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Critical Construction Conflicting Factors Identification Using Analytical Hierarchy Process

By Nirmal Kumar Acharya*, Young Dai Lee**, and Jung Ki Kim***

Abstract

The construction industry is dynamic in nature due to increase in uncertainties in technology, budgets, and development processes. Claims and litigation are on a dramatic rise throughout the construction industry. If disputes are not resolved promptly, they tend to drag on and escalate and can cause project delays, lead to claims, require litigation proceedings for resolution, and ultimately destroy business relationships. The purpose of this study is to find out the magnitude of the identified six major construction conflicting factors and responsible parties for those problems. Out of six identified conflicting factors, this study has detected four major factors contributing construction conflict using AHP tool. These four major contributors are: 'change of site condition', 'people interruptions', 'change order evaluation', and 'defective design'. The survey has also revealed the owner as a more responsible party for these conflicting factors and then followed by the consultant. The paper has suggested taking lead role by the owner to manage the conflicts in the construction sites and driving the project toward accomplishment by best planning. A construction conflict prevention model (CCPM) is suggested.

Keywords: *construction projects, conflicting factors, project participants, AHP*

1. Introduction

As a whole, the construction industry worldwide continues to perform unsatisfactorily. According to Chan, Scot and Chan (2004) the construction industry is dynamic in nature due to increase in uncertainties in technology, budgets, and development processes. Nowadays, building projects are becoming much more complex and difficult. Claims and litigation are on a dramatic rise throughout the construction industry (Slater, 1998). It has been suffered from low profit margin; persistent project overruns in schedule and budget, and is plagued with claims and counter-claims. Any shortcoming in the execution of project can derail a project and lead to complicated litigation or arbitration, increased costs, and a breakdown in the parties' communication and relationship (Harmon, 2003).

Most construction problems are minor in the beginning, but they take on mountainous proportions if not addressed quickly by the parties. If disputes are not resolved promptly, they tend to drag on and escalate and can cause project delays, lead to claims, require litigation proceedings for resolution, and ultimately destroy business relationships (Cheung, Henry and Lam, 2002). The ability to manage a conflict successfully depends largely upon recognition of the real causes. The key to successful conflict management must be a fuller appreciation of the varying aspects of conflict; including how and why it arises.

Construction litigation cost is expensive. Estimates of the approximate annual cost of litigation to the construction industry during 1997 in US only are $ 10 billion (cited in Harmon, 2003) and also it takes long time to settle the conflict. After such a long time interval, even the winner could not taste the win enthusiastically. Therefore, conflict should always be a matter of avoiding. We should not work as preparing ourselves for dispute. But, the trend of eruption conflict between various parties in the construction industry is not decreasing due to the various reasons.

There are many literatures and researches about how to analysis construction conflicts and methods to resolve the problems, but there are no such researches about what the root causes of those conflicts are. If we could identify the root causes of construction conflict, then proper measures could be applied before hand. "Prevention is better than cure," that is why; this research has attempted to find out the root factors of the construction conflicts.

This paper is based on the earlier work by Acharya, Lee and Kim (2006) and aimed to find out importance weight of critical construction conflicting factors and responsible parties for those problems. This research has been delimited to the Civil Engineering construction projects in Korea and especially focuses on construction phase. The study has adopted a quantitative research method. The results are drawn from the perceptions of the construction professionals by a field survey. Format of the questionnaire was designed to suit the pair-wise comparison matrix in AHP method.

The study has been composed in several chapters to cover all aspects of the objectives of the paper. Section 2 has reviewed conflicting factors first, and then followed next by the method of

*Ph.D. Candidate, Department of Civil and Construction Engineering, Pukyong National University, Busan; (Corresponding Author, E-mail: nirmal_pknu@yahoo.com)
**Member, Professor, Department of Civil and Construction Engineering, Pukyong National University, Busan (E-mail: ydlee@pknu.ac.kr)
*** Member, Ph.D. Candidate, Department of Civil and Construction Engineering, Pukyong National University, Busan (E-mail: civ@netian.com)

study. Section four discussed about construction conflicting factors and their consequences. AHP method is presented briefly in section five and that followed next by the results and analysis of the data. Section seven suggested some conflict mitigating and preventing measures. Finally, section eight provides limitations of this work and section nine concludes the study.

