

WASTE MANAGEMENT IN CONSTRUCTION SITES OF EMERGING CONTRACTORS IN SOUTH AFRICA

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Material management could be described as a planned procedure that includes the purchasing, delivery, handling and minimization of waste with the aim of ensuring that the requirements are met. There are indications to suggest that material management is of great concern in South Africa's construction sector, especially on sites managed by emerging contractors (young firms from the disadvantaged communities of South Africa with less than ten years in the industry). The cost of materials can exceed 50% of the cost of construction, depending on the type of construction. This proportion is high, and if appropriate measures of dealing with materials management are not adopted, there is a great possibility that the cost of materials may represent a larger proportion in the future. This indicates that an effective use and management of materials have an important influence on the company's profit, and consequently, the economy of the respective country. This paper reports on an empirical study of small contractors in the Northern Province in South Africa. The study indicates that material wastage in emerging contractors is primarily due to lack of skill, knowledge, supervision and a need for material management. This leads to ignoring the cost of material wastage and accepting waste as part of proper construction standards.

Keywords: Cost and emerging contractor, material management, material wastage.

INTRODUCTION

Illingworth and Thain (1988: 1-5), describe material management as a planned procedure that includes the purchasing, delivery, handling and minimization of waste with the aim of ensuring that the requirements are met. These requirements include staying within budget, completing the project within target time and maintaining the expected quality of work. Bad material management results in delays of deliveries, using incorrect quality of materials which calls for breakages. These delays feed on the contractor's profit.

Material management has been of concern in the construction industry. According to Abdul-Rahman and Alidrisyi, (1994), the cost of material can exceed 50% of the cost of construction, depending on the type of construction. A study by Marsh (1985), also shows that the cost of materials and equipment constitutes approximately 60% of the project cost. Olubodun (1986), in an empirical study of building construction input significance in Nigeria, established that material input significance was as high as 60% on most projects. This proportion of cost of materials to the total cost of the project is high. Bernold and Treseler (1991), commented that the cost of materials may represent a larger proportion in the future. This prediction is supported by the implementation of the Structural Adjustment Programme of the IMF in Nigeria which indicated that inflation index for building materials has risen from 100 in 1990 (base year) to 2500 in April 1995 while, the aggregated inflation index for wages and

emoluments increased from 100 to 600 during the same period. The results of a survey conducted in UK, Good (1986) showed that surplus and waste materials together account for up to 40% of the total materials cost of a construction project. Chandler (1978) showed that the contractor will incur twofold loss due to material wastage, which are:

- a) the cost of the usable material
- b) the cost of machines and lorries to transport the extra rubbish to a tip.

He contends that what appears to be just a minor sum (waste) can escalate into a sum four or five times the initial cost of the material. This suggests that contractors usually ignore the cost involved in moving the extra waste to a tip. In another study carried out by Farmer (1963), it was established that 20 to 30% of some companies' profits in US came from savings generated by the unit in-charge of purchasing (purchasing department). Brech (1971), contends that although material control is not always the area where variation of performance is the greatest, it sometimes can be a very important element in determining profitability. However, due to inflation and high percentage of material wastage and surpluses, it can be contended that material control is the area where variation of performance is the greatest, and as such, needs tight control mechanism. This is supported by Chandler (1978) when he stated that the present trend of material costs is rising at a faster rate than labour costs, and contended that the control of waste is vitally important both on and off site.

The above statistics imply that the effective use and management of materials have a great influence on a company's profitability and competitiveness.

OBJECTIVES OF THE RESEARCH

The research will suggest appropriate ways of minimizing material wastage and surplus on sites run by emerging contractors in South Africa.

The following sub-objectives must be achieved in order to accomplish the major objective:

- a) To establish the causes of material wastage and surplus on site.
- b) To analyze the existing waste management systems in the small-medium size contractors in SA.
- c) Propose ways and means of minimizing material wastage and surplus on construction sites.

TYPES OF MATERIAL WASTE

This research deals with material wastage on construction sites which is a fraction of material management. According to Akintoye (1995), waste in "The Just-In-Time" approach is any action/process that does not add value. These activities are unnecessary, and as such can be avoided. The cost of these activities can amount to as much as four times the actual cost of the job, and therefore, if they are not dealt with, could eradicate all the contractor's profits They can be reduced to a minimum if appropriate material management systems are used. Schonberger (1982), Shingo (1986) and Hay (1988) described some of these activities as waste because they do not add value and stressed that they should be minimized.

