

SMALL/MEDIUM SCALE CONSTRUCTION LOGISTICS: A STUDY INTO THE FACTORS AFFECTING PLANNING ACCURACY

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Small to medium sized contracting companies in the UK require to be client aware and efficient to compete in today's competitive construction market. This paper focuses on a logistics study carried out on small/medium contractors in the north east of Scotland. The objectives of the study were to firstly establish construction planning and resource management procedures adopted by the contractors. Secondly, to evaluate the findings; highlighting the critical variables which impinged on the planned activities. The research further suggested an innovative procedural model, which if fully developed and adopted by contractors, could facilitate a more efficient plan and delivery of resources. The study (in a macro context) encourages and recommends that small to medium sized contractors undertake a more holistic approach to planning their operations and be more pro-active in reducing the risk of delaying variables affecting productivity and efficiency.

Keywords: Construction planning, logistics, resource management.

INTRODUCTION

The construction industry has in recent years undergone a major transformation in the type and makeup of contracting organisation competing in today's UK building markets. The numerous small to medium sized contracting organisations offering expertise and services stands in stark contrast to major contracting companies who now due to commercial needs and financial constraints adopt to contract out major elements of activity. Although there has been a small drift in this position recently, it would appear that small to medium scale contracting organisations will continue to play a significant role in future UK construction operations.

This paper focuses on research undertaken in the North East of Scotland into the logistical effectiveness of small to medium contracting organisations (smcos). A sample survey indicated that numerous smcos had no formal construction planning procedures and many indicated that their existing methods were inadequate to meet stringent time management criteria and legislation. The study provides an evaluative focus into how smcos logistics are managed and further suggests a procedural model which if fully developed may provide a more efficient mechanism for delivery of resources.

BRIEF LITERATURE REVIEW

Logistics may be defined as the way in which the details of a military operation are handled. As construction operations now necessitate a regulated and planned approach it is necessary to consider construction planning.

“the ability to control must emanate from a plan-a way of proceeding-for with out a plan only chaos would ensue”

(THE CHARTERED INSTITUTE OF BUILDING, 1991.)

It is without doubt that the term planning is still widely reviewed and debated by research contemporaries such as Laufer & Tucker, 1987; Neal & Neal, 1989; Laufer, Tucker, Shapira & Senhar, 1994. Some perceive planning in the project environment to be that which covers all necessary activities to launch a project, while those that follow the launch are defined as project control. Such a division is over simplistic and provides little flexibility for adapting to project modifications. In addition, this does not facilitate the overlap of design and construction which is becoming increasingly popular.

As suggested no uniformly accepted definition of planning exists, for the purpose of this paper, the following interpretation has been accepted as covering the main essence of the topic. Ackoff (1970) stated that “planning consists partly of a decision making process performed in advance of action which endeavours to design a desired future, and effective ways of bringing it about”.

APPROACHES

Clear and unambiguous communication and dissemination of planning information to the individual responsible for executing the physical work is essential. The “doer” must be motivated to undertake work in the sequence stipulated by the planners programme . This situation cannot be easily addressed unless the planning, programming (time related schedule) and actual “doing” are under the direct control of one person. This poses the question of whether it is actually practicable for this to happen. To further evaluate this notion it is essential to visit the work of Neal (1980), in particular the “alpha”, “delta” approach. In summary this suggests that the alpha approach, where the time plans are compiled by a planner in contrast to the delta perspective, which forwards the site manager as the optimum function to not only undertake the planning, but also the control function during construction operations. Neal documented the industry’s increasing displeasure with the alpha approach and indicated his preference to the delta perspective. Nevertheless, an interesting contrast to this opinion was raised by Mace (1990) ,who suggested that a significant proportion of the problems associated with planning are due to the limited number of ‘career planners’ in the industry. i.e. those who hold the sole function of planning and are fully trained to carry out such work. A further dimension to this suggestion is that “multi-skilling” is now actively encouraged within construction companies thus diminishing a clear focus on a planning specific career.

