# MATERIALS MANAGEMENT SYSTEMS FOR THE CONSTRUCTION INDUSTRY

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## Abstract

This paper reports on the research carried out into the current theories and practices of material management in the UK construction industry.

Pervious studies have indicated that materials management is a major target area where substantial improvements can be made. As materials can constitute over 50% of the cost of a project, material wastage and late ordering need to be minimised and addressed in order to keep costs down, especially in today's competitive market.

In order to identify the current practices of material management and the ways of improving them, a postal questionnaire survey and interviews were conducted among large construction companies in the UK.

From the survey, it was concluded that the current practices of material management is basic and depended on gut feeling and subjective decisions. This has contributed to late ordering and delivery of key materials and high wastage. It was also concluded that some form of systematic approach is needed to manage materials and minimise the cost associated with late delivery and wastage. Specifications and methodology of a new approach in material management is presented.

#### 1. Introduction

"Materials Management" has been defined as the management system for planning and controlling all necessary efforts to make certain that the right quality and quantity of materials and equipment are specified in a timely manner, are obtained at a reasonable cost and are available when needed (see Bell and Stukart, (1985)).

In the past, construction managers have been more concerned with the control of labour and the control of plant. There is now a growing awareness that materials' wastage and shortages are diluting the profit to the contractors more than other reasons.

Material management functions can be generally categorised as (see Brown (1977) and Chandler (1978)):

- 1. Defining material requirements for the project.
- 2. Vendor evaluation.
- 3. Purchasing.
- 4. Storage on site.
- 5. Site distribution.

Traditionally the management of materials takes care of the material requirements, vendor evaluation and purchasing. The details of handling, storage, and site distribution are left to the site manager. The author believes that materials management is a major target area in the construction industry where substantial improvements can be made. As materials can constitute over 50% of the cost of a project, the amount of material wastage needs to be minimised to keep costs down especially in today's competitive market.

There is a tendency amongst the UK major construction contractors to establish material management systems and improve the ways and methods in which materials are planned, ordered, delivered and handled. This is partly due to the recognition of the costs associated with late ordering, wastage and poor handling facilities.

Bell and Stukhart (1986) developed a total concept for a material management system which integrate take-off, vendor, purchasing, expenditure, warehousing and distribution functions of materials. They claimed that the system had resulted in reduced material surplus, reduce material management manpower and cost savings.

Thomas and Sanvido (1989), have suggested that contractors suffer losses in productivity resulting from insufficient material management. This will eventually affect a contractor's profit margin.

Problems identified from the literature regarding material management systems used by contractors include:

- 1. material shortage and wastage due to inefficient management techniques.
- 2. lack of on-site control leading to double handling and time wasting by operatives.
- 3. a reluctance to perform an analysis of material variances.
- 4. insufficient resources allocated for the management of materials resulting in delays with ordering materials on time. The critical materials need to be purchased in a timely manner to prevent costly labour delays in the field.

The current trend in construction materials management is toward developing computer based data systems that provide the type of information needed to prevent material shortages, finding suitable vendors, surpluses and labour delays. The cost of developing and executing computer programs has been justified through the results they provide and the lack of control apparent in their absence.

The objective of this paper is to investigate the current practices of material management systems in the UK construction industry so that ways of improving them may be formulated. In order to achieve this, a survey of the current practices has been established. The following discusses the survey and the conclusions drawn from it.

#### 2. Survey of the current materials management practices in the UK

## 2.1 The Survey Methods

Several methods of obtaining information from the industry were investigated from previous literature. Four possible methods of data collection were reviewed (Oppenheim (1992) and O'Muircheartaigh (1997)):

- 1. Questionnaire.
- 2. Interviews.
- 3. On-site observations.
- 4. Analysing documents, records & census materials.

Due to the limited time available to carry out the research it was decided that the Questionnaire and interviews methods should be used. The main advantages of postal questionnaires are:

- 1. Low cost of data collection.
- 2. Ability to reach a greater amount of respondents who live at widely dispersed addresses.
- 3. Analysis of the postal survey is easier due to the structured nature of the questions and answers.

Due to the need for early responses the questions asked were of a closed form which offered the respondents a choice of answers rather than the open form. It was hoped that the closed form approach would allow a positive response as the time spent to fill it in was minimised. After analysis of the responses from the postal survey, two major construction companies were interviewed and the results were presented in a form of case studies.

