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Construction Subcontracting Attributes for Township Projects in Vidarbha: A Review

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Abstract: *The construction projects are scaling up in the Vidarbha region with growing demand for the housing units. The residential township projects are required to meet the modern trends thus demanding construction of various facilities over the basic brick and concrete construction. The item involved may be as varied as landscaping to drainage, thus demands more strategic and long-term partnering with the subcontractors. Studying some of the accessible research work carried out by various researchers over subcontracting practices, factors governing it and to arrive at effective method for subcontracting management. Evaluation of subcontracting is explored in terms of cost, quality, time and capabilities considered while studying various papers. Alongside the researches stress many issues such as timeliness of general contractors, the process of selecting subcontractor, subcontractor bonding, construction insurance, safety issues, partnering arrangements and productivity issues. The aim to arrive on system that represents a structured method for making subcontracting decisions. This paper served as a summary of literature review done on with respect to the issues with subcontracting.*

Keywords: Subcontracting, Cost, Quality, Time, Capabilities

I. INTRODUCTION

Subcontractor is a construction firm that contracts with a general contractor to perform some aspect of the general contractor's work. On many projects, especially building projects, it is common for 80 to 90% of the work to be performed by subcontractors. The key concerns are to arrive at better selection process and adopting method for evaluation and management of subcontractors. The operations of the average general contractor are not sufficiently extensive to afford full-time employment of skilled craftsmen in each of the several trade classifications needed in the field, nor is it feasible for these companies to own, operate, and maintain specialized equipment that may have only limited use during a project.

Although much may have been said about the need to manage subcontractors, little has been written in the published literature about what specifically a general contractor should do to effectively manage subcontractors. Hsieh (1998) studied the contractor-subcontractor relationship in Taiwan and provided some explanation of theeffects of subcontracting on site productivity. Tommelein and Chua (1998) focused on the task of creating detailed design drawings that are performed by specialty contractors upon award of contracts and illustrated their effect on the efficiency of the production process as a whole. In addition, Sadonioetal. (1998) developed a system that integrates a database systemwith CAD to support the design detailing process.

The subcontractor's performance data is evaluated with respect to strategy, evaluation and management. Its components includes establishment of vision and strategy, goals, categories, evaluation criteria, and indexing. The results are represented as a score, which can be applied as feedback within the management process.

Due to complexity in construction project subcontracting in the construction industry are more than any other industries. Identification of range of issues faced during the implementation of subcontracts in the construction project is important. The study is important to know the various factors of subcontracting. As its identification and assessment may help to achieve possible output within a desired period.

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SUBCONTRACTING EVALUATION AND MANAGEMENT

Supplier selection based on the total cost of ownership, main contractor–subcontractor partnering principles subcontractor rating system, multiattribute utility theories and comparative evaluation. Most of them focus on project-based partnering and have failed to discuss the process of evaluation that enables subcontractor growth in the long term.

DEVELOPMENT OF FUNDAMETAL PRINCIPALS

H. Randolph Thomas, and Christopher J. Flynn (2011), "Fundamental Principles of Subcontractor Management", stresses upon development of fundamental principles of subcontract management. Fundamental principles are actions a general contractor can take it improve job performance. In developing the principles, there was significant interaction with industry professionals. The principles are organized into two broad groupings: managing people and managing the subcontractor's work. There are a total of 21 principles listed. These are easy to comprehend and implement. If implemented, they will likely yield immediate and positive results.[6]

