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Prioritizing the countries for BOT nuclear power project using Analytic Hierarchy Process

*Sun Woo Choi*and Myung Sub Roh*
KEPCO International Nuclear Graduate School, 1456-1 Shinam-ri, Seosaeng-myeon, Ulju-gun, Ulsan, Korea
**Corresponding author: swchoigo@gmail.com*

1. Introduction

Developing Build-Own(or Operate)-Transfer (BOT) nuclear power project carrying large capital in the long term requires initially well-made multi-decision which it prevents sorts of risks from unexpected situation of targeted countries. Moreover, the nuclear power project in most case is practically implemented by Government to Government cooperation, so the key concern for such nuclear power project would be naturally focused on the country situation rather than project viability at planning stage. In this regard, it requires the evaluation of targeted countries before involving the project, comprehensive and proper decision making for complex judgment factors, and efficient integration of expert's opinions, etc. Therefore, prioritizing and evaluating the feasibility of country for identification of optimal project region is very meaningful study.

This paper proposes factors influencing the success of BOT nuclear power projects and their weighting method using Analytic Hierarchy Process (AHP) to find the optimal country which developer intends to develop.

2. Research and Analysis Methodology

In order to analyze the feasibility of project country, it is necessary to find the efficient methodology to investigate the factors influencing the BOT project success considering the nuclear characteristic in the country. Also, it is required of distributing the adequate weight of each factor in the whole and developing comparative database of countries with respect to each factor to eventually enable developer to make integrated decision.

In this paper, a multifarious approach is applied in research survey to go over the factors influencing the success of BOT nuclear power project in overseas countries. Firstly, the literature survey was conducted for identifying country-related risks to induce the factors. Secondly, interview to employees from various overseas organizations was implemented for estimating comparative weight through pairwise comparison between such factors. Finally, sorts of country report and academic database and statistical yearbooks were reviewed for developing comparative database of alternate countries with respect to each factor[1].

It is used the Analytic Hierarchy Process for solving multiple criteria decision making problems. AHP is a multiple criteria decision-making method that helps the decision-maker facing a complex problem with multiple conflicting and subjective criteria. It was originally developed by Prof. Thomas L. Saaty(1977). It simplifies preference ratings among factors (decision criteria) using pairwise comparisons, derives priorities among criteria & alternatives and provides measures of judgment consistency[2]. For the prioritizing and evaluating the country, several potential countries which Korea Electric Power Corporation is currently promoting were selected as alternatives and evaluated through Analytic Hierarchy Process. This procedure results in the ranking of the alternatives and provides a consistent and systematic method for carrying out goal-seeking sensitivity analysis of decision maker.

3. Analysis and Results

3.1 Identification of factors and alternatives

The identification of factors influencing the BOT project success was analyzed considering the followings:

Firstly, it was induced the factors by identifying the risks for overseas BOT nuclear power business. There are a number of risks for business, therefore, it was selected the risks related with country environment considering their likelihood and consequence. These risks were arranged by three part, general business risk, BOT project risk and nuclear power project risks again and collected to each representative category defined as ten factors as shown in the Fig 1. The factors also were considered whether it has availability before preliminary feasibility study of project for minimizing sunk cost and quantitative and practical criteria for evaluating the alternatives, additionally, whether it enables developer to do prompt evaluation for country candidates and periodically update data provided by authoritative literature or not. Each factor has mutual independence for alternatives evaluation since it comes from different risk and connects to the independent evaluation index of world report when it is evaluated.

The alternatives were selected 5 countries which Korea developers have a dash to participate including the Arab Emirates which the ongoing project belongs to.

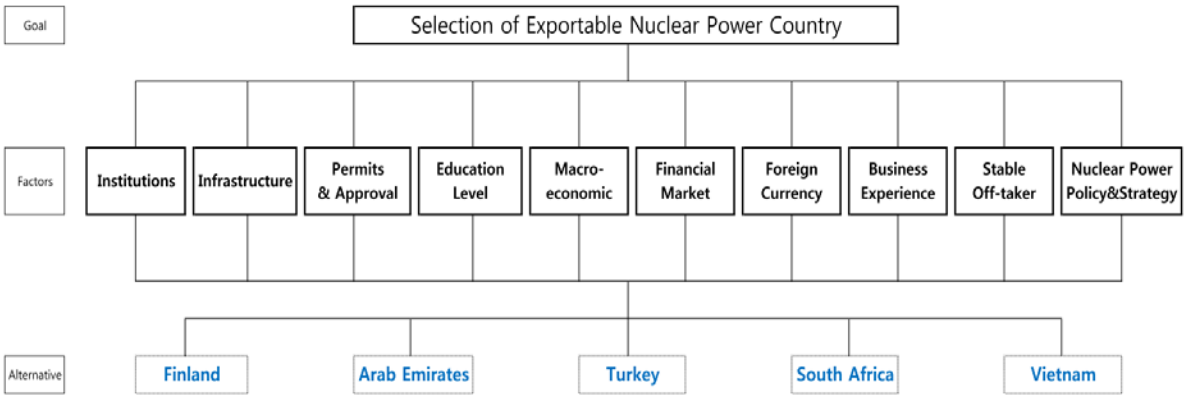

Fig. 1.The Analytic Hierarchical Structure for evaluating exportable nuclear power region