## 2.2 Selection of firms

The questionnaire survey was conducted among construction companies in the UK. Firms were selected from contractor listings provided by the ICE. A total of 24 companies completed the questionnaire.

### 2.3 Formulation, of the questionnaire

The questionnaire was formulated to allow the objectives of the research to be best achieved. In order to fulfil the requirements laid down in the aim of the research the questionnaire was divided into three sections.

#### Organisation details and background

Under this section, factual information was requested concerning the name of the organisation and the field of work they were active in. Other information was requested such as the value of projects the company deals with and the type of contract used.

## Current material management characteristics

The purpose of this, the largest section was to collect information on the current practices of the industry. This was intended to enable the author to identify the different approaches to material management used by the various organisation types and hence examine if the systems were necessary or could be improved.

Respondents were asked about their usage of material schedules, experiences with shortage wastage of materials and security of materials on site.

#### Proposed Systems

This final section dealt with proposed systems suggested by the authors.

The questions ask for the companies views on the suggestions because these are only initial proposals. It is hoped that the final proposal will come about as a result of the questionnaires received.

## 2.4 Analysis of the questionnaire

This section of the paper analyses the results of the survey and draws the conclusions which establish the current practices of material management systems in the UK Construction Industry.

#### 2.4.1 Organisation details and company background

The responses received were relatively evenly balanced with 12 from building and 12 from civil contractors. Most of the building contractors are involved with commercial contracts. The majority of their contracts are design and build and the traditional type. The civil contractors are involved in road constructions and other works. The majority of civil jobs are carried out as traditional contracts.

#### 2.4.2 Current materials management characteristics

#### Staff responsibility for material management functions

The agent has the responsibility for preparing and controlling the schedules according to the civil responses. The building contractors tend to have a materials department or a planning engineer who is responsible for co-ordinating the material deliveries.

This results indicate that the civil contracts, due in the main to their specialist nature, tend to give more responsibility to the site agent. The site agent is responsible, in some part, for eight of the twelve civil contracts but only for four of the twelve building contracts.

The building contractors give the responsibility to a planning or materials department. This is a more efficient approach as it means the planning section can schedule and monitor more than one job at a time and allow the on-site personnel more time to plan other areas of the work.

## Cost of materials with regard to other resource costs

Figure 1 indicates the cost that materials make up in a typical contract. The table and chart show that materials make up approximately one-third of the contract price which indicates the need for an efficient management system, one that cuts down the wastage and ensures the schedule is updated as required.

## Tasks carried out by the material management system

Figure 2 shows the popularity of functions which could be carried out as a material management system. The majority of firms monitor the material usage, plan material purchases and forecast the materials needed on site.

#### Information type used to forecast material requirements

Figure 3 indicates that around 95% of the respondents base their forecast on the BOQ and the clause 14 programme of works. One of the firms commented that they based their forecast on the drawings, engineers take-off and computer spreadsheet.

The comments received by certain respondents indicate that the BOQ is not accurate enough to be used solely as a base for materials forecasting. This is most common in the construction industry where the uncertainty of some works involved makes remeasurement necessary.

### Frequency of on-site material checks

Figure 4 indicates that 60% of the respondent check their materials daily. This shows that the majority of firms do operate a Quality Assurance Scheme which lays down guidelines for the checking of materials.

### Factors causing material variations

Figure 5 looks at the factors which cause variations to the cost and volume of materials during a contract. The figure shows that the main functions are wastage and BOQ changes. This is interesting as the BOQ is commonly used as a basis for predicting material requirements. As 75% of all respondents found that the BOQ needs updating then its use as the sole basis for material forecasting needs to be given some consideration.

## Material losses and causes of shortages

Figure 6 indicates the proportion of wastage found on a typical contract. A figure of 5% for both civil and building contractors does amount to a large figure in high priced contracts. This wastage figure will have to be recovered by higher bidding prices on future contracts leading to a less competitive bid. This gives the justification for improving material management practices to enable wastage and other related expenses to be reduced.

Table 1 indicate the causes of material shortages on site. The building contractors find that the most common delay is due to delivery by the vendor, all 11 respondents found this to be a problem. The civil contractors found that their shortages are attributed to late ordering. Both these statistics are disappointing as they indicate a lack of organisation and planning. This response also indicates the need to improve the system.

This statistic is interesting as the survey indicates that the main cause of material shortage is due to a delay in ordering and delivery. This suggests that the schedule is not properly used or is difficult to update and is accurate.