Principle number	Principle
1. Managing people	
1.1	Involve all subs in developing the project schedule
1.2	Build a trust relationship by treating subcontractors fairly
1.3	Do not engage in the practice of bid shopping
1.4	Seek commitments form all parties at a prebid meeting
1.5	Help the subcontractor do timely work by providing assistance and resources as appropriate
1.6	Walk the job frequently; get to know the subcontractor's workers and offer assistance as appropriate
1.7	Host a mandatory prebid meeting; explain expectations to subcontractors prior to bid submission
1.8	Meet regularly with subcontractor supervisor individually
2. Managing the work	
2.1	Identify lead subcontractor
2.2	Write a fair and balanced subcontract
2.3	Develop a submittal schedule and change order log
2.4	Pay subcontractors on time
2.5	Prequalify subcontractors on the basis of their previous work, safety, and financial situation
2.6	Require the subcontractors to hold weekly toolbox meetings
2.7	At regular intervals, evaluate the subcontractor's performance
2.8	Require subcontractors to maintain good housekeeping
2.9	Require subcontractors to maintain safe working practices
2.10	Consider the development of coordination drawings
2.11	Enforce the contract
2.12	Require every proposed change order be reviewed by all subcontractors
2.13	Meet regularly with subcontractors collectively

Fig. 1: Fundamental Principal Development [6]

BALANCED SCORECARD FRAMEWORK

Balanced scorecard framework proposed by Creed S.J. Eom, Seok H. Yun, and Joon H. Peek (1988) in his research work "Subcontractor Evaluation and Management Framework for Strategic Partnering" for evaluation and management of subcontractor. The Balanced Scorecard framework has been considered most influential business ideas within past

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15 years and appears to be most suitable model for managing the characteristics and demands of subcontractor evaluation and management framework.

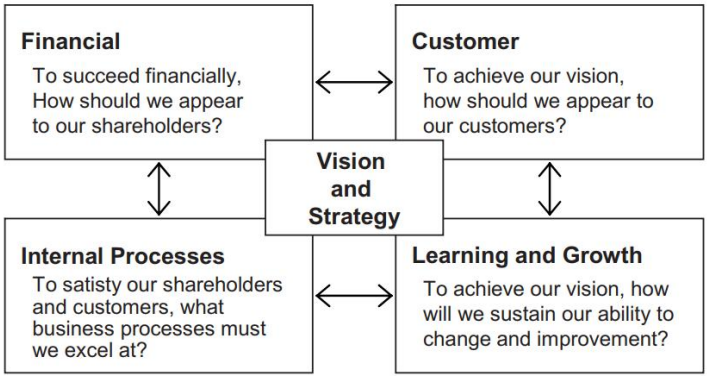

Fig. 2: Balanced Scorecard Framework [2]

Recently, main contractors have shifted their attitudes about subcontract procurement to more and long-term partnering philosophies. The objective of the study carried out by the Authors was to present a framework for subcontract evaluation and management to help main contractor develop more strategic and productive relationships with their subcontractor. The research results obtained are useful as guidelines of subcontractor management for long term partnering. [2]

AVERAGE FREQUENCY ANALYSIS OF QUESTIONNAIRE SURVEY

Questionnaire surveys investigation various issues and factor of subcontracting have been administered in various research studies. David Arditi and RanonChotibhngs (2015) in research work "Issues in subcontracting Practices" investigated general contractors, and construction owners to investigate these issues and to determine the differences in perceptions between the parties. The results confirm the existence of the issues identified in the literature and in addition indicate that (1) the practice of retainage withheld by general contractors seems to be acceptable to many subcontractors unless its magnitude is large relative to the size of the firm; (2) postaward bid shopping by general contractors is sometimes justified, particularly in cases where the scope of subcontract work is modified; and (3) current bonding and insurance practices are adequate unless the additional transferred risks are excessive. Recommen- dations are made on the basis of the findings to minimize the negative effects of said issues.

