International Journal of Smart Home
Vol. 9, No. 7 (2015), pp. 285-292
http://dx.doi.org/10.14257/ijsh.2015.9.7.29

Examination of Thai Construction Safety Factors using the Analytic Hierarchy Process

Thanwadee Chinda

School of Management Technology, Thammasat University, 131 Tiwanont Rd.
Muang Pathumthani 12000 Thailand
thanwadee@siit.tu.ac.th

Abstract

The construction industry is one of the industries with high accident rate. To improve safety standard to compete internationally, the key construction safety factors are examined in this paper utilizing the analytic hierarchy process. The results reveal the Policy factor as the most important factor to improve safety standard. The implementation plan must be practical and include regulations stated in the international safety standards.

Keywords: *Analytic Hierarchy Process, ASEAN Economic Community, Construction Safety*

1. Introduction

The construction industry is the industry with unique characteristics. It, for example, has high turnover rate, and always operates under time and budget pressures [1, 2]. The industry is one of industries in Thailand with high accident rate [3]. According to Whitman Law [4], most construction accidents are from falling from height, being run-over by operating equipment, and electrical accidents. Construction safety is, therefore, needed to raise safety standard and reduce site accident. To reduce the accident record, it is important to understand key safety factors, as well as their important weights, so that the construction company can effectively plan for its safety implementation. Moreover, Thailand, as a member of the ASEAN Economic Community (AEC), needs to focus on improving its construction safety standard, especially ones that are implemented in the AEC countries, to be able to enter the international competition.

This paper, therefore, aims at examining the importance of key construction safety factors, utilizing the analysis hierarchy process method. The interviews with experts in the construction industry are performed to gather data for the analysis. It is expected that Thai construction industry has better understanding of its safety standard, and plan for better safety implementation to compete internationally.

2. Construction Safety Factors

According to Haviriya *et al.*, [5], five key factors in improving safety standard in the Thai construction industry are 1) the Policy factor, 2) the Implementation and Operation factor, 3) the Planning factor, 4) the Checking and Corrective Action factor, and 5) the Management Review factor (see Figure 1).

ISSN: 1975-4094 IJSH
Copyright ⓒ 2015 SERSC

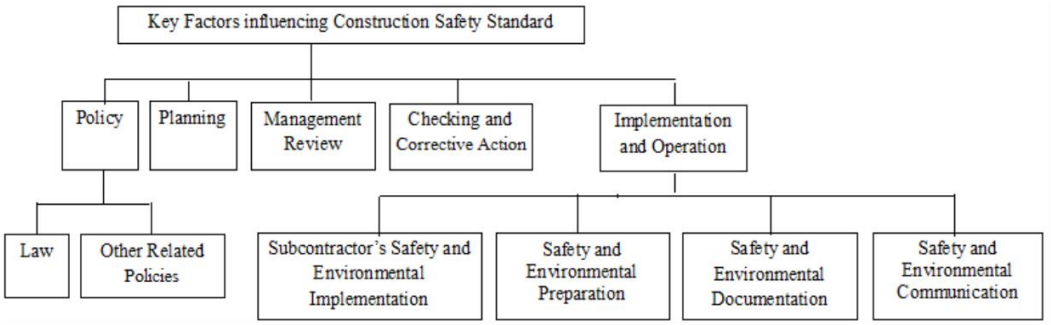

Figure 1. Key Factors Influencing Construction Safety Standard

1) The Policy factor: Top management should clearly state safety policy, and commit to improving health and safety performance. This factor consists of two main attributes, including the "Law" and "Other Related Policies" attributes.
2) The Planning factor: The organization should establish and maintain an effective safety management program.
3) The Management Review factor: Top management should review the safety management system to ensure its continuing suitability, adequacy, and effectiveness.
4) The Checking and Corrective Action factor: The organization should monitor and measure safety performance, and review corrective and preventive actions on a regular basis.
5) The Implementation and Operation factor: Top management should ensure that the safety management system is properly implemented. This factor is associated with four attributes, namely the "Subcontractor's Safety and Environmental Implementation", the "Safety and Environmental Preparation", the "Safety and Environmental Documentation", and the "Safety and Environmental Communication" attributes.

The above five key factors and their total of six attributes are then used to develop the interview questions to collect information for the analytic hierarchy process.

