

# The Analysis of Importance Index to the Dominant Category Causing Contractor Contingency Cost in Aceh Province

Hafnidar A. Rani

Department of Civil Engineering, Universitas Muhammadiyah Aceh, Indonesia

Email: nidarrani@yahoo.com

**Abstract**—Contingency cost is the money provided as the reserve cost to face the uncertainty situation relating to the construction project. The contractor need to allocate some amount of the budget for contingency cost into the offering budget proposed to anticipate the uncertainty situation that could be occurred. The problem raised is what the uncertainty factors affecting contractor contingency cost. From the results of this study are obtained five of the most factors causing uncertainty which affecting contractor contingency cost in the building construction project. These five factors are divided into two dominant categories causing uncertainty which affecting contractor contingency cost in the building construction project based on the three respondent groups which are team financial condition, security and safety in the project location, and team management capability involved.

**Index Terms**—contingency cost, uncertainty, contractor, importance index

## I. INTRODUCTION

The cost estimation is important in construction project. The construction cost estimation calculated before construction physical implementation process done and requiring detail analysis and document compilation because the cost estimation has the impact on the success of the project and the company. The accuracy of the cost estimation depends on the latest information obtained in the construction sector, in addition to the selection of cost estimation type used. Inadequate project management and unrealistic cost estimation become the cause of cost increase in the project implementation. Therefore, the contractors are required to allocate a number of contingency costs into every bidding document submitted in order to anticipate any uncertainties occurred.

Project contingency cost has become one of the important parts in the project management. Most of the studies discussing about the project management especially project cost management, generally have the references of the project contingency cost, such as explained in [1]. Although there are a lot of discussions about project contingency cost in project cost management

theory, but there is still little empirical research carried out on the understanding of project practitioners about this concept, the desired scope and methods to predict or to manage it. It is required to be investigated because contingency cost becomes one of the important factors in the project and the understanding of the people about this concept will affect how they manage the contingency cost. The study aims to identify the uncertainty factors affecting contingency cost in the construction project.

## II. LITERATURE STUDY

### A. Cost Estimation

Cost estimation can be defined as the art to estimate (the art of approximating) the possibility of the amount of costs required for an activity based on the information available at that time [2]. The cost estimation has close relation to the cost analysis, since the work related to cost assessment of the previous activities that will be used as the references to create the cost estimation. In other words, the cost estimation preparation means focus on the future condition, calculating and estimating the condition could possible happen. While the cost analysis focused on assessing and discussing the last activities cost that will be used as input.

There are two types of cost estimation in the project construction depending on work type and contract type used; they are lump sum cost and unit price cost. The components involved in the cost estimation are unit price and work volume. Then the cost estimation is required to identify construction cost components first which are divided into 3 categories mentioned below:

- Direct cost; the cost required by every material that becomes permanent component of the project. Several direct cost components such as; material cost, equipment cost, worker cost and foreman cost
- Indirect cost; the cost required to the management operational need, quality controlling, and the service to project procurement which not become permanent product, but required in the project implementation process. The indirect cost can be divided into:
  - Overhead cost, the indirect cost which used as field and company operation cost as the whole.

- Several example of the overhead cost is bidding cost, assurance cost, direction salary, and others.
- Contingency cost, the cost allocated to cover unpredictable or uncertain condition such as work accidents, mistakes in the selection of the work method, failure of work execution, and others.
  - Other cost
    - Mark-Up, bidding value addition of the estimation calculation to get additional profit or the additional of overhead cost and
    - Profit, the cost to pay contractor service in implementing the construction. The general of profit percentage is 10-15% of the total construction project.
    - Licensing fees.
    - Taxes (PPN is 10% from the total cost).

**B. Contingency Cost**

Contingency cost is defined as the cost reserve of the estimation cost or budget to be allocated on the work item based on experience and implementation of previous projects and becomes one of the integral parts of the total

project cost estimation. According to [3], contingency cost is the amount of funds provided as a reserve to face the uncertainties relating to the project construction.

In order to minimize these costs, beside do the best estimation, the contractors could also complete the uncertainty and lacking of information by discussing directly with project owners or related parties, so it is obtained the right estimation cost. [4] mentioned that in most of the construction budget, always provided the reserve cost for contingency costs or unexpected expenses that occur during the construction. This contingency cost can be allocated into one cost item, or can also be allocated into one category of construction contingency.

There is no standard formula for determining the amount of contingency cost. It depends on the understanding of the contingency costs, the attitude to the risk, cost estimation quality, as well as estimator experience estimator or related contractor company, and project development level when the cost estimation made.