All questions in the three questionnaires concern issues be- tween subcontractors and general contractors, including payment, selection, bonding and insurance, safety, partnering, and produc- tivity issues. The questionnaires also seek general information about the respondents and include factual questions about current practice and opinion questions about the respondents' views on desired improvements to the system. The questions were worded differently to account for the different groups of respondents.

$$\text{Average frequency} = (3\times A)+(2\times B)+(1\times C)+(0\times D)/\ ((A+B+C+D))$$

The findings are however different from the general wisdom expressed in the literature in some respects:

1. Retainage withheld by general contractors seems acceptable to many subcontractors unless its magnitude is large relative to the size of the firm.
2. Post award bid shopping by general contractors is sometimes justified, particularly in cases where the scope of sub contract work is modified.
3. Most general contractors stated that current bonding and insurance practices are adequate and that there is no need for improvement. Most subcontractors stated that bonding and insurance practices are adequate unless the additional trans-ferred risks are excessive. [3]

RELATIVE IMPROTANT INDEXING OF QUESTIONNAIRE SURVEY

The Relative Importance Index (RII) method used here to rank (R) the different risks. These rankings make it possible to cross-compare the relative importance of the factors as perceived by the five groups of respondents (i.e. Engineer, Architect, Contractors, consultant, and Project manager). Each individual risks' RII perceived by all respondents will be

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used to assess the general and overall rankings in order to give an overall picture of the risks in associated with residential township project during the construction phase in Amravati region. This RII technique is used by many researchers. The Relative importance index is calculated as:

$$RII = \Sigma W / (AN)$$

W = the weight given to each factor by the respondents and ranges from 1 to 5.

COST MINIMIZATION MODEL

Decision support system (DSS) that helps contractors make decisions regarding subletting construction works to subcontractors is proposed by Ashraf M. Elazouni, and Fikry G. Metwally "d-sub: decision support system for subcontracting construction works" (2000). A schematic diagram of the DSS is shown in Fig. 1.

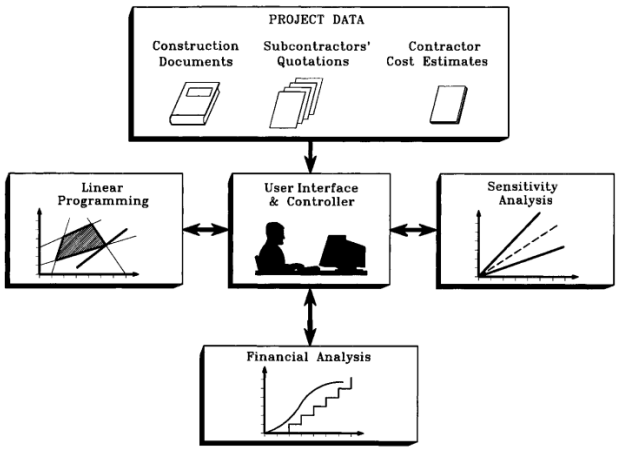

Fig. 3: Schematic Diagram of DSS [1]

A DSS for subcontracting construction works, D-SUB, is equipped with linear programming and financial analysis techniques. The linear programming minimizes the total cost of the contractor, including the cost of the self-achieved and sublet work. The financial analysis function defines the overdraft profile along the project and calculates the expected profit at the end of the project. The DSS have several interesting characteristics, including the following:

- A deterministic model that provides a structured approach for making decisions regarding the most common and frequent practice of subcontracting.
- Aids in terms of assigning work to subcontractors. In addition, it provides indications about the implications of these assignments on overdraft re requirements along the project duration and expected profit at the end of the project.
- An user-friendly interface that facilitates entering project data in table format, checking the entered data, and storing project data. The model formulates the objective function and constraints out of the data entered in the model.
- Sensitivity analysis to enable investigating the economic impact of changes in the objective function coefficients and right-hand values of the constraints

The system encompasses four basic components including project data, linear programming module, sensitivity analysis module, and financial analysis module. The sensitivity analysis adds strength and flexibility to the system by allowing the user to experiment with different scenarios. Finally, the developed system that represents a structured method for making subcontracting decisions is demonstrated through an illustrative example project.[1]