3. Analytic Hierarchy Process of Construction Safety Factors

Analysis hierarchy process (AHP) is a process for ranking level of decided, which based on pairwise comparison to investigate different alternative in the question to make the most effective answer due to answerer. In other words, AHP compares criteria on a ratio scale and incorporates qualitative and quantitative criteria to facilitate the selection of the best alternative [6]. There are eight steps for the analysis, as illustrated in Figure 2 [7].

 Copyright ⓒ 2015 SERSC

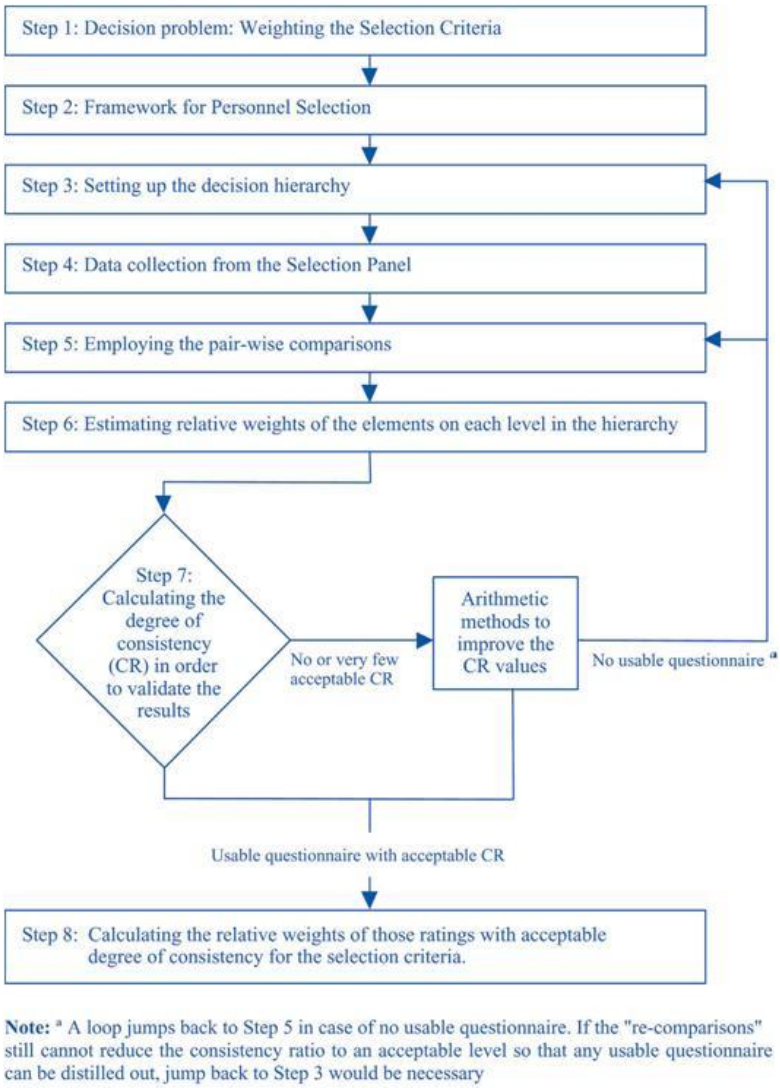

Figure 2. Eight Steps of the AHP Method

In this study, five key factors of construction safety and their total of six attributes are used to develop the interview questions to gather data for the AHP analysis. Each interviewee was asked to rate the intensity of importance between a pair of factors or attributes, pair-by-pair, using the Saaty's scale 1 to 9 of measurement.

- Score of 1 represents equal importance between the two factors/attributes compared.
- Score of 3 means that one factor/attribute is slightly favor over another.
- Score of 5 shows strong importance of one over another.
- Score of 7 means that one factor/attribute is strongly favored over another, and its dominance is demonstrated in practice.
- Score of 9 represents that the importance of one over another is affirmed on the highest possible order.

Example of the interview form of the five key factors is as shown in Figure 3.

Copyright ⓒ 2015 SERSC

No.	Factor/Attribute	Score																	Factor/Attribute
1	Policy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Planning
2	Policy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Implementation and Operation
3	Policy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Checking and Corrective Action
4	Policy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management Review
5	Planning	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Implementation and Operation
6	Planning	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Checking and Corrective Action
7	Planning	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management Review
8	Implementation and Operation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Checking and Corrective Action
9	Implementation and Operation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management Review
10	Checking and Corrective Action	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management Review

Figure 3. Interview Form

The relative weights of components on each level in the hierarchy is calculated from each interview, and is normalized to sum to 100 percent. The average weight of each factor/attribute is then calculated to represent the final weight of each factor/attribute of construction safety.