The uncertainty factors affecting the risk of cost increase in the construction implementation can be explained in the Table I.

TABLE I. THE UNCERTAINTY VARIABLES IN BUILDING CONSTRUCTION PROJECT [5]

No.	Category	Contingency Cost Variables
1	Social/culture condition and project area/location	Indication of KKN (Corruption, Collusion, Nepotism) The change of condition around the project location The improvement of the air pollution around the project location The disturbing of the traffic around the project location Noisiness Construction waste The claim of the community surrounding the project location The destroyer by the surrounding community
2	Managerial capacity of the involved team	Not appropriate implementation method The lacking of implementation technology The failure in the coordination among the workers then causing not constant not stable and not smooth of the operation The failure of the main contract in subcontractor implementation monitoring The implementation of the work changing done by subcontractor is not appropriate with the owner expectation because of the mistake of the main contractor instruction The delay of the subcontractor due to the delay of the previous work item affecting The delay of material and equipment procurements The implementation time is not suitable with the schedule The data and activity carried out during the project implementation is not well documented
3	Team financial condition, safety and security in the project	Cost estimation mistake Loose (thief) in the project location Creating the additional facility and temporary road through other land as the access to the project location The safety and security in the project location which is not guaranteed The safety and security in the project location is not good Demonstration, strike or riot by the contractor's workers The dispute between the main contractor worker and the subcontractor worker
4	Construction implementation activity	The supply of material and worker which is not suitable the standard by the contractor/subcontractor The work of contractor/subcontractor is not accepted by the owner The mistake of the work done at night The limitation of human resources The broken/defective of the material or work The damage or loss of the owner properties or other parties because of the work The damage of public facilities because of contractor/subcontractor works The damage or defective of the equipment

#### A. Project Scope Based on Company Classification

According to [6] on the Registration of Integrated Construction Services, which becomes the institution as referred in Construction Services Law, the qualification is the classification of the sector in national construction work implementation service based on level/competency and capacity in construction work sub sector, which are consisted of:

1. Small Qualification, divided into three groups such as, K3 group, K2 group, and K1 group.
2. Medium Quality, divided into two groups such as, M2 group and M1 group.
3. Large Qualification, divided into two groups such as B2 group and B1 group.

#### B. Contract

The contract is an engagement issued in the written document and the contract has been agreed upon by the employer and partner, after being signed, the contract have the law enforcement for both parties signing. It is consisted of contract document containing the requirements and the conditions that must be met to implement the agreed work according to the complaint document.

According to [7] on construction services, there are a lot construction contract models, such as: the government version, national private sector version, and the standard private/foreign standard version.

[5] system is widely used for project contract project using foreign loans or contracts with foreign private and Joint Contract Tribunals (ICT) is widely used by the service user and project owner to commit implementation agreement.

According to [8] in the guidance of the Construction Contract in Indonesia, the forms of construction contracts are based on how to calculate the work cost/lump sum price which will be written in the contract. There are two (2) forms of construction contracts which are often used; they are Fixed Price Lump Sum and Unit Price.

#### C. Risk Management in the Construction Project

The risk can be defined in several viewpoints. From the result or output viewpoint, the risk is an outcome or output that can not be predicted certainty, which is not preferred because it would be contra – productive. Meanwhile, from the process viewpoint, the risk is factors that may affect the objective achievement, so that there is unintended consequence [9].

Risk can be defined as the causing factors of unexpected conditions that can cause the disadvantage, damage, or loss. In the construction project, the risk is defined as the possibility to get failure or loss because of three factors which are time, cost and quality [10]. The risk of project time can be interpreted as a project delay of the determined schedule. The cost risk is defined as the possibility of higher cost deviations than the set budget. While the quality risk is related to the possibility to get the lower quality than the quality determined in the specification standard.

Referred from several concepts above, it can be concluded that the risk is a condition raised because of the uncertainty conditions with the current occurrence opportunities that if they occurred will create unfavorable consequences. Then the risk in the project is the condition in the project occurred because of uncertainty condition with the current occurrence opportunities that if they occurred will create physical and financial consequences which is not unfavorable to the project objective achievements, they are cost, time, project quality [11].

The objective of the project risk management is to improve the probability and impact of positive activities and reduce the probability and impact of the condition which harm the project [12]. Thus through the risk management will be detected appropriate method to avoid / reduce the loss caused by risk. The good risk management can avoid as much as possible of the costs that had to be paid due to the disadvantages occurrence business profit improvement [11].

### III. RESEARCH METHODOLOGY

The data used in this study is interview result of and questionnaire distribution with some respondents in contractor companies selected as the respondents related to offering activities.