BUYOUT MODEL

David Kelly (2014), proposed buyout model in his research work "Legal, Ethical, and Practical Considerations of Postbid Negotiations in the Award of Building Construction Subcontracts " A model buyout approach is proposed that respects the various contingent parameters at work. Academicians can benefit through thoughtful consideration of the conceptual framework and the suggested research agenda. Likewise, industry participants can benefit by gaining a

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broader understanding of the legal, ethical, and practical aspects of postbid negotiation. Model buyout is a potential pathway forward that is ethical, legal (in most instances), and considerate of all the contingent variables at work in the award of building construction subcontracts. In compliance with all applicable legal constraints, the model buyout is based on absolute prohibition on the disclosure of competing SC prices by the GCs both before the closing of the prime GC bid andduring SC buyout. This stance is then coupled with the execution of a project buyout process as noted by Andreasen et al. (2009) and Zwick and Miller (2004) as summarized in Table 1. Refer to Table 2 and Fig. 1 for a summary and graphic depicting the model buyout approach [4]

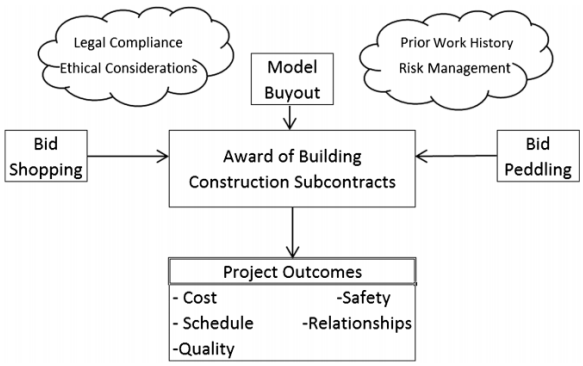

Fig 4: Conceptual framework for investigating the relationship between project outcomes and the postbid negotiation process.

The award of building construction subcontracts is a critical activity in the construction industry. Those in a position to make subcontract awards must be cognizant of the legal, ethical, and contingent risk management factors—all of which may have a direct impact on overall project success or failure. Further research is required to investigate if project performance outcomes (e.g., cost, quality, schedule, safety, and relationships) can be significantly improved through implementation of the proposed model buyout process. Likewise, future qualitative work should evaluate if long term profits, rewarding mutually beneficial relationships, and trust can beadvanced through implementation of the model buyout. [4]

COMPITATIVE MODEL

Hyun-soo Lee1; Joon-oh Seo; Moonseo Park; Han-gukRyu; and Soon-seok Kwon (2009)studied , two profit models—the competitive model and partnership model—were developed to compare the costs involved in competitive relationships and strategic partnerships. The means through which the general contractor's profit is maximized with the proper subcontractor-relationship type were determined for various conditions. The models were constructed by adapting the model of Richardson and Roumasset 1995 for the construction industry. The profit models were designed to present the general contractor's profit from only one subcontracted work with fixed quantities of work in a project, not the total profit of the project. In the models, the type of contract used for the work is a unit price contract. Although this type of contract is based on the estimated quantities and unit prices of the various items included in the project, to design a simplified model, it is assumed that only one type of item is used in the work. According to the contractor-subcontractor relationship type, the profit models have different parameters which reflect various project and subcontracted work conditions.