2. Review of Construction Conflicting Factors

Long *et al.* (2004) have studied common and general problems of construction projects in developing countries taking Vietnam as a case study. They have found five major problems from 62 numbers of identified construction problems. The problems are: i) incompetent designers/contractors, ii) poor estimation and change management, iii) social and technological issues, iv) site related issues, and v) improper techniques and tools. They have divided sources of these construction problems into seven categories namely i) sponsor related ii) owner related, iii) consultant related, iv) contractor related, v) project attributes, vi) coordination related, and vii) environmental related.

According to Miller and Lessard (2001), three major types of risks: market related (41.7%), technical related (37.8%), and institutional/sovereign related (20.5%) occur in large engineering projects. The results were drawn from investigation of 60 large engineering projects across the world. Epstein (2004) has reported that construction problems principally are caused by i) unforeseen or changed project conditions, ii) changes in work, iii) late provision of drawings, access, permits, equipment or materials, iv) inadequate drawings or specifications, and v) interference in the work.

Chan and Suen (2005) carried out a research about disputes in Sino-Foreign Joint Venture (SFJV) construction project in China. They have identified 20 sources of disputes in the research. The most serious problems were: i) payment related (93%), ii) delay of works/extension of time (77%), iii) quality of work, iv) cultural matters (unfamiliar with local conditions) 61%, v) difference in ways of doing things (48%), and vi) legal matters (24%). They have categorized these problems in three sources namely: contractual, cultural and legal. According to Awkul and Ogunlana (2002), large scale construction projects often experience internal and external conflicts. Internal conflicts originate in the form of conflicting requirements from different social groups. Acharya. Lee and Kim (2005) have dealt various conflicting scenarios in building construction projects in Nepal and have suggested six conflict management styles to rescue from those conflicts. Other researchers and scholars e.g. Fisk (2000), Kartam and Kartam (2001), Harmon (2003), Rahman and Kumaraswamy (2004) have viewed similar nature of construction problems in their works.

3. Method of Study

Quantitative research method has been adopted to carry out this study. A thorough literature review has been done for better understanding of the research topic. Earlier work by Acharya *et al.* (2006) was adopted as a base data for this study (Table 1). This data was further studied to find out the importance weightings of the identified conflicting factors and their sources. Questionnaire instruments were prepared as provided in Appendix I in pair-wise comparison matrix format to get the field responses. The rationale behind this motive was that AHP pair-wise comparison matrix method objectively measures the weight of each factor and the sum of the weightings is always unity, therefore ranking or weightage results from AHP is regarded more valid (Fong, 2000) than results for ranking from Likert survey.

Professionals working in owners', consultants', and contractors' organization were the target population. The respondents were asked to indicate the importance of one factor to other in prescribed criteria as presented in Table 2. The questionnaire was distributed by hand to hand, ordinary posts, faxes and e-mails. Some responses were received immediately and some were returned through faxes, posts and emails. Returned data were coded and entered in the software program. The data was analyzed through *Expert Choice* 11 computer software.

4. Discussion about Identified Conflicting Factors

Following subsections discuss about the implications of identified six construction conflicting factors depicted in Table 1.

4.1 Change of Site Condition

This factor is the first most conflicting factor revealed by previous study. Change of site condition is a prominent problem in construction project globally. So, it is not surprised to get this result also in the Korean context. Unforeseen condition of site causes the difficulty in implementation phase. Usually, designers sometimes assume the design factors in difficult site condition, which may be differ during construction works later. Levy (2000) has stated that many disputes arise from problems relating to site work. Since neither architect/engineer nor contractor possesses X-ray vision, even with numerous test

Table 1. Mean Score of Perceived Conflicting Factors (Acharya *et al.*, 2006)

S.N.	Perceived Conflicting Factors	Mean	Ranking			
			Overall	Owner	Consultant	Contractor
1	Change of site condition	2.06	1	2	2	3
2	People interruptions	2.07	2	1	5	2
3	Difference in change order evaluation	2.22	3	3	3	4
4	Design errors	2.31	4	5	1	8
5	Excessive quantity variation	2.38	5	4	6	6
6	Double meaning in specifications	2.39	6	18	4	1

Table 2. Scale of Preference between Two Elements

Intensity of importance	Definition	Explanation
1	Equally preferred	Two criteria are of equal importance
3	Moderately preferred	Experience and judgment slightly favor one criterion over another
5	Strongly preferred	Experience and judgment strongly favor one criterion over another
7	Very strongly preferred	An activity is strongly favored over another and its dominance demonstrated in practice
9	Extremely preferred	The evidence favoring one activity over another is of the highest degree possible of affirmation
2,4,6,8	Intermediate values	Used to represent compromise between the preferences listed above
Reciprocals	Reciprocals for inverse comparison	

borings and geotechnical site investigations, conditions uncovered during excavation operations may be at variance with what one perceived.