SYSTEMS

The choice of planning technique should not be a complex decision and must relate directly to the level of detail necessitated by the plan, as well as the number and complexity of relationships between activities. It however must be noted that the client may require and stipulate a particular planning technique to be undertaken, for example for contractual reasons, thus limiting the choice to the contractor. The following quote from Laufer et al. (1994) encapsulates the very practical approach which in todays “financially driven” construction industry , is worth reflection.

“the degree of detail should vary inversely with the planning horizon, i.e. the closer the time of implementation, the greater the detail”

RESOURCES

Resource planning in the construction context is the assessment of the real inputs required for any project and the identification of the action necessary to ensure there is a balance between requirements and availability. Hillebrandt & Meikle (1985: 249-263) stated that “Resource planning is necessary to prevent , on the one hand, the non-completion of construction programmes, and on the other, the damage to the company’s finances caused by attempting to undertake construction for which the resources are not available.” The essence and focus of this quote is fundamental to the survival and future prosperity of small to medium sized contractors. Sadly, as the research will reveal little time or thought is given to thorough resource planning.

As can be seen from the brief review, successful elements of construction logistics for smcos is of critical importance. Given the aforementioned factors it is thus a necessary, useful and relevant orientation for research, as it lies at the core of a successful and effective business, interfacing with numerous strands and centres of activity within the organisation.

RESEARCH METHODOLOGY

A measured and structured methodology was designed and implemented to gather meaningful information. Firstly, it was necessary to establish criteria for the proposed construction sample, as detailed:

- the companies should be working as main contractors on at least 50% of their contracts.
- the companies are within the turnover criteria of:
 - : small firms £0-£15m
 - : medium firms £15-£30m
- For this study The data acquisition is segregated into two distinct approaches;
- Observation (of the collaborating organisation)
- An in-depth pilot study was undertaken in conjunction with an industrial collaborator to evaluate their existing planning systems and procedures on a typical 16 week, £.5m building contract. Thus facilitating an in depth knowledge of logistical factors/variables which impinged on contract success.
- Semi-structured interviews(of smcos)
- To ensure that the findings on the pilot study were reflecting smcos in the North East of Scotland a series of 10 detailed semi-structured interviews were undertaken.Five objectives were compiled to structure and focus the data collection phase of the research. The objectives were;
- to review what the industry regards as being the main objectives of a planning system and to determine to what extent these objectives are being fulfilled.
- to establish the methods and techniques which are currently being used for project planning in the small to medium sized sector of the construction industry.
- to establish how common resource scheduling is and to what extent it is being undertaken.

- to develop a comprehensive summary of the variable factors which impinge
- upon the ultimate success of project planning /programming and to seek the industries views on the importance of these variables.
- to discuss and examine with relevant professionals within the small /medium sector the importance of setting a procedural mechanism for the preparation of construction programmes.

Once the data gathering phase was complete and fully evaluated a procedural model was designed to facilitate a more measured and effective means of delivering logistics to the specified sector.

DATA ANALYSIS

Observation (pilot study)

The pilot study and observational stage of the research provided a canvas on which to paint indicative findings. It was with some surprise that no formal progressing or updating mechanisms for the contract were identified, although an original pre-contract gantt chart existed. No quantitative resource procedures or schedules at site level were evident, however site based staff relayed daily resource requirements to head office for action. On a final assessment of the contract, a increase of 35% in labour requirements than was originally anticipated was recorded. At this early stage of the research it was clear that the problems which were emerging were not the result of a single source, but rather a matrix of many factors. The logical progression was to determine whether the initial findings of the observation stage were indeed indicative of small to medium construction companies in North East Scotland.

Semi-structured interviews

To achieve and further reinforce the objectives a sample series of (10) semi-structured interviews were undertaken with managers, the key data and corresponding analysis is outlined:

*A comprehensive list of variables which may impinge upon the ultimate success of project planning /programming was designed, and the sample candidates were asked to express the importance of each of the variables listed. Ranking each by their level of detrimental effect on the accuracy of their planning procedure. The results are tabulated.

Factors impinging on planning accuracy.

