COST CONTROL IN THE BHUTANESE CONSTRUCTION PROJECTS

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ABSTRACT

The paper provides the determination on factors affecting the cost overrun in the Bhutanese construction industry and identification of cost control techniques and recommendations. Questionnaires were distributed to 200 contractors and the results were analyzed using the statistical tools.

It was found that the three main factors were affecting the cost overrun in construction: frequent design change, delay in material procurement and changes in material specification and type. Site meetings, record keepings and work programmes comprised the main cost control techniques used by the contractors. The contractors frequently used the overall profit and loss method to control the cost overrun.

Keywords:*Cost overrun, SPSS, Reliability, Average Index, Cronbach's Alpha Value*

1. INTRODUCTION

The construction industry has a great impact on the economy of all countries (Leibing, 2001).In most developing countries, the construction industry plays a dominant role in the socio-economic development of the country. The growth of construction sector is accrued to the construction of hydro power projects and it contributes to 12.20% of the national GDP. The construction sector is run by private firms (Anon,2013) and since the country is rapidly developing, it is expected that shares from the construction industries will further increase in future.

The growing need for construction of all types coupled with a tight monetary supply has provided the construction industry to cut down the cost.

Cost is the fundamental component for any construction projects. However, cost overrun is observed as one of the most frequently occurring issues in the construction projects worldwide and need to be studied more. The main idea of this paper is to present the lessons learned.

1.1 AIM AND OBJECTIVES

The aim of this research is to study the measures that can be adopted to control construction cost in the Bhutanese construction projects.The specific objectives of the study are:

i) To determine factors affecting cost of construction in the Bhutanese construction projects.
ii) To study the cost control techniques in a construction project.

iii) To identify the cost control method frequently used by contractors during the construction stage.
iv) Recommendations of measures to minimize the cost overrun.

2. LITERATURE REVIEW

Cost control is the process continued through the construction period to ensure that the cost is kept within the agreed limits. During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process.According to (Dharwadher,1985), cost control can be achieved by selecting the right man for the right job, the right equipment and tools for right work and the right quality of materials, in the right quantity from right resources, at a right price and delivered at a right time. Austen and Neale (1984) states that the main purpose in cost controlling for a construction project should be active controlling of final costs for owner, and not just to record and registering the payment.

3. RESEARCH METHODOLOGY

The research framework followed is by identification of problem, primary data collection (questionnaire survey), secondary data collection and analysis of data and recommendation.Two sets of data were identified as being relevant to the effective conduct of this research namely primary and secondary information.The primary data refers to the field data which were obtained through interviews with representatives of the construction industry and professionals working in the construction industry. Then, a questionnaire survey was conducted to obtain the information and to study the scenario of construction industry through a well-structured questionnaire. The questionnaire is designed based on the objectives of the study and the list of barriers to the effective cost control systems that were obtained from the literature were presented in the questionnaire on five-point Likert scale.

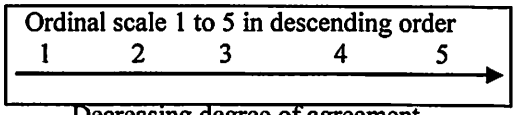

Fig1. Five ordinal measure of agreement of Likert's scale (Likert,1932)

Secondary data was collected through the review of various relevant literatures to gather information about the challenges faced by construction industry in general and also from the internet, articles in journals and papers and other published research works.

3.1. METHOD OF ANALYSIS

In the analysis method, Average Index and Relative Index Method were adopted to establish the relative importance of the causes of cost overrun and factors affecting the cost control in the Bhutanese construction projects. As discussed earlier, Likert's scale of five ordinal measures of agreement towards each statement (1, 2, 3, 4 and 5) is used to determine the relative ranking. Statistical tool SPSS16 was used to check the reliability of the factors and to analyze data based on questionnaires.