4.2 People Protest/Interruptions

Many large civil engineering projects have been jeopardized due to the opposition or protest of local people or advocacy groups. Expropriation of private property, demand for employment in the project, not fulfilling the aspirations of people from the project, demand for share in the project are some of the reasons of people interruptions. Few of major incidences of people and groups protest in Korea are suspension of KTX high speed rail tunneling on Mt. Cheongseong due to Buddhist monk's hunger strike and Green Korea along with local people protests against 15 billion won Sewage treatment plant in Seongnam city in Gyeonggi-do province (Kim, 2003).

The conflict might be erupted badly when the owner tries to overlook the protests and orders the contractor to continue the work, whereas in the same time, the contractor might feel threat to continue the work.

4.3 Change Order Evaluation

Difference in method of change order evaluation is also one of the various problems in construction industry. Tendency of high rate claim by contractor and tendency of low price offer by the owner are the differences of evaluation process. Main reason of this type of conflict is lack of citing clear cut method of change order evaluation in the contract document. It has been acknowledged by many boards and courts that the disruptive impacts of changes cannot be fully and accurately anticipated (Flink, 1998). This finding is also in line with the other researchers like Kartam *et al.* (2001) and Rahman *et al.* (2004).

4.4 Design Errors

Design professionals have accepted that some claims are caused by engineering consultants and designers' own errors and shortcomings (O'Leary, 2002). O'Leary has further argued for this that considering the vast volume of documentation produced for a single building or project, it is impractical to expect completely error-free documents. Also considering the usually lengthy time span of design and construction of the average project, it is not realistic to expect flawless behavior. Experiment motive, inexperience, overconfidence and carelessness of the designers; unfamilarization of site condition and out of date design codes are the sources of design errors.

4.5 Excessive Quantity Variations

Scope changes, revision of design, errors in quantity estimating are the causes of excessive quantity variation. It will be accepted as usual case, if contract quantity varies within ±10 ~ 15% limits. However, it will be questionable to consultant's work, if it exceeds remarkably. Increase in quantity later will certainly increases the cost burden of the project. In a dire strait condition, there could be the problem to manage for that increased cost, and the owner would be in no position to pay the contractor.

4.6 Double Meaning in Specifications

Discrepancies may result due to differences in interpretation of contractual material specifications. Contract specification omissions are frequent, with the undesirable result that decisions have to be waited for or directions given at the job site, with the consequent delays and/or increases in scope of the job. Prominent causes of specification problems might be complicated nature of work, inexperience and vested interest of specification writer, outdated standard, copy paste of other specifications, and negligence.

5. Analytical Hierarchy Process (AHP)

AHP is a very popular tool in decision making in management. It was developed by Thomas Saaty, an American mathematician in early 70's to help individuals and groups deal with multi-criterion decision making problems. This method allows the decision makers to structure complex problems in the form of a hierarchy or a set of integrated levels. In general, the hierarchy has at least three levels: the goal, the criteria and the alternatives (Shen *et al.*, 1998). According to Saaty (1980), a hierarchy can be constructed by creative thinking, recollection and using people's perspectives (cited in Atthirawong, 2002). Saaty (1980) has further noted that there is no set of procedures for generating the levels to be included in the hierarchy.

The pair-wise comparisons are guided by a nine-point scale as depicted in Table 2. Adopting the nine point scale, the experts would be able to express their judgment subjectively. Relative importance of the each of the elements is compared to each other in pair-wise comparison matrix.

The use of the AHP technique enables the decision- maker to structure a complex problem in the form of a simple hierarchy and to evaluate a large number of qualitative and quantitative factors in a systematic manner under multiple criteria (Cheung *et al.*, 2001). In construction industry, successful use of this

technique has been shown by Shen *et al.* (1998) for priority setting in maintenance schedules; Chua *et al.* (1999) for critical success factor; Fong and Choi (2000) for contractor selection; and Cheung *et al.* (2001) for procurement selection method.