Rank	Variables	Total score	Mean average
1	Information supply from architects, engineers etc	26	2.6
2	Default by sub-contractors & suppliers	24	2.4
3	Lead times for ordering, manufacturing etc	23	2.3
4a	Resource constraints e.g. plant, labour etc	18	1.8
4b	Weather variability	18	1.8
6	Time spent on planning	17	1.7
7a	Calculation of durations, outputs etc	16	1.6
7b	Construction complexity	16	1.6
7c	High industry workload	16	1.6
10	Availability of specialised resources	14	1.4
11a	Quality of design ie buildability factors	13	1.3
11b	Planning techniques being used	13	1.3
13	Feedback from previous jobs	12	1.2
14	Unrealistic deadlines	11	1.1
15a	Familiarity with the work	10	1
15b	Labour absenteeism	10	1
15c	Motivation / bonus	10	1
18a	Site characteristics e.g. access, soil conditions etc.	9	0.9
18b	Skill level of workforce	9	0.9
20	Site constraints e.g. working hours, noise etc.	8	0.8
21a	Technical parameters e.g., height, floor areas etc.	7	0.7
21b	Manpower turnover / workforce stability	7	0.7
23	Safety matters	6	0.6

The values are listed as: 0, no detrimental effect; 1, very little effect; 2, moderate effect; 3, substantial effect.

The highest ranking variable is information supply from architects/engineers, one must treat this response with some caution and expectancy. Taking cognisance of architects views etc. would facilitate a more balanced evaluation, however it is interesting and indicative that information or communication in its macro sense would still be impinging on planning accuracy.

Default by sub-contractors and suppliers, this is not a new phenomenon, however sub-contractors who do not organise and manage their work loads by under taking multi-scheduling exercises can seriously erode the effective planning of smcos. Similarly, suppliers and manufacturers of components such as doors with lead in times of 13 weeks (in some instances), must be monitored on an ongoing basis. Moreover, tasks such as scaffolding had to be left in strategic positions until late components arrived on site, thus delaying the following activities and placing previously non-critical activities onto the critical path.

* All candidates were asked if any formal procedures existed within their organisations with regard to construction planning. 70% of respondents did not have any formal procedures, with the remaining 30% suggesting that the total quality procedures were inclusive of planning. All respondents were then asked how improvements could be made to their system, their summary responses are tabulated.

A	“Although we have no written procedure, we are very happy with our existing methods”
B	“A more developed set of procedures would be an obvious advantage and should increase the quality of plans and programmes”
C	“We have our own methods but no written procedures. No time to carry out quality procedures.
D	“Although the size of the company doesn’t justify employing a planning engineer, it is still suggested that someone is employed or trained up to carry out this function. The people currently doing it have insufficient time and the existing system can not be improved until someone is given enough time to undertake all planning operations.”
E	“We have established our own methods for planning, however, we have no set procedure written down, everything is very informal. A quality procedure for planning would certainly tighten up our existing techniques.”
F	“List of information required produced before planning undertaken i.e. lead times, client milestones etc., Frequent revision of contract (updated weekly and altered programme sent to site) and improved communication with subcontractors and suppliers.”
G	“Computerisation.”
H	“The whole system needs to be upgraded with a set procedure which covers programming, feedback, progressing, resourcing etc. to ensure that planning is carried out to a high standard for each project.”
I	“Happy with existing system.”
J	“Happy with existing system.”

It is encouraging to note that a clear majority of respondents welcomed a more formal procedure for controlling planning functions.

- The candidates were asked what they regarded as being the main objectives of their planning system. The responses have been summarised in the matrix shown.

	Execution	Co-ordination	Control	Forecasting	Optimisation	Feedback
A		✓	✓	✓		
B	✓	✓		✓		
C		✓		✓	✓	
D		✓		✓		
E		✓		✓	✓	
F		✓		✓		
G		✓		✓		
H		✓		✓		
I	✓	✓	✓	✓	✓	✓
J	✓	✓		✓	✓	

It can be seen that all candidates found the objectives of forecasting and co-ordination to be of significant importance. The co-ordination of sub-contractors and suppliers through the communication of dates in the programme and by the identification of lead times, were emphasised as being particularly relevant. 60% of the sample had a general opinion that although a plan indicates when and where activities should occur

it does not have the level of detail required to specify how the work should be executed.

- The respondents were asked if a method statement is compiled, which assists in the calculations of duration's, as part of the companies planning procedure (excluding CDM implications).

