

Identification of Variables that Impinge on a Project's Budget by Factor Analysis

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Abstract - The construction industry is one of the contributors to the national Gross Domestic Product. However, a major challenge facing the construction industry is poor cost performance. Identifying and addressing the variables that impinge on a project's budget is vital for improving the cost performance of the industry. Responses from a survey of practitioners in the industry were analysed by factor analysis using the SPSS software. Four principal components (Planning/Supervision, Technical problems, Communication problems and Subcontracting) were extracted from fifteen significant variables identified by the research. In diminishing order of influence, these accounted for 30.4, 15.3, 14.5 and 13.6%, of the variances that characterised poor cost performance. By paying attention to these key factors in relation to their magnitudes of influence, project managers would minimise cost overruns and significantly improve cost performance during the execution of a construction project.

Keywords: Budget, Cost, Project, Variables, Variance.

1. INTRODUCTION

The present article is a companion paper to the researcher's article entitled "An analysis of factors that impact a project budget during execution," published in International Journal of Scientific & Engineering Research (IJSER) Volume 11, Issue 2, February 2020, pp. 58 – 72. For a full description of the sample, data collection and methodology, readers are referred to the previously published article. The main purpose of this article is to focus primarily on an evaluation of measures of association among the factors that were identified in that research as potentially impacting a project's budget. The ultimate aim is to evaluate whether sufficient inter-correlations existed among the identified factors and if so, to extract some principal contributors that could

significantly explain the observed variances among them. These are the key contributors to be recommended as the key focus for a project team's efforts and resources in order to prevent cost overruns.

2. RESEARCH METHODOLOGY

An extensive literature review coupled with discussions with industry practitioners in a previous research by the researcher [1] revealed sixty-seven variables that impinge on a project's budget during execution. The sixty-seven variables were then used to design the questionnaire for the research. The responses obtained from the survey were subjected to statistical analysis using the Statistical Package for Social Science (SPSS) software. The statistical t-test results showed that out of the sixty-seven variables, fifteen are significantly important. Table 1 presents the significant variables in rank order.

The fifteen significant factors identified in the previous research (Table 1 refers) were input into the SPSS software and factor analysis was carried out. The purpose was to ascertain if there were any further relationships among the selected variables that impact on a contractor's budget during the implementation of a construction project. Factor analysis is used in capturing the multivariate interrelationships existing among the variables in terms of degree of significance. It addresses the problem of analysing the structure of the correlation existing among a large number of variables by defining a set of underlying dimensions referred to as factors or components [2]. This is because measured variables can sometimes be correlated in such a way that their correlation may be reconstructed by a smaller set of parameters, which could represent the underlying structure in a more concise and interpretable form.

Table -1: List of the significant variables in rank order.

Variable	Mean	SD	t-value	p-value	Rank
Failure to assess and provide for risks and uncertainties.	4.27	0.90	22.89	0.00•	1
Rework due to defective work.	4.24	0.93	11.03	0.00•	2
Client’s requirements not well understood.	4.21	0.85	20.96	0.01•	3
Low quality of subcontractor’s work.	4.18	0.87	12.57	0.03•	4
Low productivity by subcontractor.	4.12	0.92	11.95	0.02•	5
Communication and coordination problems.	4.09	1.06	9.02	0.02•	6
Low productivity and inefficiency of equipment.	4.06	0.82	11.34	0.01•	7
Incomplete design scope.	4.03	0.91	12.57	0.00•	8
Proposal team different from project team.	4.00	1.17	12.57	0.01•	9
Errors in drawings.	3.97	0.87	1.79	0.01•	10
Project team formed after bid was prepared.	3.94	1.02	1.66	0.02•	11
Failure to identify and concentrate on major cost elements.	3.91	1.03	0.94	0.01•	12
Inadequate work breakdown structure.	3.88	0.98	9.68	0.04•	13
Inadequate pre-planning.	3.85	0.86	8.62	0.03•	14
Delay in receiving approvals.	3.81	1.03	9.00	0.02•	15

Source: Ikegwuru (2020)

3. RESULTS

Four factors with eigenvalues greater than 1 were extracted to represent all variances of the variables. Table 2 shows the results of the factor analysis, factor loadings, communalities and eigenvalues for the extracted factors. A factor loading is the correlation coefficient between an original variable and an extracted factor. Communality (h^2) is the proportion of the total variance of a variable accounted for by the common factors. The eigenvalue is a measure of how standard variables contribute to the principal

component and explain the relative importance of the extracted factor.

