CHAPTER II

LITERATURE REVIEW

2.1. Disputes in Construction

A construction project involves many parties working together as a team. These parties include owner, consultants, contractor and subcontractors (Susila 2012). There is always a possibility of difference in thoughts, behavior and the way of doing work. This nature makes construction projects are prone to disputes. When disputes happen, they should be solved immediately. If there are any remaining unresolved contracting issues in projects, they can grow as a relationship destroyer (Cheung and Pang 2013). Other researchers, Haugen and Singh (2014) also added if construction disputes are not properly addressed and managed, disputes can undoubtedly give negative impacts on projects.

It is usual for owner, consultants and contractor to deliberate small and simple conflicts in projects, but for larger ones, they cannot be simply handled by negotiation but in the courtroom (Jannadia et al. 2000). Settlement in courtroom is costly, time-consuming, causes delay to the project and has negative effects to the parties involved in the conflict (Steen 1994; Jannadia et al. 2000). The length of time consumed by settling disputes in courtroom can be various. A recent study in India claims that it takes 5 to 15 years to finalize a dispute and as a result, persons involved in the conflict feel frustrated because of the long duration of dispute settlement (Iyer et al. 2008). However, conflicts and disputes are reality in construction projects. It is almost impossible to find a project that perfectly is free of disputes and claims.

Disputes may arise before construction starts, during construction and even when the project has been finished. Furthermore, construction projects are full of uncertainties and contracts are sometimes lack of details and conditions, making contracts unable to confound all possible disputes happening in projects (Cheung and Pang 2013). The key to dispute resolution is promptness in addressing the issues and conducting negotiations with the goal of early settlement. This can be achieved if there is complete, accurate, and indisputable documentation regarding the events surrounding the disagreement.

2.2. Causes of Disputes in Construction Projects

Disputes in construction can arise when goals set are not achieved (Susila, 2012). Semple et al (1994) mentioned that in most cases dispute claims are because of scope changes, weather and access limit to site. Earlier before, Williamson (1979) introduced three main roots of conflict causes: behavioral problems, contract problems and technical problems due to lack of experience and uncertainty in projects. Levy (2012) mentioned in his sixth edition book “Project Management in Construction” some reasons that prompt disputes in construction projects:

- incomplete, errors and vagueness project plans and specifications;
- unforeseen subsurface conditions;
- loss of productivity;
- unstable financial condition; and
- change-order work and field conditions that diverge materially from what described in the contracts.

Earlier, Kumaraswamy (1997) identified causes of disputes in construction projects and divided them into two categories; *root* and *proximate*. Root causes include:

- unfair risk allocation;
- unrealistic time/cost/quality targets by clients;
- adversarial industry culture;
- inappropriate contract type; and
- unrealistic information expectation.

Proximate causes include:

- inadequate brief;
- slow client responses;
- inaccurate design information;
- inaccurate design documentation;
- inappropriate contract form;
- inadequate contract administration; and
- inappropriate contractor selection

Root causes are defined as fundamental reasons of the issue but are dismissible to prevent the problems or them getting bigger. Meanwhile, proximate causes are defined as those causes that have direct effects to the project.

Jahren and Dammeier (1990) found out that “Societal expectations” and “Nature of industry” became the main causes of disputes in projects. “Societal expectations” is defined as society’s denial of risky situations. Society tends to promptly file lawsuits rather than accepting the difficulties or errors that possibly exist in projects. Meanwhile, “Nature of industry” is defined as those risks, uncertainties, and unexpected errors in projects.

Common dispute causes have been summarized by Cakmak (2014) in his research in Turkey construction industry. The causes of disputes are classified into 7 broad categories, which are owner related, contractor related, design related, contract related, human behavior related, project related and external factors. He sums up the causes into a table, as shown on table 2.1.