6. Analysis of Data and Results

Two sets of question were designed in AHP format to get the data for weightings of conflicting factor and identification of responsible party for those conflicts. First question consisted about weightings of conflicting factors. The respondents were requested to compare six conflicting factors (identified by previous study) for effectiveness over each other in 1 to 9 point scale (refer Table 2) as explained by Saaty (1980).

Second question was about responsible party for the construction problems. Long *et al.* (2004) have categorized seven sources for the construction problem. However, from the nature of identified conflicting factors, this study has adopted only four main sources of problem. They are: owner related, consultant related, contractor related and others related as shown in Fig. 1. Respondents were asked to indicate the degree of responsibility of above defined four sources in 1 to 9 point scale.

6.1 Questionnaire Response and Characteristics of Responding Subjects

150 survey instruments were distributed to government/private owners, reputed and renowned consultants and contractors. A total of 103 questionnaires were returned representing 69% of total sample. Of which, 88 were fully completed representing a response rate of 59% in terms of usable data. Table 3 shows the demographic details (affiliation to organization, years of experience, management position and current working projects) of respondents. The questionnaire was responded by the construction professionals representing owner group (28%), consultant group (42%) and contractor group (30%). Regarding years of experience, respondents from owners' and consultants' groups were in the range of 10-15 years and contractors' group in between 5-10 years.

6.2 Treatment of Data and Results

The research used pair-wise comparison matrix, calculated the weightings of each variable and ranked them. The data were analyzed using the computer software called *Expert Choice*, version 11. The software gives the eigen value of each variable and reports the position of variables in descending order by percentage. A higher percentage indicates the high importance or effects on a goal set over other descending order attributes.

Table 4 shows the dynamic sensitivity (importance weightings) of construction problems by overall responses of principal project participants as well as by individual group. The AHP results are found to be within the permissible CI value (0.10). Consistency index of the overall result is 0.05, which suggests, a reliable result. Similarly individual CI for result of owner, consultant and contractor groups is 0.05, 0.04 and 0.09 respectively.

Table 4 depicts that "Change of site condition" having maximum weighting (24.1%) is the most crucial problem in the construction site and "double meaning of specification (7.1%)" is being the least. However, further study of the result by responses of individual groups reveals that there are wide variations to the importance of the problems among principal project participants. For owners, 'difference in change order evaluation' seems to be most critical, whereas 'change of site condition' is the most important factor for other two groups. It is

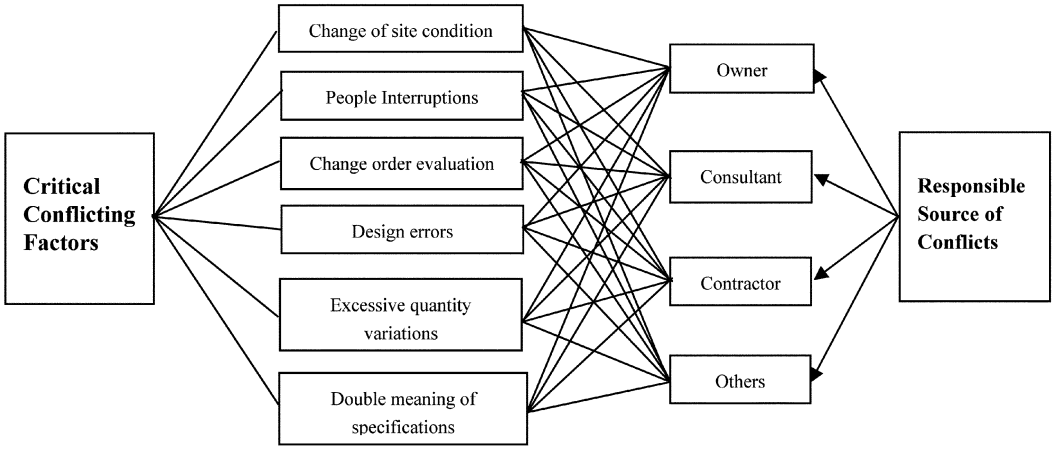

Fig. 1. Sub-hierarchy for Six Conflicting Factors and Responsible Source

Table 3. Respondents by Organization and Years of Experience

Respondents' group	Organization		Experience Years	Management Position	Working project
	N	Percent			
Clients	25	28.4%	10-15 years	Senior-70.2% Middle- 23.4% Junior- 6.4%	Building- 13.7% Road – 43.5% Railway- 22.6% Others – 20.2%
Consultants	37	42.0%	10-15 years		
Contractors	26	30.6%	5-10 years		
Total	88	100			