Chandler (1978) identified two main areas of responsibility and where action can be exercised to control material wastage, namely in:

- a) The design stage
- b) Management on site

THE DESIGN STAGE

Material wastage can result from poor designs that require cutting of materials on site, poor specifications, late variations, etc. Designers can limit the incidence of waste by rationalisation of materials and components, dimensional co-ordination, manufacturing to design tolerances, packaging materials and dimensional utility.

MANAGEMENT ON SITE

However, this research deals with the management of waste on site. It will concentrate on a survey carried out on emerging contractors in South Africa (SA) as there is evidence to suggest that material wastage in South African construction sites is on the increase.

Chandler (1978) divided material waste factor on site into five variables, namely,

- a) waste through mixing, cutting, etc.
- b) waste from leaving materials unprotected and badly stored.
- c) waste from leaving materials behind as the work progresses.
- d) waste from pilfering.
- e) e) waste from the nature of the application of the material (i.e., mortar squeezed out in bricklaying).

Another type of waste factor that needs to be included is waste from surplus materials.

HISTORY OF THE EMERGING CONTRACTORS IN SA

The Apartheid regime in SA did not allow black people to study technical careers. Black workers were also not allowed to do any technical jobs, e.g. to use a trowel. They were required to bring materials and tools to the white tradesmen. However, from the 1970s, they were then allowed to do artisan jobs.

Now in the new SA, these black artisans decided to take the opportunity of the Reconstruction and Development Programme. Most started their own construction firms. Black business people with no idea of construction started building firms, where they finance the project and hire artisans to do the job. Over 85% of the contractors are semi-illiterate (below matriculation) and they do not have management skills, however, they are running construction firms.

THE SURVEY

The population of the emerging contractors in the Northern Province is about 150. The data for the survey was collected through semi-structured questionnaires which were distributed to the contractors when they visited the office of their association in Pietersburg, South Africa. Their arrival was at random and the first 125 contractor were asked to complete the questionnaire. Out of this 125; 119 questionnaires (79% of the population) were analysed.

LIMITATIONS

This survey is limited to the Northern Province in South Africa. It only concentrate on the emerging contractors (newly formed contractors from the disadvantaged communities of South Africa).

BIASNESS OF THE RESPONDENTS

The findings of this survey could be biased because it is believed that the contractors did not tell the whole truth in some of their responses. This could be because of fear that the information might be used to marginalize them in future jobs.

FINDINGS FROM THE SURVEY

Table 1 shows the frequency of using labour-only sub-contractors to do specific jobs. The question was designed to ascertain whether material wastage on site is due to misuse of materials by labour-only sub-contractors because they do not bear the cost of the materials they use. From this table, it can be seen that 32.20% of the emerging contractors always employ labour-only sub-contractors, 33.90% sometimes employ them and 27.97% never engage them. From the history of the emerging sub-contractors, it can be assumed that the use of labour only subcontractors is due to the fact that some contractors (owners) do not understand what goes on in the construction of a building. Another reason could be that most of the contractors are just bricklayers with no experience in other trades and some are business people who have financial resources but no idea about construction. Above all the majority of the contractors do not have a standard ten qualification (matriculation certificate).

Given the above experience of the contractors, it can be suggested that the percentages of the labour-only sub-contractors is too high for them to manage effectively. They do not know how much material is needed to complete a particular task. Therefore, they cannot tell whether there is waste or shrinkages.

Frequency of use	No. of respondents	% of respondents
Always	38	32.20
Frequently	7	5.93
Sometimes	40	33.90
Never	33	27.97
Other	0	0.00
Total	118	100.00

Table 1: *The frequency of using labour-only sub-contractors by the emerging contractors.*

Studies on big construction companies in the world indicated that the cost of material waste can reach up to 40% of the material cost of the project. The lack of education, experience and management skills, more especially financial management in the emerging contractors are shown in table 2. 30.25% of the contractors believe that the cost of material wastage on their site is between 0-10% of the material cost. Just over 50% perceive their material wastage to be between 10% and 20%, while only 2.52% said their waste is between 30% and 40%. This indicates the lack of understanding

and financial management. It also suggest that to them, waste on building materials is normal in construction.