Table 2.1. Common causes of disputes by categories (Cakmak, 2014)

Category of disputes	Causes of disputes
Owner related	Variations initiated by owner Change of scope Late giving of possession Acceleration Unrealistic expectation Payment delays
Contractor related	Delays in work progress Time extensions Financial failure of the contractor Technical inadequacy of the contractor Tendering Quality of works
Design related	Design errors Inadequate / incomplete specifications Quality of design Availability of information
Contract related	Ambiguities in contract documents Different interpretations of the contract provisions Risk allocation Other contractual problems
Human behavior related	Adversarial culture / controversial culture Lack of communication Lack of team spirit
Project related	Site conditions Unforeseen changes
External factors	Weather Legal and economic factors Fragmented structure of the sector

2.3. Analytic Network Process (ANP)

Analytic Network Process (ANP) approach is multi-criteria decision making and was firstly proposed by Prof. Thomas L Saaty in 1996. Analytic Network Process is the extension of the Analytic Hierarchy Process (AHP). The

2 approaches both accommodate multi-criteria decision making (Lesmes at al. 2009). AHP comprises one goal, some criteria and alternatives and are formed as hierarchy structure. The hierarchy structure consists of relationship between lower level element and the higher-level element. This means that relationship in the AHP goes one way from top to bottom. However, there are many decision problems that cannot be structured as a hierarchy because they require dependences between the alternatives, dependence of the criteria that are on the same level, or dependence of higher level elements on lower level elements (Lesmes at al. 2009). Because of this concern, Saaty developed another alternative called the ANP to facilitate such requirements. The ANP accommodates interrelations between criteria, dependence between alternatives and dependence between higher level elements and lower level elements. Instead of a hierarchy structure, ANP forms networks among its elements.

ANP is a method that allows decision maker to set priorities and choose the best alternative where qualitative and quantitative aspects are considered (Cakmak 2014). The ANP consists of two kind of relationship called inner dependence and outer dependence. Inner dependence is a connection that applies between sub-criteria in a criterion. Normally, a criterion consists of some sub-criteria and inner dependence connections are applied among them. On the other hand, outer dependence is connection that applies between 2 different criteria. These connections are not limited by numbers, which means that any kind of dependence of sub-criteria to another sub-criteria, sub-criteria to alternatives are possible to apply. This makes ANP is a powerful method to model complex decision problem that involve many dependences. The structure of AHP and ANP are shown on figure 2.1.

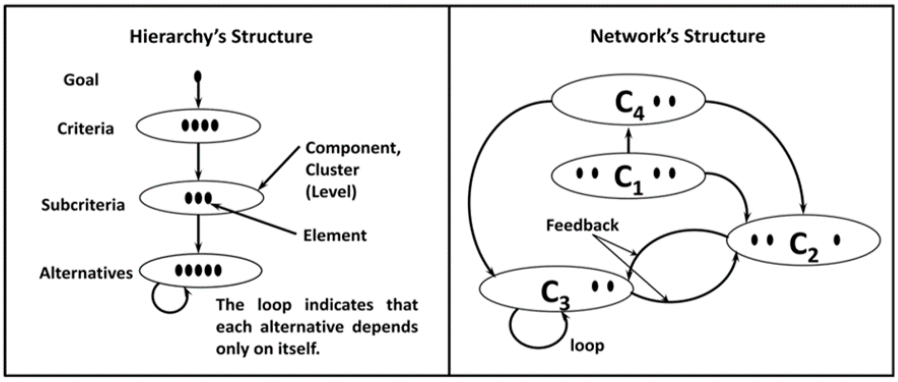

Figure 2.1 Hierarchy's and network's structure (Lesmes et al. 2009)

2.3.1. ANP fundamental scale

In science, measurement depends on the use of scale, most frequently ratio scale (T.L. Saaty, 2008). Different ratio scale are combined by means of formulas which the formulas apply within structures involving variables and their relations under natural laws (T.L. Saaty, 2008). In decision making, there are not set of laws to characterize structures in which relations are predetermined for every decision (T.L. Saaty, 2008). This implies that, understanding is needed to structure the problem and to use judgements to represent importance and preference quantitatively. Judgements should reflect not only knowledge about influences, but furthermore the strengths which these influences lie. These strengths are expressed by humans, especially experts which have experienced the complexity with the concerned problem and through judgements, priorities are derived that reflect numerical intensities (T.L. Saaty, 2008).