The factor analysis reduced the 15 variables into four major groups (F1 – F4), where each group now contains similar variables (Table 5.17 refers). The four factors are:

- F1: Planning and supervision.
- F2: Technical problems.
- F3: Communication problems.
- F4: Subcontracting.

Table 2 Results of Factor Analysis

Variable	Communality (h^2)	Factor Loading	Factor (eigenvalue; %)
Inadequate work breakdown structure.	0.848	0.667	F1 Planning/Supervision (7.596; 30.4)
Inadequate pre-planning.	0.910	0.940	
Failure to identify and concentrate on major cost elements.	0.787	0.171	
Failure to assess and provide for risks and uncertainties.	0.900	0.912	
Rework due to defective work.	0.895	0.797	
Errors in drawings.	0.833	0.579	F2 Technical problems (3.835; 15.3)
Incomplete design scope.	0.882	0.688	

Proposal team different from project team.	0.965	0.799	
Project team formed after bid was prepared.	0.945	0.876	
Low productivity and inefficiency of equipment.	0.831	0.707	
Delay in receiving approvals.	0.897	0.552	F3 Communication problems
Client's requirements not well understood.	0.902	0.850	
Communication and coordination problems.	0.968	0.937	
Low quality of subcontractor's work.	0.827	0.322	F4 Subcontracting (3.397; 13.6)
Low productivity by subcontractor.	0.937	0.822	

4. DISCUSSION OF RESULTS.

4.1 Factor Analysis Results.

For cost control to be effective during the implementation of a construction project, the results indicate that construction firms urgently need to develop new ways of strategically viewing, questioning and analysing project needs for alternative solutions both technical and non-technical [3] [4]. Construction companies should also be able to systematically analyse their situations in terms of their Strengths, Weaknesses, Opportunities and Threats (SWOT). SWOT analysis (also called Position Audit), will enable the construction manager to know and recognise potential risks that might adversely affect the project budget during the implementation stage. This is because, according to [5], "forewarned" positions the construction manager to be "forearmed."

The results of the factor analysis are beneficial to construction firms because the variables have now been condensed into four major components. The four factors have highlighted the areas where construction firms need to pay particular attention during the execution of a construction project. The four factors are:

1. Factor 1: Planning and Supervision.
2. Factor 2: Technical problems.
3. Factor 3: Communication problems.
4. Factor 4: Subcontracting.

The factors are now discussed.

4.1.1 Factor 1: Planning and Supervision.

The factor (F1) is labelled as "Planning and Supervision". Five variables are grouped under this component. The variables are:

1. Inadequate Work Breakdown Structure.
2. Inadequate pre-planning.
3. Failure to identify and concentrate on major issues.
4. Failure to assess and provide for risks and uncertainties.
5. Rework of defective work.

The first variable listed under F1 is "inadequate work breakdown structure" (Mean = 3.88, SD = 0.98). Investigations showed that sometimes the WBS is not accompanied by an adequate description of the scope of effort required. This makes it difficult for those to execute the work to have a complete understanding of what has to be accomplished. It cannot be overstressed that the WBS acts as a vehicle for breaking the work down into smaller elements, thereby providing a greater probability that every major and minor activity will be accounted for. It provides a framework from which the total program can be described as a summation of subdivided elements. It also serves as a tool from which costs and budgets can be established. More importantly, it provides the means by which time, cost and performance can be tracked.

The results highlight the need for constructions firms to ensure that the WBS is thoroughly crosschecked after its development. This is to determine if the WBS is a correct logical subdivision of the total work involved in the project. This research argues that any

proposed WBS must be checked against the reporting requirements of the organisation as a whole. Besides, a well developed WBS will ensure that work packages are of the proper size [6]. That is, they should be manageable with organisational accountability and they should be realistic in terms of effort and time. Additionally the findings indicate that construction firms need to ensure that the characteristics of each work package are thoroughly perceived and management plan well defined at the start of a construction project.