Table 4. Dynamic Sensitivity of Construction Problems

Perceived variables	Importance Weightings			
	Overall	Owner	Consultant	Contractor
Change of site condition	24.1% (1)	18.9% (3)	27.4% (1)	31.2% (1)
People interruptions	22.5% (2)	25.3% (2)	14.7% (3)	26.4% (2)
Change order evaluation method	21.0% (3)	26.3% (1)	09.8% (4)	23.6% (3)
Defective design	17.1% (4)	14.8% (4)	26.3% (2)	10.6% (4)
Excessive variations	08.2% (5)	08.5% (5)	10.7% (6)	04.5% (5)
Double meaning of specifications	07.1% (6)	06.3% (6)	11.0% (5)	03.7% (6)
Consistency Index (CI)	0.05	0.05	0.04	0.09

Table 5. Comparison of Ranking between Likert-Scale and AHP Survey Results

Perceived variables	Overall	Responsible party		
		Owner	Consultant	Contractor
Change of site condition	I – (1)	III - (2)	I – (2)	I – (3)
People interruptions	II – (2)	II – (1)	III –(5)	II – (2)
Change order evaluation method	III – (3)	I – (3)	IV –(3)	III – (4)
Defective design	IV – (4)	IV – (5)	II – (1)	IV – (8)
Excessive variations	V – (5)	V – (4)	VI – (6)	V – (6)
Double meaning of specifications	VI – (6)	VI – (18)	V – (4)	VI – (1)

interesting to observe that the consultant group has perceived the 'defective design' as the most important factor in second position. Contractors' ranking of importance follows the overall ranking trend, but with unlike values. Owners and consultants ranking are widely differ from each other as well as with the overall values.

6.3 Comparison of Results between Previous Study and AHP Survey

Table 5 compares the ranking result of Likert-scale survey of previous study and present AHP survey. In table 5, roman characters (I, II…) represent the AHP result, whereas numerical (1, 2…) represent the Likert-scale survey. Surprisingly, overall ranking for all the variables by both survey methods are identical. However, the table shows little variations in ranking of individual organization groups between two methods.

6.4 Responsible Party for Conflicts

In the second part of AHP survey, it was intended to know about which party belongs to the perceived six construction conflicts. Table 6 shows the overall results of the conflicts belonging to the party as well as comparison of perceptions among respondents' group.

According to table 6 the owner should be responsible for conflicts or should take major responsibility for four conflicting factors e.g. 'change of site condition (42%)', 'people interruptions (40%)', 'method of change order evaluation (39.1%)' and 'double meaning of specification (37%)'.

Weighting of all of the identified conflicts were found to be more related to the owner than other parties. However, for 'defective design (50.4%)' and 'excessive variations (34.3%)' types of conflict source, the respondents have indicated the designers as a more responsible party. Obviously, owners and designers are the creators of the construction projects; so those problems should be controlled by them prior to the execution of the project.

Table 6 also shows an interesting result about 'people interruptions.' The authors have expected that the source of 'people interruptions' would be related to 'Others' category. However, by contrast, the results of this study showed that the owners should take responsibility for this problem too. By some logic, it is also true. Because, if the project creators do not anticipate consequences of the project or do not involve the important stakeholders in the project planning process; the project might face the problems from concerned stakeholders during work implementation phase.

While observing contractors' response, another interesting result was also surfaced out. According to the results in table 6, Contractors' group does not opinion that the owners are mainly responsible for all the perceived conflicting factors. They have categorically indicated that the consultant is the main responsible party for all of these conflicting factors. Therefore, consultant should take responsibility of these conflicts. This result indicates that the relationship between contractor and consultant might not be harmonious or smooth in construction sites.