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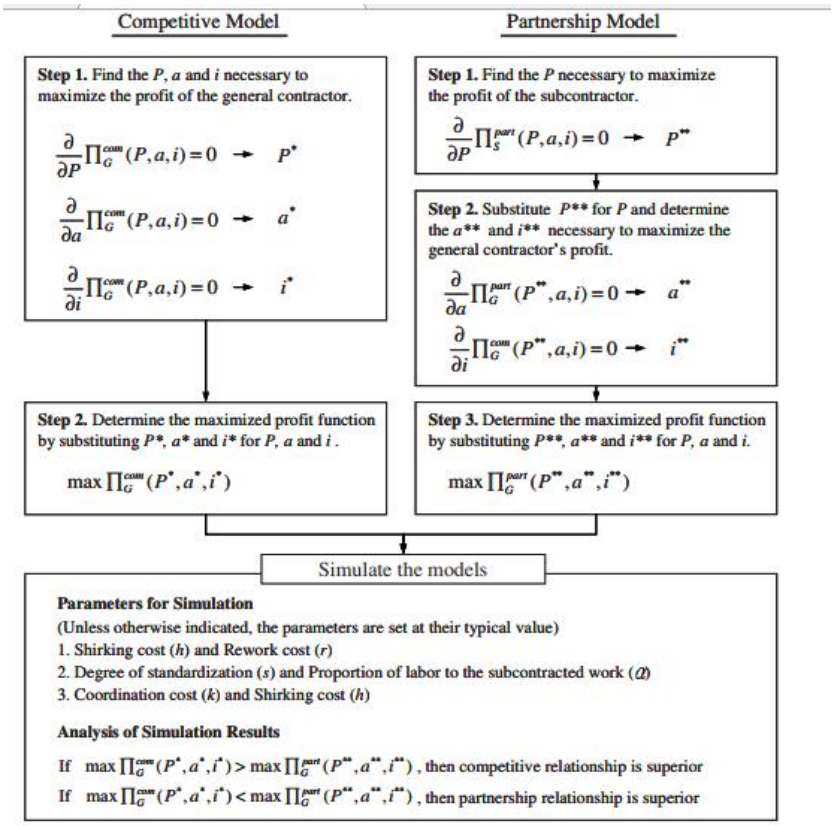

Fig 4: Competitive Model

The following practical guidelines for selecting the most appropriate relationship type were determined. First, it was found that the partnership relationship is superior to the competitive relationship only when general contractors incur a low shirking cost due to subcontractors' opportunistic behavior. This opportunistic behavior results from subcontractors' awareness that they will be less impacted by the negative consequences of poor performance than the general contractor. Therefore, even as the amount of shirking cost incurred by subcontractors increases, their opportunistic behavior can be controlled. [5]

DISCUSSION

The principles described by H. Randolph Thomas, and Christopher J. Flynn (2011), Fundamental Principles of Subcontractor Management", aid in the effective management of subcontracts. They will enhance the team-building concept. Some principles contribute to building trust and maintaining open lines of communication. Other principles concentrate on managing the work performed by subcontractors. The principles are easy to understand and implement and can yield positive results. To establish evaluation and management framework , a case study was conducted by Creed S.J. Eom, Seok H. Yun, and Joon H. Peek (1988) in his research work "Subcontractor Evaluation and Management Framework " using Balanced scorecard framework. The components of study included establishment of vision and strategy, subcontractor evaluation and management goals, four modified categories, designation of 15 evaluation criteria and 25 subcontractor indexes. The research results obtained can be usefuleas guidelines of subcontractor management for long term partnering.

David Arditi and RanonChotibhngs (2015) in research work "Issues in subcontracting Practices"analysed Three sets of questionnaires were written and mailed to the top 450 subcontractors, top 300 contractors, and top 250 owner firms listed by ENR. Responses were received from 124 subcontractors, 66 general contractors, and 33 owners. These firms generate mil- lions of dollars in services, employ a large number of employees, have been active in the industry for many years, and handle a large number of subcontracts. The fact that responding owners are larger than general

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contractors and general contractors are larger than subcontractors reflects the current structure of the industry. One of the limitations of this study is that it surveyed large sub- contractors, general contractors, and owners

The Relative Importance Index (RII) method is used in this sudy in order to conduct analysis on the survey results for capabilities. It is weighted average method in which the average rank for each question is calculated and then the rank for each capability is drived from the average of the ranks of the questions grouped under that capability. Technological capability of USL has been assessed based on the questions.