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	BUILDERS						CIVIL					
Scale (1: effective, 2: not effective)	1	2	3	4	5	1	2	3	4	5		
Delivery Delay	4	1	2	2		3	2		2	1		
Ordering Delay	1	1	1	3	3	3		2	2			
Problem finding materials		1			8				3	4		
Credit/Finance	1				6				1	6		

## Table 1. Reasons for shortages

#### Material forecast and display tools

Table 2 shows what the respondents thought about using diagrams to display the usage of materials during a contract. The builder response shows that the use of network diagrams such as the activity-on-node and activity-on-arrow diagrams is limited.

This is probably because many site personnel are not familiar with such techniques. The majority of builder responses suggest that they do not use charts to display the forecast and to monitor the usage. Those which indicated an alternative simply use reconciliation sheets to show the actual materials delivered against the estimated requirements. This would indicate the amount of wastage but would not identify the reason for the alteration.



Figure 1





















The majority of civil contractors have not indicated anything. Of the contractors who do use charting techniques the majority use bar charts and precedence diagrams to display the material requirements on site.

## Table 2. Techniques used in materials management

	BUILDERS					CIVIL				
Scale (1: effective, 2: not effective)	1	2	3	4	5	1	2	3	4	5
Bar Chart	1	2	1		6	1	2	1		3
Net-works	2				9			1		7
Line-of-Balance					16	2	l	2		10
Others	5				4					6

## Current ordering/storage policy

Table 3 shows the policy used by the contractors when ordering the materials on site. The replies show that each sector both schedule materials to arrive on site when required.

## Table 3. Current ordering and storage policy

	В		CIVIL					
Scale (1: effective, 4:not effective)	1	2	3	4	1	2	3	4
Stockpile materials	1		1	7			8	3
Store Critical materials	1		1	7	3	1	4	3
Schedule materials	8	1			8	3		

### Wastage control techniques

Table 4 indicates the safeguards used by the contractors to minimise material wastage on site. The Tables show that many checks are carried out to minimise wastage on site. The site layout is also an important factor as it must be utilised properly to ensure the materials are close to their final location.

## Table 4. Method of security applied

	BUILDERS				CIVIL			
Scale (1: effective,4: not effective)	1	2	3	4	1	2	3	4
Secure storage	4	3		2	6	2	1	
Minimum double handling	3	5		1	3	2		1
Check off deliveries	7	1		1	5	2	2	
Palletised deliveries	4	2	2	1	1	1	3	4
Q. A Scheme (BS 5750)	6	1		2	7	1	1	

## 3. The Proposed Materials Management System

The materials management system to be developed in this research will be composed of the following elements:

- Activities in construction work which will be modelled in "work break down structure" using
  object oriented programming. In this case detailed information about materials needed will
  be presented.
- Timing of activities and sub-activities in the "work break down structure" and materials needed for the planning period .
- Stock information system which keeps track of materials used, materials in the storage yard and decides on the safety stock.
- Site layout model that shows where activities should be carried out, the travelling route of materials and the handling method needed.
- Vendors information system.
- Forecast of materials needed and lead time needed.
- Reporting facilities on the progress of the work, and materials used and materials needed.

The potential benefits of this proposed system include:

- Advising management on the materials needed, when and where they are needed, so that ordering, delivering and storing arrangements can be made.
- Reducing on-site overheads caused by materials delays and thus improving productivity.
- Ensuring that materials are available when required and monitoring of the actual usage during the execution of projects using bar code technology.
- Updating materials requirements to take into account any variations that may occur.
- Allowing the already busy site staff more time to carry out other tasks.
- Computerised for speed and accuracy.
- Create a historical database as reference for future projects.
- Minimised cost impact of changing orders.
- Fewer project delays.

## 4. Conclusions

The object of the paper is to examine the currant practices of material by seeking the views of industry.

This objective has being achieved as there was a 24% response rate to the postal questionnaire sent out. Interviews have also been conducted with managers of local contracting firms. This information has given the author an appreciation of the current practices of material management systems in the construction industry and the problems associated with it.

The conclusions of the analysis show that there are still common problems with material management systems leading to a wastage of resources. These include the following:-

1. contractors still find there are delays in calling off materials; this can lead to late deliveries causing the work progress to be held up.

2. methods used to display material requirements during a project are not updated or are not fully understood as material shortages still occur.

The interview found that it is important to have a good working relationship with the material suppliers to get the best discounts available. As the cost of materials can account for 50% of the total cost the importance of getting the lowest possible price is evident.

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