A. AVERAGE INDEX METHOD

Average index is one of the methods for the manual calculation of mean.

$$AI = \frac{(1x1+2x2+3x3+4x4+5x5)}{(x1+x2+x3+x4+x5)}$$

Where;

x1=No. of respondents "Extremely Signifcant"
x2=No. of respondents "Very Significant"
x3=No. of respondents "ModeratelySignificant"
x4=No. of respondents "Slightly Significant"
x5=No. of respondents for "Not Significant"

The evaluation ranges to assess significant level as adopted by (Ghani 2006) and (Abdullah 2010) was used in this study as follows:
$1.00 < AI < 1.50$ Extremely Significant
$1.50 < AI < 2.50$ Very Significant
$2.50 < AI < 3.50$ Moderately Significant
$3.50 < AI < 4.50$ Slightly Significant
$4.50 < AI < 5.00$ Not Significant

B. RELATIVE INDEX METHOD

Relative Index (RI) is a technique used for determining first whether predictor variables can be ranked in terms of importance. It shortens surveys by eliminating the need for direct ratings of importance. RI adoptedby (Holt et al,1996) is used in this research:

$$RI = \frac{\Sigma(1n_1+2n_2+3n_3+4n_4+5n_5)}{5(n_1+n_2+n_3+n_4+n_5)}$$

Where,
n =No. of respondents for each rating of factors.

3.2 STATISTICAL TOOL FOR DATA ANALYSIS

The extracted data from the questionnaires were analyzed using SPSS in this research, after having carefully completed the variable view and extracted data appropriately on data view. SPSS (Statistical Package for Social Science) is predictive analytic software that can predict with confidence what will happen next so that smarter decisions can be made, problems can be solved and outcomes can be improved(Angelis,2006).

A. RELIABILITY ANALYSIS

Reliability means consistency. Reliability can take on values of 0 to 1.0 inclusive (Wei-Yuan & Kwok,2003). In this research, Split Half Method and Cronbach's Alpha Reliability Analysis is adopted in order to draw the comparison and to check the reliability of the data collected.

Cronbach's alpha is a measure of internal consistency which shows how closely related a set of items are as a group. The higher the score, the more reliable the generated scale is.

A commonly accepted rule of thumb for reliability check in this research is using Cronbach's Alpha. Figure 3-3 represents the alpha value to assess the reliability of data (Cronbach 1951).

Table1 Cronbach's Alpha Value (Cortina 1993)

Cronbach's alpha	Internal Consistency
$\alpha > 0.9$	Excellent
$0.8 < \alpha < 0.9$	Good
$0.7 < \alpha < 0.8$	Acceptable
$0.6 < \alpha < 0.7$	Questionable
$0.5 < \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Split Half Reliability Test is used in comparison with Cronbach's Alpha Value and check the reliability. The test items are divided into two halves, with the items of the two halves matched on content and difficulty.

4. DATA ANALYSIS & INTERPRETATION

A total of 200 questionnaires were distributed out of 300 sampled numbers for effective sampling, through emails and manually in printed form. Out of a total of 200 questionnaires sent,

76 responses were found adequately filled for the study, and the findings were as below:

The understanding of the respondents can be divided into four different types for data analysis. They are totally understand, understand, average understand and do not understand.

There are 24 % of the respondents who totally understand the cost control system (18 out of 76 respondents), 63% understand the cost control system (48 out of 76 respondents), 13% (10 out of 76 respondents) who average the cost control system and 0% who do not understand the cost control system. This respondent clearly depicts construction professionals are aware of the cost control system in the construction.

4.1. COST REPORT PREPARATION AT SITE

The cost reports are prepared at three different interval time; they are weekly monthly, and quarterly. About 18.42% of the respondents prepared the cost reports weekly (14 out of 76respondents), 47.36% of the respondents prepared the cost reports monthly (36 out of 76 respondents) and 34.21% (26 out of 76 respondents) prepared cost reports quarterly.

Most of the respondents prepared cost reports on monthly basis about 47.36% as shown in Figure 2 This is because they are able to know the actual deviation from the set standards when major portion of the work has begun and another reason was due to the time constraint.