The second variable listed under F1 is “inadequate pre-planning” (Mean = 3.85, SD = 0.86). Investigations during the site visits revealed that planning is sometimes done haphazardly and infrequently too. All these lead to errors and delays that of course impact on costs. The most important responsibilities of a project manager, as identified by [7], are planning, integrating and executing plans. Project planning must be systematic, flexible enough to handle unique activities, disciplined through reviews and controls, and capable of accepting multifunctional inputs. According to Kerzner [8], “the alternative to systematic planning is decision making based on history and this generally results in reactive management leading to crisis management, conflict management and fire fighting.” Few people in the construction industry will deny this assertion.

The investigation also showed that some managers do a less thorough job during the planning phase. That is, they try to cut costs by not planning as well as they ought to. The result of this is managers are put in a position where they are incapable of anticipating adverse conditions before they occur. Consequently, they are not able to deal with such adverse conditions when they eventually occur.

The results of the study also emphasise the need for planning to be done by people who are experienced in and thoroughly familiar with the type of field work involved. Thus it is particularly essential that those who will be expected to implement the plan at the construction site be given the opportunity to participate in the development of the plan. There was a general consensus among the interviewees that people generally demonstrate a sense of commitment

to plans they drew up themselves. The investigation showed that the site staff of construction firms that have central planning departments usually consider the plans drawn up by the central planning department as an imposition on them. The results also showed that inadequate formal planning sometimes results in “scope creep” (that is, unnoticed or often uncontrolled increase in scope or effort). A direct consequence of this is that most times work cannot progress as planned.

Another important variable under Factor 1 is the “failure to identify and concentrate on major cost elements” (Mean = 3.91, SD = 1.03). The investigation showed that when planning a project, some managers fail to identify and concentrate on the major cost elements of the project. In other words, sufficient attention is not paid to those elements or activities that have a major impact on the total project. When problems develop, as they often do, the project manager then engages in fire fighting. Again, this will have an adverse effect on costs. Thus when planning and budgeting for a project, it is expected that more than the usual attention should be paid to those items that account for a greater percentage of total cost. Incidentally, that is not always the case.

The 80/20 rule (which states that 80% of the costs arise from 20% of the sources of costs) applies almost universally and is a powerful indicator of where the cost-consciousness should concentrate. In other words, attention should be paid to those areas where the most significant cost data are to be found. Pareto’s 80/20 rule emphasises that in most projects, the largest percentage of costs is spent on small items. The application of this rule will enable construction firms to pay attention to the significance of that small percentage of activities which account for the greatest percentage of total cost.

An important factor under F1 is the “failure to assess and provide for risks and uncertainties”

(Mean = 4.27, SD = 0.90). Risk is inherent in every construction project. Therefore, it is important that when planning a project, the risks and uncertainties that are likely to have an impact on the budget are assessed and provided for. The investigation showed

that projects are sometimes planned without adequate consideration of and provision for risks. The investigation also revealed that because of the uniqueness of projects, some project managers have developed a “live with it” attitude on risk and attribute it as part of doing business.

However, it is the contention of this research that proper risk management will force those responsible for planning projects to focus on the future where uncertainty exists. This will enable them to develop suitable plans of action to prevent potential issues from adversely impacting on costs. Incidentally, when the risk materialises (as it often does), the manager would then start reacting to the crisis. Of course, valuable time would be lost in the process. This of course would have a deleterious effect on the project budget.

This research argues that if proper risk management is set up as a continuous, disciplined process of planning, assessment (identification and analysis), handling and monitoring, then surprises that eventually become problems will be greatly minimised, if not completely eradicated. This is because, contingency plans for handling such risks would have already been developed well in advance. Put more appropriately, a thorough risk analysis will enable the Project Manager to have backup strategies in anticipation of potential problems. It is a truth very certain that this type of proactive management will eliminate crisis management, conflict management and fire fighting which are generally associated with reactive management. All the project managers interviewed admitted that an examination of things that can go wrong is never undertaken by their various organisations when planning and budgeting for a project.

Rework of defective work (67, Mean = 4.24, SD = 0.93) is another significant variable classified under F1. This result was not unexpected because researchers overwhelmingly concur that rework of defective work is a significant factor that contributes to cost overruns in construction projects [9] [10] [11] [12] [13] [14] [15].