Decision support system (DSS) that helps contractors make decisions regarding subletting construction works to subcontractors is proposed by Ashraf M. Elazouni, and Fikry G. Metwally "d-sub: decision support system for subcontracting construction works" (2000). DSS for subcontracting construction works, D-SUB, was developed using linear programming and financial analysis techniques. The objective function of the linear programming minimizes the total cost of the contractor, including the cost of the self-achieved and sublet work. The minimization is done subjected to constraints. The constraints express the different reasons the contractor may consider in making decisions regarding the distribution of work items between self-achieved and subcontracted. The financial analysis function defines the overdraft profile along the project and calculates the expected profit at the end of the project.

David Kelly (2014), proposed buyout model in his research work "Legal, Ethical, and Practical Considerations of Postbid Negotiations in the Award of Building Construction Subcontracts "erature is absent quantitative studies investigating the consequences of bid shopping, bid peddling, and the model buyout. Moreover, quantitative studies of the competing legal, ethical, and contingent risk management factors are also recommended. The following research problems and questions need to be addressed: The relationship between project performance (e.g., cost,quality, schedule, safety, and relationships) and the use of bid shopping is not well understood.The relationship between project performance (e.g., cost, quality, schedule, safety, and relationships) and the use of bid peddling is not well understood. The relationship between project performance (e.g., cost, quality, schedule, safety, and relationships) and the use of theproposed model buyout process is not well understood.

Hyun-soo Lee1; Joon-oh Seo; Moonseo Park; Han-gukRyu; and Soon-seok Kwon (2009) studied , two profit models—the competitive model and partnership model. In this paper, two types of construction industry relationships between general contractors and subcontractors were discussed: competitive relationships and strategic partnerships. Based on the argument that construction firms should not use a one-size-fits-all approach for subcontractor management Dyer et al. 1998, this study attempted to determine the conditions under which each relationship type is the most beneficial. The model of Richardson and Roumasset 1995 was adapted to the construction industry to develop two profit models for general contractors and subcontractors in both relationships. Then, these models were simulated for the parameter variations that affect the conditions and characteristics of subcontracted work, and the results were analyzed. Due to the difficulties involved in collecting actual data on transaction costs during construction Constantino and Pietroforte 2002, in the examination of the relative fluctuations of transaction costs, relative values were focused on instead of the absolute values of the parameters. The simulation was conducted for: 1 the significance of subcontracted work to general contractors and subcontractors; 2 the characteristics of the subcontracted work; and 3 the costs affecting general contractors' transaction costs.

CONCLUSION

With the aid of industry professionals, a number of principles for managing subcontracts and subcontractors have been developed. Some principles were contributed by the industry professionals, others were contributed by the authors. The principles are presented in the form of a "to do" list for general contractors. The principles are easy to understand and implement. They are presented as a part of a prescription for productivity improvement and should have an immediate and positive effect on job performance. As the strategic performance feedback model, the balanced scorecard concept was adopted with modification. The research indicated useful guidline of subcontractor management for long term partnering and also to enhance overall productivity within the construction supply chain. Subcontractors are often paid late by general contractors be- cause of pay-when-paid and pay-if-paid clauses included in most contract forms. The consequences of the subcontractors being paid late are grave. In such situations, some subcontrac- tors tend to increase their quotations, which in turn increases total project cost, an undesirable condition for owners. It should be possible to improve subcontractor payment practice if owners pay general contractors on time, and in turn general contractors pay

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their subcontractors right after completion of subcontract work. Retainage is often withheld from subcontractors but is not con- sidered a major problem except for smaller subcontractors, where it causes serious cash flow problems. General contrac- tors should avoid automatically imposing a retainage on sub- contractors, but should consider each individual subcontrac- tor's past work performance before deciding whether retainage is necessary or not. has a user-friendly interface that facilitates entering project data in table format, checking the entered data, and storing project data. The model formulates the objective function and constraints out of the data entered in the model. It incorporates sensitivity analysis to enable investigating the economical impact of changes in the objective function coefficients and right-hand values of the constraints.

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