management* (MIS = 4.31) and *Reduction in Material Surplus* (MIS = 4.30). The other impact of material management on the cost delivery of construction projects are also significant. These range from *Quality Control* (MIS = 4.26) to *Stock Reduction* (MIS = 3.90). Averagely, all the identified impact of material management on the cost delivery of construction projects are also significant in Niger State are significant (average MIS = 4.12)

It is shown in Table 4 that the most significant impact of material management on the time delivery of construction projects are *Reduction in energy Consumption* (MIS = 4.43) and *Availability of material* (MIS = 4.39). *Sufficient quantity of material*, *Incorrect bill of material*, *Material procurement*, *Storage changes*, and *Inaccurate cycle counts* with MIS of 4.23, 4.23, 4.19, 3.93 and 3.73 respectively also have significant impact on the time delivery of construction projects. *Shipping error* and *Receiving error* with MIS of 3.50 and 3.43 respectively are shown to be fairly significant impact of material management on the time delivery of construction projects. On the average, all the impacts of material management on the time delivery of construction projects in Niger State are significant with average MIS of 4.01.

The findings of this section are in line with the study of Adafin *et al.* (2010). Adafin *et al.* (2010) reported that poor material management can lead to issues with the timeline for the entire project. Therefore effective practice of materials management plays a key role in the successful completion of a project in terms of cost and time delivery. Hence, construction material management is of central importance to the

economic development of the construction industry.

Cost Control Techniques for Improving Materials Management

The study employed the use of MIS to examine the level of effectiveness of the identified cost control techniques for improving materials management in construction projects based on the opinion of the respondents. Table 5 shows five (5) major cost control techniques for improving material management in construction projects. Table 4.8 reveals that *Planning the Project Budget* (MIS = 4.61) is the most effective cost control techniques for improving material management in construction projects. It was also shown that *Effective Time Management, Keeping a track of costs, Use of Earn Value and Project Change Control* with MIS of 4.46,

4.1, 4.24 and 4.17 respectively are also effective cost control techniques for improving material management in construction projects. It was also revealed that all the identified cost control techniques for improving material management in construction projects in Niger State are effective (average MIS = 4.8). This finding is synonymous with the finding of Sheriff *et al.* (2015). Sheriff *et al.* (2015) discovered that cost control techniques enhance the measuring and collecting of the cost record of a project. It was further stated that the techniques enhance work progress through the comparison of actual project with the planning, thereby bringing about gaining of maximum profit within designated period and satisfactory quality of work.

Table 3: Impact of Poor Materials Management on Cost Delivery of Construction Projects

S/No	Code	Cost Impact of Poor Materials Management	MIS	Rank	Decision
1	C1.2	Better cash flow Management	4.31	1st	Significant
2	C1.1	Reduction in Material Surplus	4.30	2nd	Significant
3	C1.8	Quality Control	4.26	3rd	Significant
4	C1.12	Control of Materials on Site	4.26	3rd	Significant
5	C1.5	Improvement in labour Productivity	4.23	5th	Significant
6	C1.7	Labour Saving	4.14	6th	Significant
7	C1.10	Better handling of Material	4.11	7th	Significant
8	C1.4	Reduction in Duplicated Order	4.09	8th	Significant
9	C1.6	Reduce Cost of Material	4.06	9th	Significant
10	C1.11	Good Relationship with Suppliers	4.00	10th	Significant
11	C1.13	Material Waste Reduction	3.96	11th	Significant
12	C1.3	Stock reduction	3.90	12th	Significant
13	C1.9	Stock Reduction	3.90	13th	Significant
<i>Average MIS</i>			<i>4.12</i>		<i>Significant</i>

Table 4: Impact of Poor Materials Management on Time Delivery of Construction Projects

S/No	Code	Time Impact of Poor Materials Management	MIS	Rank	Decision
1	C2.1	Reduction in energy Consumption	4.43	1st	Significant
2	C2.2	Availability of material	4.39	2nd	Significant
3	C2.4	Sufficient quantity of material	4.23	3rd	Significant
4	C2.8	Incorrect bill of material	4.23	4th	Significant
5	C2.3	Material procurement	4.19	5th	Significant
6	C2.9	Storage changes	3.93	6th	Significant
7	C2.7	Inaccurate cycle counts	3.73	7th	Significant
8	C2.5	Slipping error	3.50	8th	Fairly Significant
9	C2.6	Receiving error	3.43	9th	Fairly Significant
<i>Average MIS</i>			<i>4.01</i>		<i>Significant</i>

economic development of the construction industry.