60% of respondents indicated that method statements were not prepared for the purposes of planning. This would undoubtedly give a more detailed and structured approach to their planning activities.

Other key findings from the interviews are summarised:

- *70% of companies do not have systematic feedback channels.
- *60% prepare activity duration's based on non-formalised historic data.
- *Although 65% of contracts were completed within the prescribed time window, it was evident from the responses that a high over subscription of resources was required to complete within programme time.
- *60% of companies do not compile resource schedules.

The interviews highlighted the apparent strengths and weaknesses of existing logistical components within the companies sampled. There would appear to be a high reliance on informal communication and non-documentation of systems, and in some significant areas no formalised feedback mechanisms. The structured interview data also consolidated the findings of the detailed observational pilot study with particular regard to contemporary logistical practices and procedures.

PROCEDURAL MODEL(A HOLISTIC VISION)

After careful evaluation of the sample data, it become evident that in terms of future logistic success for smcos, a planning process re-design was required. This fundamentally new approach is underpinned by the data and recorded suggestions from the managers interviewed and will facilitate a more structured procedure both at pre-tender and post-tender stages. In addition, reduce the probability of influencing variables impinging on the effectiveness of planning. The development models for the re-design of both stages are illustrated in Figs1. and 2.

PRE-TENDER PLANNING

The model which refers to the pre-tender planning stage has only critical outline procedures associated with it. The practical rationale for this approach is based on the premise of diminishing returns, due to the low ratio of tenders being won by the smcos(30-1 is not uncommon) in the North East region of Scotland, thus work output and associated cost on individual pre-tender programmes is minimal . Endorsing the concept of acceptability and simplicity in the model design, in contrast to a more elaborate system which would be financially non-viable, at this juncture.

POST-TENDER PLANNING

The outline procedural model for the post-tender stage flags up a “generic map” which address the practical planning issues and attempts to reduce the likely hood of impinging variables affecting the planned outcomes. The model is self explanatory,

giving cross reference as to how these procedures should be incorporated into existing company practices (not included due to spatial reasons). This approach encourages synergy between strategic planning and quality assurance systems, with a view to closing the quality loop and reinforcing a practical structured procedure, thus facilitating logistical effectiveness.

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

It is clear from the early stages of this research work that smcos are not following defined procedures for logistical effectiveness, 30% of respondents had set procedures for planning, with a similarly low figure for resource management 40%. Enhancement of effectiveness could be achieved by improving (installing) procedures and acknowledging the variables which impinge on planning. This in stark contrast to further complicating existing planning techniques. Based on the structured interviews a procedural model to regulate planning activities from pre-tender to project completion was designed. This approach emphasises and indeed encourages a more holistic approach to planning in contrast to improving existing techniques such as network diagrams, or creating novel solutions. The “model environment” must be underpinned by, and installed with the following recommendations:

- pre-tender site visit reports
- method planning coupled to supplementary method statements
- probabilistic methods for calculating duration's
- use of sub-contractor and supplier approved lists
- use of MET office Sitewise weather forecasting services
- organisation and monitoring of “pre-commencement meetings”
- use of control and monitoring systems.

Contingencies, complexities and unforeseen difficulties will always arise on construction projects due to the latent nature of variables which impinge on successful and regulated progress. There can be no exact science for project logistics, however the procedural model and its associated management techniques could result in progressive improvement. There is one imperative proviso, however, that sufficient “quality time” and resources are allocated by smcos to undertake all necessary planning activities. There can be no ambiguity that this is a worthwhile and ultimately a cost effective practice, so often overlooked and given low management priority. On the other hand, frenetic and highly competitive construction markets in this sector, frequently do not allow realistic time scales for a systematic approach to be adopted. Clients and their advisors must ensure realistic and achievable duration's are stipulated for the tendering and pre-construction processes to be executed systematically and accurately.

The model provides an interesting starting point, further sampling is required to substantiate and refine the initial research findings. The installation and monitoring of such a model into a typical smcos will provide the focus and stimulus for continuing

the investigative work, with a clear aim of enhancing logistical effectiveness and ultimately providing the client with a good value for money project.

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