% of material waste	No. of respondents	% of respondents
0 - 10	36	30.25
10 - 20	60	50.42
20 - 30	5	4.20
30 - 40	3	2.52
40 - 50	4	3.36
+50	7	5.88
No idea	4	3.36
Total	119	100

Table 2: Average cost of material waste and surplus as a percentage of total project cost in previous jobs.

Table 3 indicates the different types of securities used on sites to combat material shrinkages. The contractors were allowed to indicate all their security systems, hence the number of responses exceed the number of contractors.

Type of security	No. of Responses	% of responses
Night watchman	110	47.21
Security fence	41	17.60
Dogs on site	21	9.01
Storage sheds	39	16.74
Floodlighting	18	7.73
No security	1	.43
Other/specify: Self	3	1.29
Total	233	100

Table 3: Types of security systems used by emerging contractors.

It can be seen from table 3 that the employment of a night watchman is the mostly favoured with over 47% relying on it. This is followed by the use of a security fence and storage sheds with 17.60% and 16.74% respectively. This indicates that many sites are not fenced and their materials are left outside without any further security besides the night watchman. It is not possible for a watchman to see all activities on site at the same time. The fact that flood-lights are rarely used (with only 7.73%), the vision of the watchman will be minimal more especially during dark nights. This type of security put the materials on site at high risk of theft during the night.

When asked the frequency or period when they do the checking/reconciling of materials, table 4 indicates that 44.85% of the contractors reconcile their materials at the end of each month, 38.24% at the end of each element and 5.88% at the end of the project.

These frequencies happen too late to help identify and stop material wastage. Reconciling at the end of the project, for example does not help the contractor at all. Only 2.94% reconcile their material usage daily and 8% reconcile at random. This suggests that about 80% of the contractors do not check the usage of material on site to help reduce misuse and identify any material shrinkages until it is too late.

Frequency of checking	No. of responses	% of responses
As work progresses, e.g. monthly	61	44.85
At the end of each element	52	38.24
At the end of the project	8	5.88
Daily	4	2.94
Random	11	8.09
Total	136	100

Table 4: Frequency of checking/reconciling materials on site

Table 5 shows how the contractors do their reconciling. It can be seen from this table that 36.17% check their materials only on delivery. 7.45% employ the services of a Quantity Surveyor to reconcile only once a month. 27.66% do their stock taking only once a month (bearing in mind that most do not have a standard ten qualification). Only one percent make use of computers to reconcile material. This further indicates the inexperience and lack of knowledge in the cost of material waste and management. Therefore, reconciling once a month leaves identifying and minimising waste till too late.

Method of checking	No. of responses	% of responses
Employ QS to check monthly	7	7.45
Stock taking every month	26	27.66
daily	12	12.77
Weekly	4	4.25
On delivery	34	36.17
End of element	4	4.25
When taken from storeroom	1	1.06
Use computer	1	1.06
Material balance sheet	5	5.32
Total	94	100

Table 5: Methods of checking/reconciling

To make sense in the analysis of the data in table 6, it must be known that in about 80% of the sites the foreman, the bricklayer and the owner is the same person. It must also be understood that of this 80%, less than 15% have a standard ten qualification.

Person responsible	No. of responses	% of responses
Secretary with std 10	8	8.16
Secretary with std 8	2	2.04
Foreman Max. std 10	44	44.90
Store keeper	7	7.14
Bricklayer	27	27.55
Owner with std 10	6	6.12
Security guard	4	4.08
Total	98	100

Table 6: People who are responsible for checking/reconciling material

It can be seen from table 6, that the owners do the checking. Foremen comprise 44.90%, bricklayers 27.55% and "owner" 6.12%. These owners, most of whom are bricklayers do not have a clue of the amount of work in other trades, and as such the control of materials in such trades is almost nil. The other owners who are financiers do not understand even a single trade. Therefore, they either rely on the bricklayers and/or quantity surveyors. The use of secretaries and security guards also proves that material management is not a critical issue for the emerging contractors.