The population in this study is the construction service provider located in Aceh Province, with the small, medium and large qualifications registered in the Construction Implementing Association and member of Gapensi in 2015. The sampling technique used is Purposive Sampling. The criteria of sampling as the respondents are mentioned below:

- a. Working in the construction company.
- b. Above 20 years old.
- c. Have been involved in building construction project minimal for 2 years.
- d. The minimal position in the company is field officer or one level above and beyond (project manager).

The each sample of each qualification mentioned below:

- a. The small qualification is 17 respondents.
- b. The medium qualification is 15 respondents.
- c. The large qualification is 5 respondents.

### IV. RESULT AND DISCUSSION

#### A. Validity and Reliability Test

The result of validity test and reliability test carried out can be shown in the Table II and Table III.

TABLE II. VALIDITY TEST

No.	Group	Rs	Information
1	Small – medium	0.771	Valid (rs > 0.3)
2	Small – large	0.320	Valid (rs > 0.3)
3	Medium – large	0.498	Valid (rs > 0.3)

**B. Importance Index (II) Analysis**

The calculation results of Importance Index and the combined mean for five top-ranked based on each respondents group combination to the factor causing uncertainty in the building construction project implementation can be seen in Table IV.

TABLE III. RELIABILITY TEST

Measurement category	Reliability value	Information
Factors of uncertainty the contractor responsibility	0.874	Reliabel ( $\geq 0.6$ )

TABLE IV. RESULT OF IMPORTANCE INDEX

No	Factors of uncertainty	Mean	Rank	Importance Index (II)		
				Small	Medium	Large
1	Loss (theft) in the project location	6.97	1	4.47	4.73	4.73
2	Cost estimation errors	6.96	2	4.59	4.67	4.67
3	Less precise method implementation	6.89	3	4.59	4.60	4.60
4	Delay of materials and equipment procurements	6.81	4	4.29	4.67	4.67
5	Lack of technology implementation	6.80	5	4.53	4.53	4.53

**C. Rank Spearman Correlation Analysis**

While Table IV describes the categories of group identity from uncertainty causing factor in building construction project. There are two categories that became dominant because it is a grouping of these factors. The calculations show that the answers among the respondent groups have correlation, in which  $Z_{counted} > Z_{table}$ , as shown in Table V.

TABLE V. CATEGORIES OF UNCERTAINTY DOMINANT FACTORS

No	Categories	Factors of uncertainty	Mean	Rank
1	Team financial condition, safety and security in the project	Loss (theft) in the project location	6.97	1
		Cost estimation errors	6.96	2
		Less precise method implementation	6.89	3
2	Managerial capacity of the involved team	Delay of materials and equipment procurements	6.81	4
		Lack of technology implementation	6.80	5

**D. Discussion**

Based on ranking results to the answers of the combined respondents, it is obtained that the respondents from all of three groups have a common understanding that team financial condition, safety and security in the project categories become dominant category causing uncertainty

in building construction projects implementation. There are two top factors raised from these categories; they are loss (theft) in the project location, and cost estimation errors. The occurrence is probability happen because of the contractor as the constructor implementer. The company financial failure, whether because of the owner, contractor or subcontractor can cause serious financial problems for the main contractor. The Owner should carefully review the main contractor will be given the responsibility to handle the project. Meanwhile the main contractor must also carefully review the qualifications of subcontractors who will be involved in project implementation. This is because the failure of a party to run the responsibility or failure paying the bill on the other parties will substantially cause delays in project implementation so that the project cost could be higher.

The understanding of the uncertainty sources, the relationship between the uncertainty which may create the risk and the impact risks to the project implementation cost is very important for contractors and helping in decision making faced.

The project estimation cost become important element in managing the overall project cost because it has a very comprehensive functionality in planning and controlling the resources such as material, worker, time and others. Before carrying out the project implementation activity, the cost estimation is required to be done as accurately as possible.

Managerial capacity of the involved team categories become the categories that according to respondent groups can contribute to the uncertainty condition of in building construction projects implementation if not managed properly. The lacking of managerial capacity of the project owner, main contractor or subcontractor may cause condition that can create the failure in the implementation, vulnerable to accidents as well as discomfort in the work. It is caused by the lacking of implementation technology.

The various project types require different specialized expertise types. To get better quality work, the subcontractor procurement specialists become common phenomenon in the construction project implementation. Given the differences in each type of project, the technology complexity is used by several equipments, methods and specialized employee required to apply the planning and then the expertise combination pattern of subcontractors required will be different too. On the other word by the available of the subcontractor, the contractor does not need to allocate additional cost for training or specific education. The other important matter is the contractor can easily control the cost, because the contract generally agreed between the contractor and the subcontractor is fixed price contract and the transfer of risk due to the uncertainty that may occur because of subcontractors' performance.