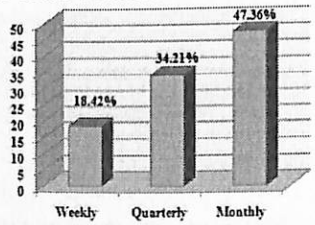

Fig 2. Percentage of interval of cost report preparation **at site**

4.2. COST CONTROL METHODS USED

Through the literature review, three types of cost control methods frequently used by contractors were identified, namely overall profit and loss (overall cost of the project compared to the money received), unit rates (compare actual unit rate to estimate unit rate), and profit and loss based on progress payment. The respondents are asked to rate based on its use.

Percentage of use of cost control methods are divided into five types; most frequently used (MF), frequently used (F), average used (AF), not frequently used (NF) and totally not used (NU) in the questionnaire and the contractors and the site engineers were made to rate them based on its usage.

A. OVERALL PROFIT AND LOSS

In overall profit and loss method, 28.95% respondents most frequently used it (22 out of 76 respondents), 9.21% frequently used it (7 out of 76 respondents), 23.68% average frequently used it (18 out of 76 respondents), 9.21 not frequently used it (7 out of 76 respondents) and 28.95% not used the method at all (22 out of 76 respondents).

Figure 3 shows that because most of the contractors aim at obtaining the maximum profit rather than ensuring the quality of the work, they lend up subcontracting the works by keeping certain per cent of profit within them with the method being frequently used (28.95%).

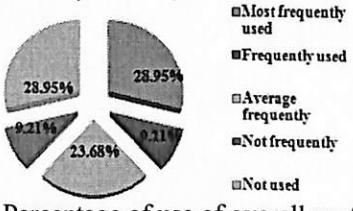

Fig 3. Percentage of use of overall profit and loss method

B. UNIT RATE METHOD

In the Unit Rate Method, 38.16% of the respondents showed that engineers and contractors most frequently use it (29 out of 76 respondents), 23.7% frequently use it (18 out of 76 respondents), 14.5% average frequently use it (11 out of 76 respondents), 5.3% not frequently used it (4 out of 76 respondents) and 14% not used it (18.34% out of 76 respondents).

From Figure 4 it is clear that, woks are carried out based on unit rate (38.16%) and very few are in negligence with this method with a percentage of 5.3%. This is because most of the contractors are not well aware as works are being mostly carried out by engineer. Also site engineers are ensured to obtain maximum quality of the work within the allocated budget as per unit rate.

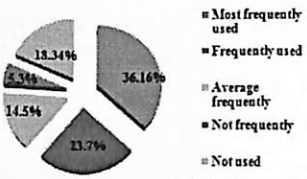

Fig 4. Percentage use of Unit Rate Method

C. PROFIT AND LOSS BASED ON DAILY PROGRESS PAYMENT

In the Profit or Loss Method based on progress payment, 19.7% of respondents responded most frequently use it (15 out of 76 respondents), 9.2% frequently use it (7 out of 76 respondents), 9.2% average frequently use it (7 out of 76 respondents), 19.7 of respondents not frequently used it (15 out of 76 respondents) and 42.2% not use it at all (32 out of 76 respondents).

Figure 5 illustrates the percentage of use of Profit orLoss Method based on daily payment by the contractors and site engineer in general.

It is clear from Figure 5; this method is not used much about 42.2% of the respondents. This method is not much in use since laborers despite having adequate skills, they do not work sincerely and rather work is given on piece-work basis as the efficiency of the laborer increases considerably.

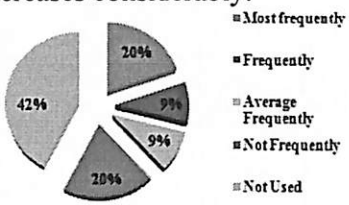

Fig5. Percentage of use of Profit or loss Method based on daily progress payment

4.3 COMPARISON BETWEEN COST CONTROL METHOD ADOPTED BY SITE ENGINEERS AND CONTRACTORS

Figure 6 shows the cost control method most frequently adopted by the site engineers and contractors.About 70% of site engineers use Unit Rate Method. In case of contractors, overall Profit and Loss Method is found to be most frequently adopted method with a percentage usage of about 66%.The prime reason are most of the site engineers try to achieve quality work and so their worksare based on unit rate method. Also site engineers use it to find the budget requirement of the project. The work is done to earn profit irrespective of quality of work in the case of contractors generally.