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4.1, 4.24 and 4.17 respectively are also effective cost control techniques for improving material management in construction projects. It was also revealed that all the identified cost control techniques for improving material management in construction projects in Niger State are effective (average MIS = 4.8). This finding is synonymous with the finding of Sheriff *et al.* (2015). Sheriff *et al.* (2015) discovered that cost control techniques enhance the measuring and collecting of the cost record of a project. It was further stated that the techniques enhance work progress through the comparison of actual project with the planning, thereby bringing about gaining of maximum profit within designated period and satisfactory quality of work.

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4	C1.12	Control of Materials on Site	4.26	3rd	Significant
5	C1.5	Improvement in labour Productivity	4.23	5th	Significant
6	C1.7	Labour Saving	4.14	6th	Significant
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9	C1.6	Reduce Cost of Material	4.06	9th	Significant
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11	C1.13	Material Waste Reduction	3.96	11th	Significant
12	C1.3	Stock reduction	3.90	12th	Significant
13	C1.9	Stock Reduction	3.90	13th	Significant
<i>Average MIS</i>			<i>4.12</i>		<i>Significant</i>

Table 4: Impact of Poor Materials Management on Time Delivery of Construction Projects

S/No	Code	Time Impact of Poor Materials Management	MIS	Rank	Decision
1	C2.1	Reduction in energy Consumption	4.43	1st	Significant
2	C2.2	Availability of material	4.39	2nd	Significant
3	C2.4	Sufficient quantity of material	4.23	3rd	Significant
4	C2.8	Incorrect bill of material	4.23	4th	Significant
5	C2.3	Material procurement	4.19	5th	Significant
6	C2.9	Storage changes	3.93	6th	Significant
7	C2.7	Inaccurate cycle counts	3.73	7th	Significant
8	C2.5	Slipping error	3.50	8th	Fairly Significant
9	C2.6	Receiving error	3.43	9th	Fairly Significant
<i>Average MIS</i>			<i>4.01</i>		<i>Significant</i>

Table 5: Cost Control Techniques for Improving Material Management in Construction Projects

S/No	Code	Cost Control Techniques	MIS	Rank	Decision
1	D1	Planning the Project Budget	4.61	1st	Very Effective
2	D3	Effective Time Management	4.46	2nd	Effective
3	D2	Keeping a track of Costs	4.41	3rd	Effective
4	D5	Use of Earn Value	4.24	4th	Effective
5	D4	Project Change Control	4.17	5th	Effective
<i>Average MIS</i>			4.38		Effective

Conclusion and Recommendations

The study identified a problem of contractors' ineffective ability to exercise cost control on materials management during construction activities which automatically results in time and cost overrun in building projects it is observed that many contractors are facing the problem of. This necessitated an evaluation of the effect of material management on the delivery of building construction projects in Niger State with a view to improving the cost, quality and time performance of construction projects. Data were collected from professionals in (4) Government Ministries in Minna who are in-charge of the execution of housing and construction projects in Niger State with the adoption of questionnaire survey. Analysis of data was carried out with the use of descriptive statistical techniques such as Mean Item Score (MIS) and Relative Importance Index (RII).

As a result of the findings from the data analysis carried out for this study, it was revealed that all the identified barriers to effective materials management in building construction projects in Niger State are important but *Lack of proper Work Plan, Transport Difficulties, Waste, Improper handling on Site, Inappropriate Material Delivery, Management of Surplus Materials, and Misuse of the Specification* are the most important barriers to effective materials management in building construction projects. It was also shown that all the identified impact of material management on the cost delivery of construction projects are also significant in Niger State but the most significant impact of material management on the cost delivery

of construction projects are *Better cash flow Management and Reduction in Material Surplus*. All the impacts of material management on the time delivery of construction projects in Niger State are significant but the most significant impact of material management on the time delivery of construction projects are *Reduction in energy Consumption and Availability of material*.

Finally, the study indicated that all the identified cost control techniques for improving material management in construction projects in Niger State are effective but *planning the project budget* is the most effective cost control techniques for improving material management in construction projects. It can therefore be concluded that the barriers to effective materials management in building construction projects in Niger State are important. Therefore, material management at construction sites has a significant effect on the delivery of building construction projects in Niger State is significant.

In view of the findings and conclusion of this study, it is recommended that more attention should be directed towards addressing the problems of *Lack of proper Work Plan, Transport Difficulties, Waste, improper handling on Site, Inappropriate Material Delivery, Management of Surplus Materials and Misuse of the Specification*. This will enhance effective materials management on construction sites. Government should also ensure that the main objectives of its construction projects are set to achieve better cash flow management and reduction in material surplus. This is to improve the cost and time

performance of construction projects in Niger State

In addition, all relevant stakeholders should ensure total implementation of the cost control techniques for improving material management in construction projects in order to avoid cost and time overrun especially planning the project budget. This study did not address the impact of materials management on the quality delivery of construction projects due to time constraint.

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