3.2 AHP analysis results

Pairwise comparisons by expert-oriented survey are made with the grades ranging from 1-9 to determine the relative weights of factors as the below Fig. 2(A basic, but very reasonable, assumption: If attribute A is absolutely more important than attribute B and is rated at 9, then B must be absolutely less important than A and is valued at 1/9). Also, it is calculated Consistency Ratio (CR) to measure how consistent the judgments have been relative to large samples of purely random judgments. The 40 nuclear experienced working level employee from various countries participated in the interview, however, Only 20 consistent responses among them were reflected to survey results with average consistency ratio 0.0875.

Classfication	Institutions	Infra-structure	Permit & Approval	Education	Macro-economic	Financial Market	Foreign Currency	Experience	Stable Off-taker	Nuclear Policy
Weighting										

Consistency Index :		Consistency Ratio (O.K < 0.1)	

☐ Pairwise Comparison Matrix

Matrix	Institutions	Infra-structure	Permit & Approval	Education	Macro-economic	Financial Market	Foreign Currency	Experience	Stable Off-taker	Nuclear Policy
Institutions	1									
Infrastructure	#DIV/0!	1								
Permit&Approval	#DIV/0!	#DIV/0!	1							
Education	#DIV/0!	#DIV/0!	#DIV/0!	1						
Macroeconomic	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1					
Financial Market	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1				
Foreign Currency	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1			
Experience	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1		
Off-taker	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1	
Nuclear Policy	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1

Fig. 2. AHP excel tool for determining the relative weights

Pairwise comparisons in the same way by authorized agency report are made to determine the relative rankings (priority) of alternatives according to each factor and then multiplying the weight of each alternative by the weight of factor yields the overall weights of alternatives as the below Fig. 3[3].

Classfication	Institutions	Infrastructure	Permit & Approval	Education	Macro-economic	Financial Market	Foreign Currency	Experience	Stable Off-taker	Nuclear Policy	Total Weights	Ranking
Weight	0.0683	0.0683	0.0305	0.0211	0.1127	0.1579	0.0329	0.2231	0.2231	0.0753	1.0	
A Country	0.3006	0.2528	0.2008	0.3189	0.2365	0.2429	0.4544	0.0477	0.1624	0.3130	0.2010358	3
B Country	0.2491	0.3046	0.4199	0.2280	0.2936	0.1880	0.3065	0.4427	0.3161	0.1765	0.3108803	1
C Country	0.1487	0.1800	0.1176	0.1729	0.1842	0.1630	0.0600	0.1476	0.1624	0.0988	0.1547493	4
D Country	0.1806	0.1520	0.2008	0.1527	0.1566	0.2784	0.1314	0.0477	0.3161	0.3130	0.2027316	2
E Country	0.1209	0.1105	0.0610	0.1276	0.1292	0.1277	0.0478	0.3142	0.0429	0.0988	0.1437513	5

Fig. 3. Weight of alternatives with respect to each factor.

It is compared the countries viability for the project as shown in the below Fig. 4 and might be obseverd of rank variation according to specific factor's fluctuation by sensitivity analysis.

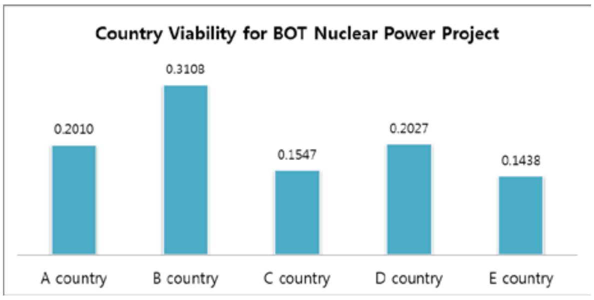

Fig. 4. Comparison of countries viability for the project.

4. Conclusions

To summarize, this analytic method enable the developer to select and focus on the country which has preferable circumstance so that it enhances the efficiency of the project promotion by minimizing the opportunity cost. Also, it enables the developer to quantify the qualitative factors so that it diversifies the project success strategy and policy for the targeted country. Although the performance of this study is insufficient due to the limitation of time, small sampling and security of materials, it still has the possibility to improve the analytic model more systematically through further study with more data.

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