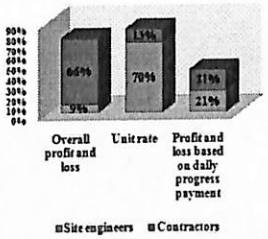

Fig6. Percentage of use of methods by site engineers and contractors

Table 2 Mean of factors affecting cost of construction

Sl. No.	Factors affecting cost over-run	AI	Rank
1	Frequent design change	1.28	1
2	Delay in material procure-ment	1.37	2
3	Changes in material speci-fications and type	1.50	3
4	Mistakes during construc-tion	1.54	4
5	Mistakes and error in de-sign	1.55	5
6	Shortage of technical per-sonnel	1.62	6
7	Labor productivity	1.64	7
8	Poor design and delay in design	1.64	8
9	High cost of labor	1.74	9
10	Price fluctuation	1.82	10
11	Lack of experience of technical consultants	1.88	11
12	Policy in biding tender to the lowest price one	1.92	12
13	Poor financial control on site	1.99	13
14	Impractical and complicat-ed design	2.00	14
15	High cost of machinery and its maintenance	2.00	15

4.4. IDENTIFICATION OF FACTORS CAUSING COST OVERRUN IN THE CONSTRUCTION

The causes of cost overrun from the questionnaire surveys are identified based on respondent's response on each variables of cost overrun in causing cost overrun. The respondents were asked to rate their agreement on each particular variables of cost overrun.

The factors affecting cost of construction (cost overruns) are found to be reliable with the Cronbach's Alpha Value of 0.995(α>0.9) and also Split-half coefficient value of 0.983 which is greater than 0.9 indicated that the factors are reliable and closely correlated.

A. RANKING OF FACTORS AFFECTING COST OF CONSTRUCTION

According to their mean values, each of the factors is ranked in Table 2. The mean values of each factor affecting the cost of construction are calculated manually by average index based on rating given by the contractors on Likert scale basis and compared with the values obtained from SPSS analysis.

Table 2 represents the top 15 factors affecting cost of construction. It is observed that the five major factor affecting the construction cost are frequent design change (AI=1.28), delay in material procurement (AI=1.37), changes in material specifications(AI=1.5), mistakes during construction (AI=1.54), mistakes and error in design(AI=1.55)etc. Whereas accident on site related causes of cost overrun are rarely accounted in the Bhutanese construction projects.

Design change is the most important factor as it inhibits the ability to control cost and time of construction. This is because when the design of a particular project is changed, more time is taken in preparing the new design and also the cost deviates from the original budget taking into consideration of the new design. In Bhutanese construction industry, design change occurs mostly due to change of client's requirements, additional work, and mistakes in design and site conditions. Most of the Bhutanese contractors incur over budget of the project due to design change during the implementation of the work.

Delay in material procurement (AI-1.37) is also significant in our country since as most of the resources are to be purchased from neighboring country. And country's terrain

is such that it is very difficult to transport the material on time.

Bhutan	UK
Frequent design change (RI=0.26)	Design changes (RI=0.94)
Delay in material procurement (RI=0.27)	Risk and uncertainty associated with projects (RI=0.89)
Changes in material specifications and type (RI=0.30)	Inaccurate evaluation of projects time/duration (RI=0.86)
Mistakes during construction (RI=0.31)	Non-performance of subcontractors and nominated suppliers (RI=0.82)
Mistakes and error in design (RI=0.31)	Complexity of works (RI=0.81)
Shortage of technical personnel (RI=0.32)	Conflict between project parties (RI=0.81)
Poor design and delay in design (RI=0.33)	Discrepancies in contract document(RI-0.80)
Labourproductivity (RI=0.33)	Inflation of prices (RI=0.79)

Shortage of technical personnel (AI-1.62) and labor productivity (AI-1.64) cumulatively leads to increase in cost. As our country is at developing stage, lots of construction works are taking place whereby the demand for the labors and technical personnel increases ultimately leading to shortage of technical personal and decrease in labor productivity.