7. Managerial Solutions to Conflicting Factors

Appendix II analyses the probable causes of six conflicting factors in construction projects. The effects of these causes could be mitigated through applying various measures. Following sections describe some of conflict avoiding and mitigating measures. Although, in this study contractor was not found in conflicting role however, conflict is always happens to be

Table 6. Responsible Party for Construction Conflicts

Construction conflicts		Responsible party for the conflict (%)				CI
		Owner	Consultant	Contractor	Others	
Change of site condition	**Overall response**	**42.0**	**31.2**	**14.5**	**11.6**	**0.03**
	Owner response	42.0	28.9	16.8	12.3	
	Consultant response	51.9	21.1	15.8	11.2	
	Contractor response	36.1	41.6	11.2	11.2	
People interruptions	**Overall response**	**40.0**	**25.3**	**18.7**	**16.0**	**0.03**
	Owner response	37.6	17.7	24.0	20.7	
	Consultant response	54.6	17.1	17.1	11.3	
	Contractor response	32.0	39.2	14.4	14.4	
Change order evaluation	**Overall response**	**39.1**	**27.6**	**21.0**	**12.3**	**0.03**
	Owner response	34.0	23.9	28.1	14.0	
	Consultant response	48.9	20.4	18.5	12.2	
	Contractor response	37.2	37.2	15.0	10.6	
Defective design	**Overall response**	**25.2**	**50.4**	**13.6**	**10.8**	**0.02**
	Owner response	21.8	53.4	14.5	10.2	
	Consultant response	31.1	43.9	14.6	10.4	
	Contractor response	21.4	55.6	11.2	11.9	
Excessive variations	**Overall response**	**30.3**	**34.3**	**23.0**	**12.4**	**0.01**
	Owner response	28.0	31.2	28.0	12.7	
	Consultant response	35.6	32.6	19.4	12.4	
	Contractor response	27.2	40.1	20.7	12.0	
Double meaning of specification	**Overall response**	**37.0**	**36.3**	**14.9**	**11.8**	**0.02**
	Owner response	31.7	38.9	17.2	12.2	
	Consultant response	51.1	24.3	14.4	10.2	
	Contractor response	30.9	43.5	12.8	12.8	

between two parties. A competent contractor could avoid potential conflicts with justifiable dealings. Therefore, contractor's role in proposed conflict avoiding measures is also suggested. A conflict prevention model has also been developed as shown in Fig. 2.

7.1 Change of Site Condition

- The owner should inquire and assess the contractor's knowledge about the geographical area of the proposed construction site.
- The owner should know as much about the site conditions as possible before entering into the contract by conducting adequate site or subsurface investigations through its geotechnical consultant.
- Separate the case from main contract by change order as soon as possible and include it in another contract with the contractor to be completed later (Samantha, 2002).
- The owner should avoid "disclaimer clauses" or "limiting clauses" in the contract which contain exculpatory (barring) language and require that the contractor assume most, if not all, of the risk of differing site condition.
- Ensure fair and complete disclosure of information at an early stage of the construction project.

7.2 People Interruptions

- By involving stakeholders in the decision making process.
- Exploring various alternate solutions from people, NGOs etc. which involves them in planning process as well as economic and viable options could be also revealed.
- *Outreach program*:

  Planning and constructing public projects from start to finish with the public's input. This can be done with strategic outreach plan. Providing accurate and pertinent information on a timely basis not only educate the community, but also build trust and foster a sense of partnership among the users, neighboring communities and the project office. Outreach program was successfully implemented in road and bridge maintenance projects in New York, USA (Zetlin and Ojar, 2003). The outreach plan involves following process:

  i) Identifying the target audiences (people)
  ii) Determining what information is needed and when
  iii) Deciding on the communications methods (Radio/TV broadcast, pamphlets, Newspaper, public presentations, letters etc.) that will be used to deliver the information (message).
  iv) Teaming up of engineering, communication as well as public relation development consultant. The team would educate the