The investigation showed that rework of defective work accounted for more losses than other factors at the construction sites visited. The investigation showed that there was no Quality Management (QM) department in any of the six firms investigated. Thus the level of implementation of quality practices was rather too low. That is, their use in practice was not a common occurrence. The lack of QM practices and inadequate supervision during the construction process were the major causes of rework in the projects investigated. All the six organisations investigated did not measure quality costs. When asked how they measured the quality of their work, they stated that they use some form of internal and external benchmarks. They did not disclose what the benchmarks were.

Incidentally, a research carried out by [16] showed that projects without a quality system in place typically experience a 10% increase because of rework of defective work. There is no doubt that the introduction of QM would help construction firms to eliminate waste especially in the form of rework. Other factors responsible for rework in the projects investigated included low skill level of construction workers, poor use of materials, setting out errors, failure to provide protection to the works against inclement weather, carelessness, among others.

4.1.2. Factor 2: Technical Problems.

The second factor is labelled “Technical Problems”. Five variables are classified under this component namely:

1. Errors in drawings.
2. Incomplete design scope.
3. Proposal team different from project team.
4. Project team formed after bid was prepared.
5. Low productivity and inefficiency of equipment.

The first variable listed under F2 is “errors in drawings” (Mean = 3.97, SD = 0.87). The main problems usually encountered in drawings as discovered during the course of the research emanate from inadequate or ambiguous specifications. According to the respondents, contractors sometimes try to interpret specifications

on their own without confirmation from the consultants or they use “standard” practice specifications. With errors in design, the project manager must refer such drawings to the designers for clarification. It is obvious that when that happens, work will not proceed according to plan. This, of course, would affect the contractor’s project budget especially if work had already started when such errors were detected.

Again, consultants are supposed to study and clearly check drawings before approval. But according to the respondents, this is not always the case. The respondents stated that consultants sometimes approve drawings without thoroughly checking them due to either incompetence or lack of accountability. It is the contention of this research that the competence of a consultant does not depend only on the ability to recheck drawings, but also on the ability to provide drawings that can be constructed. Constructability of drawings is very important to contractors. Consultants without enough experience and onsite practice are not aware that constructing the design is not the same as drawing it. The respondents stated that there had been some occasions where consultants designed columns and beams with dense reinforcement bars without considering whether concrete can be poured through it or not.

Problems such as those highlighted above usually affect the compatibility between drawings and method of work. A direct consequence of this is that adjustments are often required in such cases. This invariably implies that more time would be needed and work cannot proceed as planned. This, of course, will definitely affect the contractor’s budget for the project.

This result was not unexpected because [17] observed that engineering design has a high level influence on project costs. Furthermore, a survey by [16] also revealed that about one third of Architectural and Engineering projects miss their cost budgets as a result of design errors. As a matter of fact, there have been few instances where an engineering design was so complete that a project could be built to the exact specifications contained in

the original design documents [19]. As observed by [20], “many construction problems are due to design defects and can be traced back to the design process.” Chang [21] also noted that design performance is usually unsatisfactory.

“Incomplete design scope” (Mean = 4.03, SD = 0.91) is another factor listed under F2. The investigation showed that most private clients allocate small amounts of money for designs. The consultants therefore prepare only general designs and specifications without the complete details. In such cases, only construction drawings of buildings are provided with some specifications still not fixed. The result of course would be ambiguous perceptions from contractors. The specifications not yet detailed would mean that design consultants cannot directly approve important drawings and materials before discussing with and receiving permission from the clients. Such clients would then get involved in the project. Additional work may evolve during clients’ involvement because clients may change their minds or even introduce new ideas.

It goes without saying that delay in completing the design will affect the contractor’s original budget for the project. This is particularly so if the contractor had already mobilised his work force before realising that the complete design would not be ready as he had anticipated. More recent studies have shown that one of the most important ingredients to a successful project is the accurate definition and effective control of project scope [22]. This research therefore contends that if project scope is not adequately defined by the time contract documentation is finalised, then necessary changes during construction may eventually lead to rework which may, in turn, have detrimental consequences on project budget.

Put more appropriately, decisions made during the design phase of a project often have a great impact on the eventual total project cost. If specific client requirements are not determined before signing a contract, then changes may result in rework which of course would affect the contractor’s budget adversely. Appointing the contractor very early in the project can eliminate problems associated with inadequate scope definition and design errors.