4.5. COST CONTROL TECHNIQUES ADOPTED BY CONTRACTORS

Figure 6 illustrates the extent to which the different techniques where used by the subjects to control cost. The techniques most frequently used was site meeting (19.28%) which was used to review the progress of the work and to compare the monetary allocations. The site meeting helped them in motivating the workers and thus helped speed up the work.

Record keeping was second (18.44%), which helped in early detection of the deviations from the set standards through the documentation of the works. This helped them in avoiding the errors and mistakes in other construction projects undertaken by same firm. Work programmes were third in list (18%) and followed by inspection of work (16.18%). Inspection of work helped to judge whether the budget is in accordance to the works done or lacking.

Evaluation of the works (15.15%) was by observing how much had been executed and comparing with the money allocated. The least used amongst the techniques was monitoring and cost performance (13%).This is because it is very difficult to monitor the work daily. Control of material wastage on site and cost benefit analysis was suggested by respondents beside the mentioned techniques.

Table 3. Comparison of factors affecting cost of construction

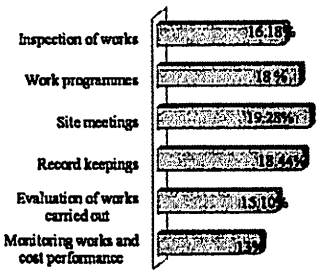

Fig7. Percentage of use of cost control techniques used at site

4.6 COMPARATIVE STUDY

The objective of this section is to give a general view about the causes of cost overrun among developing countries and developed countries. As compared to other studies conducted, particularly study conducted in U.K (Awale & Sun,2004) is adopted for comparison to identify more cost related factors and effects of factors on construction costs. The factors have been assigned rank in relation to their relative importance index (RII).

Design change is the most significant factor affecting the cost of construction and is ranked 1st in Bhutan. This is because more time was taken in preparation of new design, change in specification of the materials, client's requirement. It is also at top rank in UK due to general decline in the production of detailed design.

Delay in material procurement is the second leading factor (Ranked 2) as most of the materials procured are from other countries. This result in delay of most of the critical activities in the schedule and consequently result to delay of whole project and cost overrun in long run. Whereas in UK, risk and uncertainty associated with projects is ranked second. Regarding the risk and uncertainties, risks are mostly not allocated a cost and time implication during risk management and this can often make it difficult to assess their impact on the cost and time objectives of construction projects during control.

The comparison shows that even developed countries like UK face the problem on the way of advancement. That is, lack of appropriate software and work complexity contribute to increase in project cost. Although these researches are not definitely similar about the purpose and methods of survey, but the comparison helped to understand the problems of construction projects in different countries especially between Bhutan and U.K.

4.7 MEASURES TO MINIMIZE COST

The measures to minimize cost are obvious to the experienced practitioner, but are useful to the less experienced and people new to the project management profession. The study should be viewed as the first effort in developing solutions for mitigating cost control inhibiting factors. Some of these measures are outlined what need to be done, but do not address how they can be achieved.

The most effective measure of minimizing construction cost is:
Ensure efficient time management through proper resource planning, duration estimation and schedule development and control. This will help prevent the risk of change in design especially during the time of implementation.

- Allow sufficient time for feasibility studies, design, planning and tender submission. This will help reduce error and mistakes in design.

- Mechanization of construction process would help in reducing the cost of construction irrespective of plant breakdown cost and other miscellaneous items. Alinaitwe (2006) found in Uganda that the use of machines at the building sites are insignificant yet the mechanization of construction can reduce the cost of buildings by 30%.
- To effectively control the cost, the project must be done on lump-sum contract. It is one of the effective methods of controlling cost and achieves quality within the allocated budget, but the estimates must be accurate.
- To improve on the labour productivity on sites, activity such as recording laborer's work progress, daily work evaluation, recruitment of laborers with the right skills for the job, substituting labourers with equipment, and having schedules and proper control procedure and records in place as identified in the study.