Six interviewees provided useful data for the analysis. The results are as ahown in Figures 4 to 9. It is clear that majority of the interviewees agree that the Policy factor is the most imporant factor in improving construction safety in Thailand. The interviewees mentioned the company's safety law and policy is crucial in a success safety implementation program. Apart from that, the Implementation and Operation factor is also considered the most important factor among the two interviewees, and that proper safety and environmental preparation and documentation are needed.

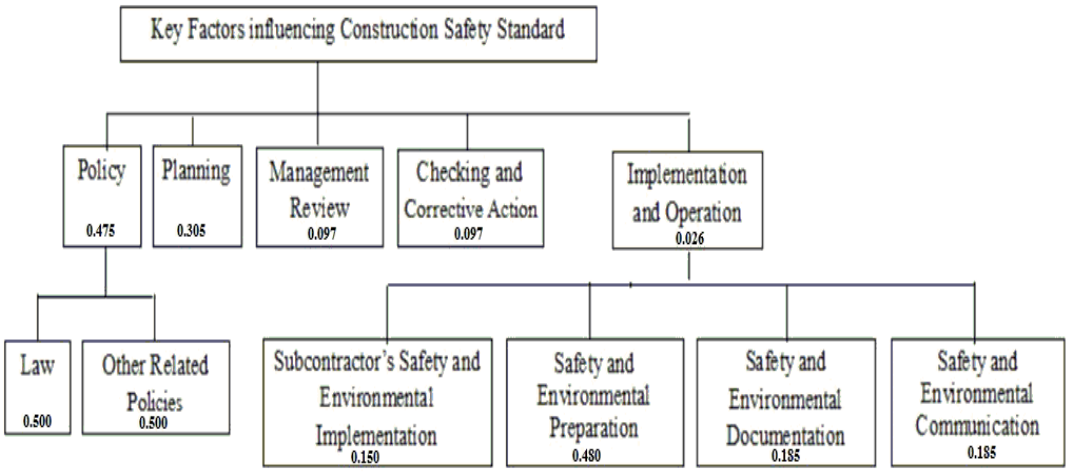

Figure 4. AHP Results of Interviewee 1

Copyright ⓒ 2015 SERSC

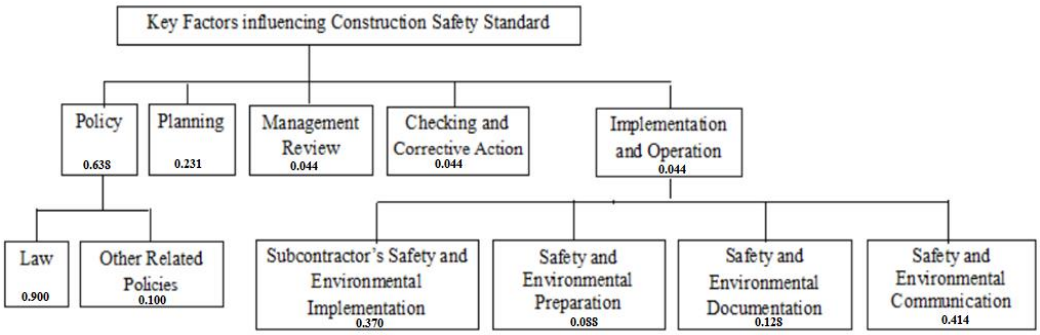