Judgements are usually made in qualitative terms and are expressed numerically. To do this, there should be score to assign these judgements that is designed in a carefully scientific way. Of course, it is possible to simply assign someone's judgements arbitrarily by some score but then it should be based on a defined law of measurement which in decision making is not available. Therefore, Saaty designed fundamental scale numbers to express the judgements. These fundamental scale number are presented in table 2.2.

Table 2.2. Saaty's fundamental scale of absolute numbers (T.L. Saaty, 2008)

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favor one activity over another
4	moderate plus	
5	Strong importance	Experience and judgement strongly favor one activity over another
6	Strong plus	
7	Very strong demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order
1.1 - 1.9	When activities are very close a decimal is added to 1 to show their difference as appropriate	Perhaps a better way than assigning the small decimals is to compare two close activities with other widely contrasting ones, favoring the larger one a little over the smaller one when using the 1-9 values
Reciprocals of above	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	A logical assumption

These scale numbers represent ratio scale that can be transformed to other interval or ratio scales respectively. These scale numbers are absolute, which means that these numbers cannot be changed into another number and mean the same thing. From these numbers, priorities can be derived which also belong to an absolute scale of relative numbers whose total sum is equal to 1 (T.L. Saaty, 2008).

To see how these scale numbers work on ANP, see the following problem as an example. Suppose that what drink is most consumed by people in Yogyakarta is to be determined. In general, it is known that drinks that are consumed by people are tea, coffee and water. To use the scale ratio, these drinks are pairwise compared to each other. The comparisons should show which drink is more favorable than another by people. For example between tea and coffee when compared, tea is more favored by people 5 times more than coffee. These numbers represent the strength of a variable over another in ratio scale. These problem example if expressed, will appear as table 2.3.

Table 2.3. Example matrix of drink consumption in Yogyakarta

	Tea	Coffee	Water
Tea	1	5	5
Coffee	0.2	1	1
Water	0.2	1	1

The shaded cells in the table show the scale of element *j* over *i* which in this case is coffee over tea, water over tea and water over coffee. This represents the logical assumption used in the ANP scale number which is called reciprocal.

2.3.2. ANP consistency ratio

Judgements are very subjective in any way. When we use judgements, consistency cannot be ensured (T.L. Saaty, 2008). However, according to Saaty there are some ways to measure the consistency of expert in judgements and how these consistency can be improved. Since, pairwise comparison is based on scientific design and due to limitation of human brains to process information, it becomes difficult to be perfectly consistent. The concept of pairwise comparison is based on mathematics transitive property. If element A is less favored than element B and element A is more favored than element C, then it can be concluded that element B is far more favored than element C. If judgements reflect this concept then judgements are consistent.

What is being measured by consistency ratio is how inconsistent the experts are with their judgements. In pairwise comparison, to satisfy such condition expert must correctly put scale where these ratio would lie after previous judgements are given. In the previously discussed case of elements A, B and C, it is strongly possible if the last judgement where B is compared to C and element C is favored than B by the expert. But how strong element C should be to reach a value of tolerance is measured using consistency ratio. As it is emphasized by Saaty, consistency ratio should not exceed 0.1.

According to T.L. Saaty (2008), if consistency ratio (CR) is still far away larger than desired, these 3 things should be done:

1. Find the most inconsistent judgement in the matrix
2. Determine the range of values to which that judgement can be changed corresponding to which the inconsistency would be improved
3. Ask judge to reconsider, if he can, change his judgement to a plausible value in that range.

If judge is not willing to do so, the decision is postponed until a better understanding of the theory is reached by the judges. Judges who understand theory are always willing to revise their judgements even not to a fully perfect consistency.

3.3.2. ANP application in decision making

Analytic Network Process (ANP) has been applied in various disciplines such as economic, business, marketing, sociology and management (Coulter and Sarkis 2006). In marketing and advertising, ANP has been applied by Coulter and Sarkis (2006) to media budget allocation decision. In construction industry, the ANP has been applied on contractor selection (Cheng and Li 2004). Cheng and Li (2006) has also applied the approach to evaluate job performance for construction companies. Other researcher has applied ANP to analyze causes of disputes in Turkey construction industry (Cakmak 2014). In other discipline, ANP has been used to establish weights to re-accredit a program of a university by Lesmes et al (2009).