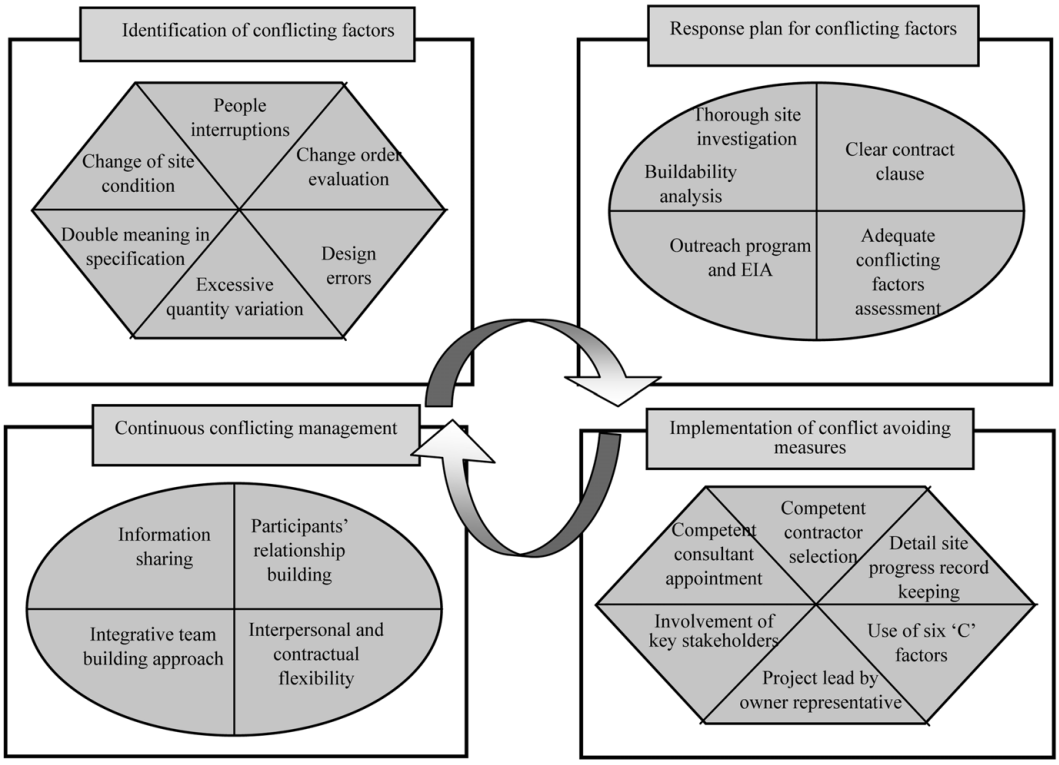

Fig. 2. Construction Conflict Prevention Model (CCPM)

public about how the project would affect them, and also address stakeholders' concern.
- Justifiable compensation of expropriated property
- Conduct environmental impact assessment (EIA).

7.3 Difference in Change Order Evaluation

- Correct method of change order evaluation with example in contract document
- Use of collaboration and compromise (fair deal) management style
- Keeping detail record of change order work

7.4 Design Errors

- An owner should hire a reputable and competent design consultant to reduce likelihood of insufficient plans and specifications.
- An owner contract with the consultant should contain provisions which require and ensure sufficient plans and specifications, and which will give the owner recourse if plans or specifications are insufficient.
- The owner should include in its contract with the consultant an indemnity (protection) clause in the event that a contractor claims for damages in respect of design error, insufficient plans and specifications or deficient or late review of shop drawings by the consultant.
- The designer should thoroughly study local condition of construction sites and design the facilities suitably.
- The contractor, itself should inquire about patent design errors prior to submitting its bid.
- Contractors should also ensure that they adequately review plans and specifications for obvious deficiencies and to alert the owner and consultant in respect of any such defects.

7.5 Excessive Quantity Variation

Extensive project preplanning, confirming site condition and design as well as buildability analysis would prevent scope of work changes during construction phase.

7.6 Double Meaning in Specification

- Appointment of a reputed and experienced not a cheap consultant
- Avoiding cut paste of previous similar specifications
- Writing a field based (practical) specification rather than theoretical based
- Extensive discussion among experts about methods of implementation of specification

8. Limitations

Construction industry is dynamic in nature. Findings of this study tend to be change in the course of time. This study however, was able to indicate some key problems in the construction industry in present context. Follow up studies have to be continued in regular time interval. The relationship between project participants depends upon a number of factors and situation. This result is based on the sample study in the construction sites located in Kyungnam region of Korea.

9. Conclusions

Construction conflict has been jeopardizing the relationship between the project participants. So, it is necessary to find out those conflicting factors before construction work starts. This study used six construction conflicting factors identified in previous work of authors'. These six factors were further studied

in this paper for their importance weightings and responsible parties (sources).