Figure 5. AHP Results of Interviewee 2

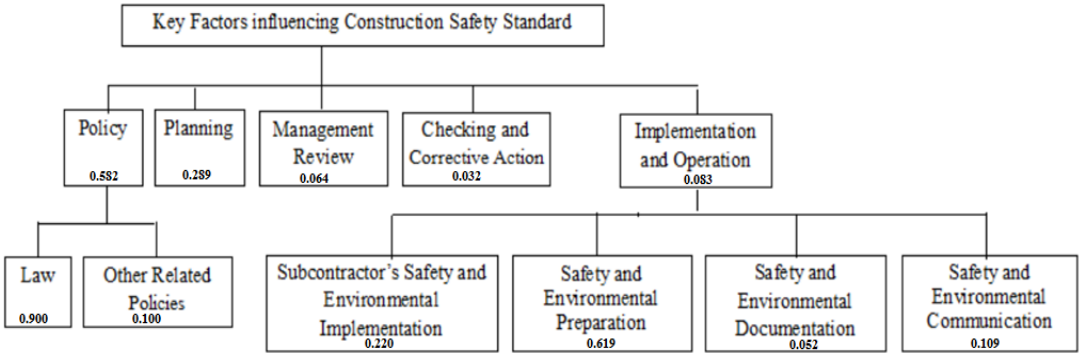

Figure 6. AHP Results of Interviewee 3

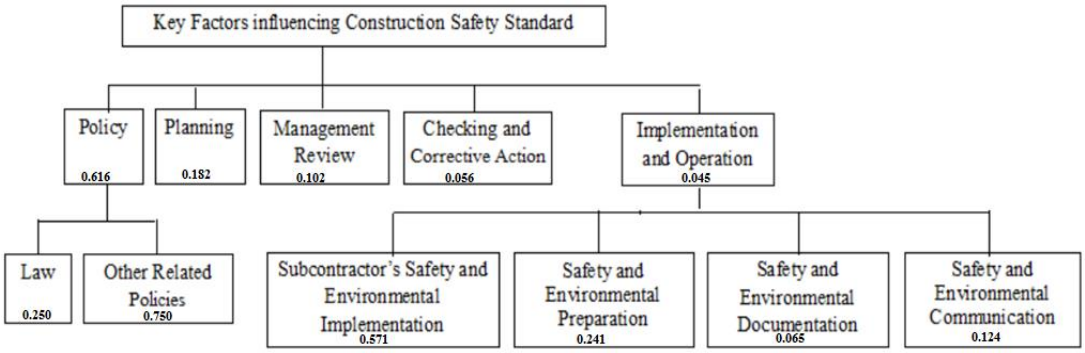

Figure 7. AHP Results of Interviewee 4

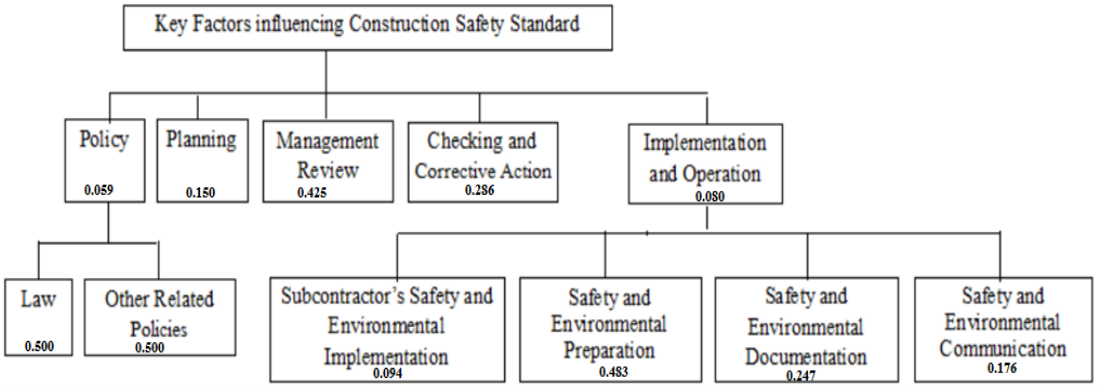

Figure 8. AHP Results of Interviewee 5

Copyright ⓒ 2015 SERSC

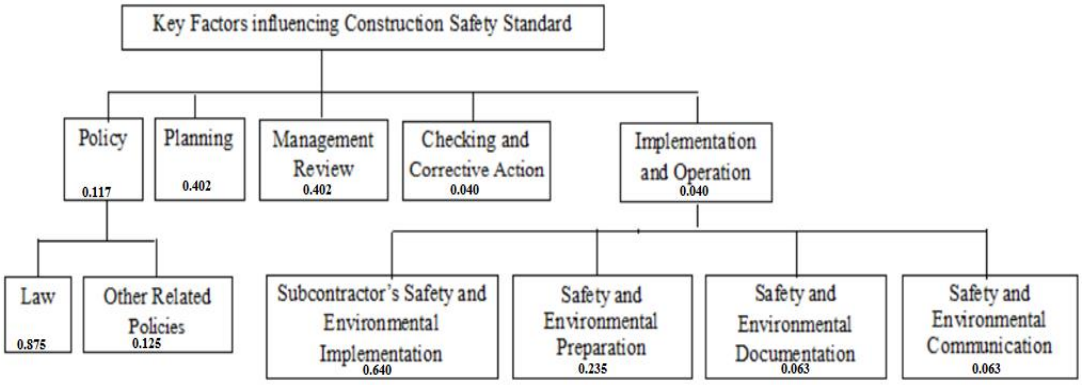

Figure 9. AHP Results of Interviewee 6

The average weight of each factor/attribute is as shown in Figure 10. The results confirm the importance of the Policy factor among the group. It is also seen that the company's safety-related law is as important as other related laws, such as the OHSAS 18001 and the ISO 14001, if the company needs to enter the international competitions.