“Proposal team different from project team” (Mean = 4.00, SD = 1.17) is another variable listed under F2. Both theory and practice dictate that the proposal team should be made the project team in order to avoid conflicts during the execution of a project. This will ensure commitment by the members of the project team. Commitment is widely recognised as another important factor that enhances the performance of project team members. Commitment is a reflection that all members of the project team are highly interested in the project. Both theory and practice show that people in projects are often unwilling to conform to imposed standard [23].

“Project team formed after bid was prepared” (Mean = 3.94, SD = 1.02) is another variable listed under F2. The investigation showed that the current practice is for the project team to be formed after the bid had been prepared and the contract awarded. This research however contends that it is appropriate for the project team be formed before the preparation of a bid so that the team members can actively participate in all the negotiations leading to the award of the contract. This is a technical problem within the domain of the construction firm.

It is obvious that since the project team members did not participate in the negotiations leading to the award, they may not be aware of the considerations that led to the award. Consequently, when discrepancies are observed at the site, as they often are, the project team members must consult those that prepared the bid for clarification. This again would result in delays which ultimately have a bearing on the cost of operations.

Besides, it can also lead to poor performance due to lack of commitment on the part of project team members. Poor performance invariably results in rework, which again impacts on the project budget.

Additionally, a number of variables are considered when bidding for a project. One of such overriding factors is the method of work. When members of the project team are assembled after the bid had been prepared it is apparent that problems are likely to be encountered during site operations. This is because

work may not proceed as conceived by those that prepared the bid. There is also the likelihood the project team members may not put in their very best because they originally were not consulted during the preparation of the bid. In other words, there might be no commitment from such members of the project team, as they did not know the calculations that went into the preparation of the bid.

“Low productivity and inefficiency of equipment” (Mean = 4.06, SD = 0.82) is the next variable listed under F2. The investigation showed that most contractors (including the large ones) procure equipment but keep maintenance costs as low as possible. They only maintain equipment regularly only when the equipment is still under warranty. They fail to continue maintenance after the warranty period because they do not want to spend money if “there is nothing wrong with the equipment”. As a result of this, equipment is fixed or maintained only when breakdowns occur.

Secondly, due to the high cost of procuring new ones, equipment is often kept in service beyond its service life. In other words, contractors keep equipment in service as long as it can work even though the productivity is low. Occasionally, work has to stop because of problems with the equipment.

The equipment operator also has an important role to play in supporting the productivity and efficiency of the equipment. The investigation showed that, more often than not, what contractors do to reduce labour costs and perhaps because of limited skilled labour, is to make use of, not skilled equipment operators but just anyone who can make then work. As a result some aspect of the work cannot finish as expected.

It cannot be overemphasised that the use of proper equipment during site operations will not only improve site productivity; it can also shorten construction time. Furthermore, it will also help construction firms to improve their competitiveness. Also, it is important that construction firms consider the issue of regular maintenance of their equipment. When equipment is in good condition, its productivity will be high and this will of course

translate into an increase in the overall productivity of the project.

4.1.3 Communication Problems.

The third factor F3 is labelled "Communication Problems". Three variables are classified under this component namely:

1. Delay in receiving approvals.
2. Clients' requirement not understood.
3. Communication and coordination problems.

The first variable under F3 is "Delay in receiving approvals" (Mean = 3.81). The approval process in the construction industry is time consuming. Usually, there are many shop drawings to be prepared for approval. The investigation showed that even though contractors are aware of the fact that the approval process in the construction industry is time consuming, they nevertheless submit proposed materials and drawings a few days to the day they would be needed in the project. Furthermore, due to time constraints, contractors often prepare drawings in a hurry and fail to review them thorough before making proposals to the consultants. More often than not, such proposals are either not complete or have mistakes in them. Of course, time has to be spent in redoing such proposals for approval again. These are operational or management errors, which can be eliminated if contractors realise, understand and manage their time and schedule appropriately.

Additionally, due to inadequate or ambiguous specifications, contractors misinterpret specifications or use common specifications. When they propose drawings, specifications are sometimes below clients' or consultants' expectations and they are rejected. This results in rework for the contractor. The delay in approval means that material delivery would inevitably be late and work cannot proceed as expected.

"Client's requirements not well understood" (Mean = 4.21, SD = 0.85) is the second variable listed under F3. The investigation showed that with inadequate and ambiguous specifications, the contractor may not properly understand what the client wants. With

limited time and long procedures for obtaining permission, the contractors sometimes use common standard specifications based on their own interpretation. As a result, when clients check, their quality expectations may not be met.