5. CONCLUSION

Financial resources are so scarce in developing countries like Bhutan, hence, cost related issues in the Bhutanese construction industry are sensitive issues. Therefore,

carrying out a research in this area was of paramount importance. Hence, the aim of the this research was to control the cost through study of various factors affecting cost of construction, cost control techniques and methods adopted by contractors, and measures that would help minimize the cost.

The major factors affecting construction cost were found to include: Frequent design change (AI=1.28),Delay in material procurement (AI=1.37), Changes in material specifications and type(AI=1.5), Mistakes during construction(AI=1.54),Mistakes and error in design (AI=1.55), Shortage of technical personnel (AI=1.62), Labour productivity (AI=1.64), Poor design and delay in design (AI=1.64), High cost of labour (AI=1.74), Price fluctuation (AI=1.82).

There are six cost control techniques adopted by the contractors on site which include use of: Evaluation of works carried out (15.10%), Monitoring of works and cost performance (13.00%), Record keepings (18.44%), Site meetings (19.28%), Inspection of works (16.18%), Work programmes(18.00%). Among the six methods, most frequently used techniques are site meetings (19.28%) and record keepings (18.44%). The techniques that are least adopted are monitoring and cost performance with 13% response.

From the study, the cost control method frequently used by the contractors during the construction is overall profit or loss, unit rates, profits or loss based on daily payment and also lump sum contract system is followed.

The method most widely adopted by the contractors was found to be based on overall profit or loss (66%) as compared to that of unit rates and profit or loss based on daily payment.

6. RECOMMENDATIONS

The following recommendations are deduced from this study in minimizing the cost:

- Much focus should be placed on the major factors affecting construction cost in order to reduce the cost of construction cost, enhance construction performance and generate confidence within the construction industry.
- Procurement of construction materials and other items must be done in collaboration with the client ahead of time. This would help prevent wastage during procurement which result from can result from one or more of the following causes: buying materials of wrong specifications, buying more than the actual requirements to cater for unrealistic and unforeseen eventualities, untimely buying of short-life materials, improper and unnecessary handling of materials, and wastage in transportation.
- There should be proper coordination and communication among various parties working on the project in order to improve management, control problems and reduce any avoidable delay.
- There should be thorough cross-checking of estimates based on updated price information in order to avoid any wrong estimation.
- Clients should clearly identify their requirements and needs, whether they are able to achieve them with their financial capability in order to reduce payment problems.

- The duration of the project should be estimated accurately. This could help avoid delay in construction.
- Lump sum contract system should be adopted so as to keep project within budget. It has the advantage of avoiding client's interference in project.

7. FUTURE SCOPE OF THE STUDY

After the study, some of the future studies that could be carried out are:

- In current research, the severity of occurrence of factors affecting cost of construction is not known. So, an exercise can be conducted to find out the impact of these factors in relation to their occurrence pattern and their severity impact.
- In this study, the impact and effectiveness of cost control techniques/ methods are not being studied in this research. So an exercise can be conducted to determine the impact and effetiveness of these control techniques in detail. And also measure for controlling cost could be broadly studied in future studies. The manner in which this process proceeds is not studied in detail.

•The current research is much more focused around contractors and site engineers. So, study can be conducted among other stakeholders especially construction managers, clients, consultants for their perspective as to these cost overrun factors and their patterns. Their input can be useful to have a broad picture of cost overrun on construction projects in Bhutan.

•In future, there is scope to explore SPSS software and used for interpretation of results beside the reliability check and also comprehensive study should be made on questionnaire design for data input in SPSS software.

•In future, research can be conducted to cover all parts of Bhutan to identify the problems faced by the contractors in controlling cost and the measure adopted to overcome them to give the broader picture the study.

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