CAUSES OF MATERIAL WASTE

Contractors were asked to rank the following causes of material waste on their site from 1 to 18, allocating 1 for the most problematic cause and 18 for the least problematic. These points are not listed in the order of importance.

- Poor workmanship and skill of workers
- Theft
- Lack of supervision and misuse of materials
- Setting out errors
- Excessive use of materials
- Incomplete and/or poor designs
- Ordering more or less than required
- Materials not meeting specifications
- Bad storage conditions
- Breakage in handling materials
- Rehandling
- Inadequate transportation
- Early deliveries
- Inadequate packaging

- inconsistency during ordering
- Influence of the weather
- Inefficiency/lack of quality control on deliveries
- Other, specify

Table 7 shows the major causes of material waste as ranked by the contractors. It shows how they were ranked from 1 to 5. Due to space problem the others with less impact are not included.

Rank	% Rank 1	% Rank 2	% Rank 3	% Rank 4	% Rank 5
Theft	46.34	12.20	7.32	8.54	3.66
Lack of supervision and misuse of materials	28.05	7.32	7.32	7.32	17.07
Poor workmanship and skill of workers	8.54	30.49	13.41	19.51	17.07
Breakage in handling materials	7.32	25.61	10.98	3.66	7.32
Ordering more/less than required	2.44	14.63	13.41	6.10	6.10
Early deliveries	0	0.00	24.39	3.66	0.00
Excessive use of materials	2.44	1.22	8.54	15.85	3.66
Inefficiency/lack of quality control on deliveries	1.22	1.22	0.00	6.10	12.20
Influence of weather	0	2.44	2.44	6.10	0.00
Setting out errors	3.66	4.88	3.66	7.32	8.54

Table 7: The most problematic factors in material wastage

From the table 7 it can be seen that the factors that are ranked number 1 in material wastage are theft, and lack of supervision and misuse of materials with 46% and 28% respectively. In the second ranking, poor workmanship and skill of workers, and breakage in handling materials are the highest with 30% and 26% respectively. It can therefore be seen from this table that the most problematic factors in material wastage are theft, lack of supervision and misuse of materials, poor workmanship and skill of workers, breakage in handling materials, early deliveries and excessive use of materials. These figures confirms the findings in lack of education and management skills by the contractors.

Table 8 shows that about 35% of the contractors are embarking on educating their workers about the cost of material wastage in order to minimise waste. 31% make use of their supervisors or material manager who can either be a secretary, bricklayer/foreman or a security guard. Another 21% employ a quality controller who is usually a foreman/bricklayer. Only 6.6% charge their employees for misusing the materials.

Method of minimising waste	No. of responses	% of responses
Quality controller	44	20.75
Material manager/supervisor	65	30.66
Planned small deliveries	15	7.08
Educating workers	74	34.91
Charging waste to workers	14	6.60
Others	0	0.00
Total	44	100

Table 8: Methods of minimising material waste

CONCLUSIONS

Material management is a very important area in construction as the cost of material can be above 50% of the cost of the project. This area should therefore not be undermined because savings of about 30% of the profit can be achieved through proper material management. The SA's emerging contractors are not aware of the effects of material waste. The survey indicated that most of the material waste is due to theft, poor workmanship and skill of workers, lack of supervision and misuse of materials, excessive use of material, ordering correct quantities and scheduling of deliveries. These areas are problematic because of lack of education and management skills, more especially financial and material management by everyone on site. Another problem is that the owner tries to do everything on his own, e.g. material management, supervision workforce, laying of bricks and attending to labour-only sub-contractors.

Coupled with the lack of management skill, one person cannot effectively manage everything on site. Therefore, to minimise the material waste in these contractors' projects, it is recommended that an awareness of the costs and effects of material waste be taught to the owners (contractors), who should in turn educate their workers. The owners should also educate matriculants by paying for their studies in construction management and supervision fields. The students should sign a contract which will bind them to work for that contractor for a stated minimum number of years. This will improve the management on site and will help to educate other site staff. The contractors should also try to delegate some of their duties. Theft of materials can be reduced by using security fences, floodlighting, dogs and night watchmen, the numbers will depend on the size and complexity of the site.

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