Also it was observed that due to the short time for submitting tenders, a lot of assumptions are made while completing the tender documents. Thus during the implementation phase, the contractor must consult the designers for explanations. During the period in question, work will not proceed as planned. Besides, redrawing may be required and this would result in delays. It is strongly advocated in this research that time and money can be equated. Thus a delay in any activity would definitely impact on the project budget.

"Communication and coordination problems" (Mean = 4.09, SD = 1.06) is the third variable listed under F3. It is a well-known fact that most construction workers (i.e. the operatives) generally have little or no formal education. Consequently, they do not possess sufficient knowledge and the analytical thinking to do or take decisions by means of their own judgment. Thus coordination is very important for work to proceed smoothly.

The investigation showed that coordination problems also originate from the main contractors themselves. For instance, it was observed that site engineers do not update project schedules regularly either because they are too busy or they are not able to do so in the first place. It is commonplace to say that it is very rare to find work on a construction project progressing on schedule. It is a truism that if schedules are not regularly updated, there would be no way of knowing the exact progress and development of the project. This of course would result in difficulties in coordinating their own work and manpower as well as those of subcontractors.

The investigation further showed that coordination problems also occur during the construction process when the progress is not on schedule and the schedule itself is not updated by the contractor. When that happens (as it does most times) the order of work activities changes and adjustments must be

needed. However, in the absence of records or data about the current progress, it would be extremely difficult, if not impossible, to decide what the appropriate solution should be. This is an operational error in the domain of the contractor.

Furthermore, a competent consultant is very important because the consultant coordinates and manages the overall project. The consultant and the contractor should work together for a smooth progress of the project. This is even more so since the consultant is the link between the contractor and the client. It goes without saying that effectiveness of communication in this case would depend mainly on the capability of the consultant.

The results of the study therefore suggest that very clear and well-defined project objectives and scope will eradicate this symptom. Put more appropriately, project participants should be informed about the direction of the project, the expected project outcome and more importantly, their individual roles in the project. Clear responsibility and accountability are necessary to sweep away what [23] called “counter-productive effects of individualism.”

Projects are run by communication. Communication is the process by which information can be exchanged. Effective communication is therefore needed during the execution of a construction project in order to ensure that the right information gets to the right people at the right time. If this is done, delays in receiving approvals will be minimised, if not completely eradicated.

The results of the investigation also showed that effective communication between the prime contractor and the consultants is very essential if the client’s requirements are to be understood. Above all, effective communication will ensure that the prime contractor is able to coordinate the activities of both his employees as well as those of subcontractors.

Project schedules are used to communicate information to members of the project team, including subcontractors. But when the prime contractors do not properly update the project schedules, the exact progress and development of the project cannot be determined. Thereafter, the

contractors then experience difficulties in coordinating work and manpower, including subcontractors. A direct consequence of this is that subcontractors will experience low productivity in their own aspect of the project. This will in turn impact on the contractor’s project budget.

Information is the basis for problem solving and decision making. Besides, communication ‘pitfalls’ are the greatest contributors to project difficulties [24]. Communication has been gaining increasing importance in today’s information age [25]. Intensive communication is a central factor in leading and integrating people and taking decisions to create successful projects [26]. The results of the study therefore underscore the need for the establishment of an effective information system for construction projects. If this is done, every member of the project team can access and share ideas. Put in other words, “shared project vision” will be impossible when there is poor communication among project participants. According to [23], as people become better informed and more aware of what is happening in their project, they will become more involved and committed to the progress of the project, and, as a consequence, become better motivated.

More broadly speaking, communication helps clarify and disseminate all necessary project information and status to all members of the project team. The project will then have the opportunity to avoid failure and reach for success through the achievement of team spirit [24]. As a result of the complex nature as well as the ever-changing environment of construction projects, [27] suggested that the management system in a construction environment should be flexible, sensitive to effective communication and continually improving.

One way of ensuring that communication is effective and realistic is through regular meetings. This will guarantee co-operation from all members of the project team. Incidentally, all the interviewees admitted that meetings are not frequently held to discuss site progress.

Phua and Rowilson [28] have argued that cooperation is a vital determinant of construction

project success. This implies that frequent meetings are therefore inevitable in a construction project environment. According to [24], "What's going on?" needs to be communicated to all project participants. This way, corrective and preventive actions would be timely applied in order to ensure good project performance.