The company should also establish practical safety plan that includes the risk control and hazard identification. Management should also assigh approapriate safety and environmental responsibilities, is available for safety-related consultation, encourage safety communication, both top-down and bottom-up, and commit to improving safety standard in the company.

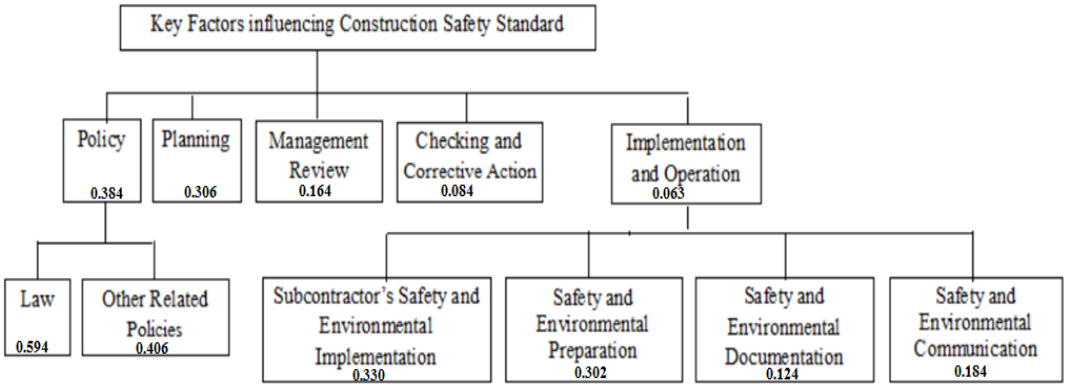

Figure 10. The Average Weights of the Construction Safety Factors/Attributes

4. Conclusion

Thailand, as a member of the ASEAN Economic Community, needs to focus on improving the construction safety standard, to be able to compete internationally. The five key construction safety factors, including 1) the Policy factor, 2) the Implementation and Operation factor, 3) the Planning factor, 4) the Checking and Corrective Action factor, and 5) the Management Review factor, are used to develop the interview questions to collect data for the AHP analysis. The results reveal the Policy factor as the most important factor to improve the construction safety. Practical safety rules and regulation should, therefore, be established. A number of international safety standards should also be considered to raise the company's standard, and compete internationally.

A comparative study could be performed to examine the differences of key factors influencing construction safety standard between developed and developing countries.

 Copyright ⓒ 2015 SERSC

References

[1] W. R. Park and W. B. Chapin, Editors, "Construction Bidding: Strategic Pricing for Profit", 2nd eds,, John Wiley and Sons, Runeson, **(1992)**.
[2] A. Andi, "Construction workers perceptions toward safety culture", Civil Engineering Dimension, vol. 10, no. 1, **(2008)**, pp. 1-6.
[3] Department of Labor. Statistic of accident in 2007-2011. Available at: http://professional projectmanagement.blogspot.com/2009/11/measuring-effectiveness-of-safety.html, [Access 28 March, 2014].
[4] Whitman Law. Types if Construction Site Accidents. Available at: http://www.whitmanlaw.com/aop/personal-injury/construction-accidents.html#construction-accidents [Access 28 March, 2014].
[5] A. Haviriya, N. Sanglertsilapachai, T. Peechapat, W. Chaitummawuth, W. Pattamasirikul and T. Chinda, Editors, "Investigation of Construction Safety Factors for AEC Preparation", Proceedings of the International Conference on challenges in IT, Engineering and Technology (ICCIET'2014), Phuket, Thailand, **(2014)** July 17-18.
[6] A. Shapira and M. Simcha, "AHP-based weighting of factors affecting safety on construction sites with tower cranes", Constr Eng M ASCE, vol. 135, no. 4, **(2009)**, pp. 307-318.
[7] E. W. L. Cheng and H. Li, "Analytic hierarchy process an approach to determine measures for business performance", Measuring Business Excellence, vol. 5, no. 3, **(2001)**, pp. 30-36.

Copyright ⓒ 2015 SERSC

Copyright ⓒ 2015 SERSC