The resources procurements such as materials and equipment in the construction project implementation become the important parts. The use of the material has high percentage of the total project cost, while the availability of equipment with various sizes and types used

must be adapted to the needs on the project location. Therefore, in the selection of materials and equipment suppliers, the contractor must define some criterias beside based on the lowest price, such as the supplier reliability, services offered, the agreed payment requirement, the quality and ability to provide the needs in the unscheduled condition. In order to make the process of material and equipment allocations can be done effectively and efficiently, everything related to the resource should be distinct explained in the contract.

## V. CONCLUSION

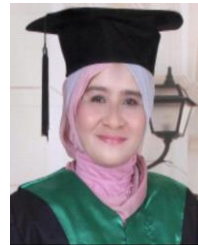
From this study is obtained 5 (five) of the top factors which become the main factors contributing to the uncertainty condition affecting contingency cost in building construction projects implementation, they are loss (theft) in the project location which the mean is 6.97; the cost estimation errors which the mean is 6.96; the less precise method implementation which the mean is 6.89; the delay of materials and equipment procurements which mean is 6.81; and a lack of technology implementation which mean is 6.80. These five factors are divided into two dominant categories causing uncertainty condition affecting contingency cost building construction project implementation based on the responses from the three respondent groups; they are team financial condition, safety and security in the project and the financial condition of the team, safety and security at the project site, and managerial capacity of the involved team.

## REFERENCES

- [1] PMI Standard Committee. *A Guide to the Project Management Body of Knowledge*, PMI USA, 2004.
- [2] I. Soeharto, *Manajemen Proyek (dari Konseptual Sampai Operasional)*, Erlangga, Jakarta, 2001.
- [3] S. Mak and D. Picken, "Using risk analysis to determine construction project contingencies," *Journal of Construction Engineering and Management*, March/April. p.p 130-136, 2000.
- [4] C. Hendrickson, "Project management for construction: Fundamental concepts for owners, engineers, architects and

builders," Departement of Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, 2003.

- [5] Fédération Internationale des Ingénieurs - Conseils International Federation of Consulting Engineers Internationale Vereinigung Beratender Ingenieure (FIDIC). *Persyaratan Kontrak Untuk Pelaksanaan Konstruksi*, MDB Harmonised Edition, 2008.
- [6] National Construction Service Development Institution, Number 5, 2014.
- [7] Long, "Delay and cost overruns in Vietnam large construction project: A comparison with other selected countries," *Korean Society of Civil Engineering Journal of Civil Engineering*, vol. 12, 2008.
- [8] N. Yasin, *Mengenal Kontrak Konstruksi di Indonesia*, Gramedia Pustaka Utama, Jakarta, 2006.
- [9] A. Alijoyo, *Enterprise Risk Management*, PT. Ray Indonesia, Jakarta, 2006.
- [10] A. J. Palmer and S. Male, "Holistic appraisal of value engineering in construction in united states," *Journal of Construction Engineering and Management*, ASCE, December, 1996.
- [11] M. S. Soemarno, "Risiko penggunaan lahan dan analisisnya laboratorium PJP jurusan tanah," Malang 2007.
- [12] Project Management Body of Knowledge. *A Guide to the Project Management of Body Knowledge (PMBOK Guide)*, USA, 2008.



**Hafnidar A. Rani** was born in Aceh on March 14<sup>th</sup>, 1970. She graduated her Bachelor Degree from Syiah Kuala University as a Civil Engineer in 1995. Then she continued her Master Program in Management Magister of Syiah Kuala University and graduated in 2000. She commenced her doctoral program in Construction Project Management of Universiti Utara Malaysia in 2006 and graduated the program in 2012.

After receiving her bachelor degree, she became the Civil Engineering lecturer and teaching in Muhammadiyah Aceh University. Her subjects are Construction Management, Project Management, Research Methodology, Statistic and Probability, Engineering Economic, and Value Engineering.

Dr. Hafnidar has been in her current position as the Dean of Engineering Faculty in Muhammadiyah Aceh University since 2016. She is actively conducting the researches especially in the last 5 years and also participating in seminar and conferences both national and international. In 2012, she also conducted the research for the community dedication which title was Techniques for Earthquake Resistant House Construction in Coastal Areas. She is also active as the keynote speaker in the seminar both national and international and as the reviewer of some Civil Engineering Journals. Her newest guideline book written is Construction Project Management produced in the beginning of 2016.