Importance orders of conflicting factors in overall context found similar in both studies' results. Survey results of this study reveal that 'change of site condition (24.1%)', 'people interruptions (22.5%)', and 'change order evaluation method (21%)' are three top most problems in the construction sites. These factors are then followed by 'defective design (17.1%)', 'excessive variations of contract quantity (8.2%),' and 'double meaning of specification (7.1%)'. Furthermore, this study result also shows that the Owner should take major responsibility for four risks (change of site condition, people interruptions, change order evaluation, and double meaning of specifications), whereas the Consultant should take responsibility for 'defective design' and excessive variations' factors. The results are quite obvious to the real situation of construction sites. Nonetheless, this study was able to detect the magnitude of the effect of conflicts in construction sites and responsibility of the principal participants for the risk sharing.

This study would like to suggest taking leading role in the construction project by the owner than consultant group. As four conflicting factors 'change of site condition', 'people interruptions', 'change order evaluation', and 'defective design' have the major implications in the construction projects; these factors should be controlled by giving more time for detail investigation of site, encouraging full participation of the local people and their advocacy group right from the project planning process, citing precisely methods of change order evaluation in the contract document and avoiding design experiment by the designers.

It is hoped that this study will be helpful to project implementers to execute the projects as a conflict free or minimal conflict-prone project. It is also believed that this study has provided a base for further researches in the construction field.

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Appendix

Appendix I: Survey questionnaire (AHP) for importance weighting and responsible parties of conflicting factor

This survey is the extension of previous survey to identify critical construction conflicting factors. The purpose of this study is to evaluate importance weighting of six conflicting factors and responsible parties by AHP method. You are requested to rate the criticality of six factors as well as most responsible party for those factors as per the given rating scales.

1. Organization affiliation: i. Owner ii. Consultant iii. Contractor iv. Others ( )
2. Job title: 3. Field work experience: ( ) yrs.
4. Types of project: (1) Building (ii) Road/Railway (iii) Harbor/dam (iv) Watersupply/sanitation (v) Others ( )

Rating scale

1	3	5	7	9
Both indicators are equally important	Weak importance (slightly better than other)	Strong importance (better than other),	Very strongly important (much better than other),	Absolutely important (much better than other)

Please tick (√) at the appropriate cell in regard to criticality of conflicting factor (section A) and responsible party (section B) in its direction from center than other factor at reverse side.

A. Weightings of Conflicting factor

Conflicting factors	Importance Rating									Conflicting factors
	9	7	5	3	1	3	5	7	9	
1. Changed site condition										2. People interruptions
1. Changed site condition										3. Change order evaluation
1. Changed site condition										4. Design error
1. Changed site condition										5. Excessive quantity variation
1. Changed site condition										6. Double meaning specification
2. People interruptions										3. Change order evaluation
2. People interruptions										4. Design error
2. People interruptions										5. Excessive quantity variation
2. People interruptions										6. Double meaning specification
3. Change order evaluation										4. Design error
3. Change order evaluation										5. Excessive quantity variation
3. Change order evaluation										6. Double meaning specification
4. Design error										5. Excessive quantity variation
4. Design error										6. Double meaning specification
5. Excessive quantity variation										6. Double meaning specification

B. Responsible party

(1) Change of site condition

Responsible party	Importance Rating									Responsible party
	9	**7**	**5**	**3**	**1**	**3**	**5**	**7**	**9**	
1. Owner										2. Consultant
1. Owner										3. Contractor
1. Owner										4. Others
2. Consultant										3. Contractor
2. Consultant										4. Others
3. Contractor										4. Others

(2) People interruptions

Responsible party	Importance Rating									Responsible party
	9	7	5	3	1	3	5	7	9	
1. Owner										2. Consultant
1. Owner										3. Contractor
1. Owner										4. Others
2. Consultant										3. Contractor
2. Consultant										4. Others
3. Contractor										4. Others

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(5) Double meaning specification

Responsible party	Importance Rating									Responsible party
	9	7	5	3	1	3	5	7	9	
1. Owner										2. Consultant
1. Owner										3. Contractor
1. Owner										4. Others
2. Consultant										3. Contractor
2. Consultant										4. Others
3. Contractor										4. Others

Appendix II: Cause Factors of Construction Conflict