It cannot be over emphasised that a proper project monitoring and control system cannot be possible without effective progress meetings.

A project has a chance of being successfully completed at the planned budget if project plans are regularly updated. Moreover, in order to ensure the effectiveness of the cost control system, [23] suggested that the plans should be kept simple, with the appropriate level of detail that can encourage a project to be reviewed regularly.

The findings showed that construction firms do not undertake comprehensive risk assessment before the commencement of a project undertaking. Both the Questionnaire Survey (Mean = 4.27, SD = 0.90) and the site investigation established this.

4.1.4 Factor 4: Subcontracting.

The fourth factor is labelled "Subcontracting". Two variables are classified under this component namely:

1. Low quality of subcontractors' work.
2. Low productivity by subcontractors.

The first variable listed under F4 is "low quality of subcontractors' work" (Mean = 4.18, SD = 0.87). The site investigations showed that specific factors responsible for subcontractors' low quality of work include damage to work done by other trades due to carelessness, inadequate supervision, poor choice of materials in a bid to increase their profit margin and the use of low skill level of construction labour. This research argues that proper coordination of subcontractors' work is extremely important during site operations if the project budget is not to be exceeded. There is also a need for input from

subcontractors during the planning process since they are also integrated into the project team.

Clough et al. [29], also advocated that "participation by key subcontractors is also vital to the development of a workable plan". One of the benefits of this procedure is that both the prime contractor and the subcontractors are brought together to discuss the project. By so doing, problems could be detected early enough and appropriate steps would be taken well in advance toward their solutions. Consequently, the issue of low quality of work by subcontractors would not arise. Furthermore, if subcontractors participate in the development of a plan there is every possibility that they would be committed to its actualisation.

Another variable listed under F4 is "low productivity by subcontractors" (Mean = 4.12, SD = 0.92). The investigation showed that some clients insist on using certain subcontractors for their projects because of reasons best known to them; even when they may know that those subcontractors may not be truly qualified to execute the job. More often than not, such contractors create problems for the main contractor. The consequence of the above is that work cannot finish on time and subcontractors experience low productivity in their work.

5. SUMMARY OF FINDINGS

The factor analysis has condensed the risk factors identified by the research into four major components. The four components (Planning and supervision, Technical problems, Communication problems and Subcontracting) have highlighted the areas where project team members need to pay particular attention during the execution of a construction project.

Another important finding is that rework of defective work (RF 67: Mean = 4.24, SD = 0.93) significantly impacts on a contractor's project budget. Investigations during the site visits showed that QM activities are generally not being utilised during the construction process. Both prime contractors as well as subcontractors are guilty in this regard.

For construction firms to improve upon their cost control practices and remain profitable, the risk factors listed in Table 5.11 must be effectively managed.

6. RECOMMENDATIONS

1. There should be increased emphasis on the integration of design and construction processes. If this is done, most design-related errors would be eliminated.

2. Project Managers should ensure that every project member understands that they have to react, respond and take action when deviations are observed.

3. Construction firms should analyse critical risk factors to determine how they will affect the project before commencement. PM's need to conduct "what if" games to develop contingency plans.

4. Subcontractors should be appointed early in the project so that they can participate in developing the project plan.

5. Every project should be hierarchically structured in a WBS and all participants at the work package level should be monitored. Besides, the characteristics of each work package must be thoroughly perceived and the management plan well defined at the start of a construction project.

6. Planning should be in the short term because having a few key objectives at a time focuses the project team on target and creates commitment and agreement about project goals. Plans should be kept simple with the appropriate level of detail that can encourage a project to be reviewed regularly.

7. QM tools and techniques should be used by construction firms to eliminate waste, typically in the form of rework, thereby improving the effectiveness of their processes. The benefits of establishing a QM department will more than outweigh the setting up costs.

8. Project Managers should ensure that an effective information system is established for every construction project. They should equally ensure that information is realistic and that the means for measuring progress is determined very early in the project.

9. Routine and scheduled maintenance of equipment as well as the use of skilled equipment operators during the execution of a project should be taken seriously. It is axiomatic that the use of appropriate equipment and skilled equipment operators will not only improve productivity, it will definitely reduce construction time. In the long term, this can help construction firms to improve their competitiveness and even outperform their competitors.

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