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A Conceptual Design of Analytical Hierachical Process Model to the Boko Haram Crisis in Nigeria

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Abstract

This study applied Analytical Hierachical Process (AHP), a mathematical model for resolving complex systems, to solve the incessant Boko Haram Crisis in Nigeria. At the core of conflict resolution is the need to assess the benefits and costs of the proposed solutions. AHP which is a model for conflict resolution was used to build a real life model of the Boko Haram Crisis. The model relies soely on the hierarchical structure of AHP which was the basis for the software designed for this work. The most CRITICAL point in this work is the determination of the relative priority of the criteria, objectives and alternatives used during the decission making.
This research concludes that for a lasting solution to the incessant Boko Haram Crisis, violent demonstration should be in the direction of dialogue. Dialogue should be centered on Imposition of Sharia Rule and Security as these two objectives have the highest priority with respect to Boko Harm Sect and Federal Government Respectively.
Keywords: Analytical Hierarchical Process, Boko Haram, Conflict resolution, Dialogue

1. Introduction

Nearly all of us, in one way or another, have been brought up to believe that logical thinking is only sure way to face and solve problems. We also believe that our feelings and our judgments

must be subjected to the acid test of deductive thinking. But experience suggests that deductive thinking is not natural. Indeed, we have to practice, and for a long time, before we can do it Since complex problems usually have many related factors, traditional logical thinking leads to sequences of ideas that are so tangled that their interconnections are not readily discerned.

The lack of a coherent procedure to make decisions is especially troublesome when our intuition alone cannot help us to determine which of several options is the most desirable, or the least objectionable, and neither logic nor intuition are of help. Therefore, we need a way to determine which objective outweighs another, both in the near and long terms. Since we are concerned with real-life problems we must recognize the necessity for tradeoffs to best serve the common interest. Therefore, this process should also allow for consensus building and compromise. How can we capture the natural acts of people with mathematics today? The Analytic Hierarchy Process (AHP) for decision making uses objective mathematics to process the inescapably subjective and personal preferences of an individual or a group in making a decision. The AHP have been used repeatedly in decision making in all fields of human endeavours, its wide applicability is due to its simplicity, ease of use, and great flexibility. This research describes the application of AHP in resolution of Boko Haram crisis.

2. Literature Review

The foundation of the Analytic Hierarchy Process (AHP) is a set of axioms that carefully delimits the scope of the problem environment [4]. It is based on the well-defined mathematical structure of consistent matrices and their associated right- eigenvector's ability to generate true or approximate weights. The AHP methodology compares criteria, or alternatives with respect to a criterion, in a natural, pair wise mode. To do so, the AHP uses a fundamental scale of absolute numbers that has been proven in practice and validated by physical and decision problem experiments [7]. The fundamental scale has been shown to be a scale that captures individual preferences with respect to quantitative and qualitative attributes just as well or better than other scales.

It converts individual preferences into ratio scale weights that can be combined into a linear additive weight W (a) for each alternative a. The resultant W (a) can be used to compare and the alternatives and, hence, assist the decision maker in making a choice. Given that the three basic steps are reasonable descriptors of how an individual comes naturally to resolving a multi

criteria decision problem, then the AHP can be considered to be both a descriptive and model of decision making. The AHP is perhaps, the most widely used decision making in the world today. Its validity is based on the many hundreds (now thousands) of actual applications in which the AHP results were accepted and used by the cognizant Decision Makers.

AHP applications enormously multiplied after the development of proper software, which simplified the computations and directed step-by-step Decision Makers to reach the "best" decision. Ernest Forman (2001), who developed the Expert Choice software by integrating AHP concepts with personal computers, states that the official webpage of the company "contains references to over 1000 articles and almost 100 doctoral dissertations".

Any complex situation that requires structurng, measurement and synthesis is a good candidate for AHP. AHP has been sucessfully employed include: selection of one alternative from many; resource allocation, forcasting, public policy, health care decission making, quality management, business process re-engineering, quality management, choice, Prioritization / Evaluation, and conflict resolution.

AHP was applied towards Iran conflict resolution. The threat of war in Iran is a complex and controversial issue, involving many actors in different regions and several possible courses of action. Nearly 40 people were involved in the exercise done in October 2007. They were divided into groups of 4 or 5 and each of these groups worked out the model and derived results for a designated merit: benefits, opportunities, costs or risks. In the end there were two outcomes for each merit which were combined using the geometric mean and then the four resulting outcomes were combined into a single overall outcome.

3. Methodology

Based on the AHP approach and group decision-making algorithm, the following methodologies were employed:

- Structuring the problem: The first step in the Analytic Hierarchy Process was to model the problem as a hierarchy by identifying the overall Goal, the actors, the strategic criteria, the objectives of each actor, and the alternatives of how to structure the model?

- Building the decision hierarchy: To model the problem as a hierarchical structure, it entailed coming down from the goal as far as possible by decomposing it into the most general and most easily controlled factors. Going up from the alternatives to objectives

that must be satisfied and aggregating the objectives into generic criteria until the two actors are linked in such a way as to make comparison possible. Figure 1 shows the Hierarchical Structure of AHP.

- Consulting experts by administering questionnaires: 100 experts or knowledgeable people from different fields were used as the sample space. The Delphi method was applied. The Delphi method aims to obtain the consensus of experts by using a questionnaire survey. A total of 100 questionnaries were sent out, 12 of them could not be retrieved back, 8 was not properly filled. Thus 80 of the the 100 questionnaires wee used.

- Calculation of criteria weights: The criterion weight was gotten by combining the pair-wise comparison matrix from all experts together and finding the geometric mean. The set of all such judgments in making comparisons with respect to a single property or goal is represented by a square matrix in which the set of elements are compared. All judgments with respect to some property to be processed were synthesized along with other matrices of comparisons involved in the decision. Each judgment represents the dominance of an element in the left column of the matrix over an element in the row on top. It reflects the answers to two questions: *which of the two elements is more important with respect to a higher level criterion, and how strongly.* The matrix was constructed using a scale of relative importance of 1 - 5. The judgments were entered using the fundamental scale of AHP as given in Table 1.
- Numerical analysis: Eigen vector is used to calculate each comparison matrix weight using Rayliegh, Power algorithms.
- Rayleigh Quotient*:* Is an iterative method, that is, it must be repeated until it converges to an answer.

$$AX = \lambda_{max}X \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (i)$$

Eigenvector is denoted as X, A denotes the pairwise matrix and λ_{max} denotes the maximum eigen value.This quotient is called the Rayleigh's quotient. Given an n X n matrix the algorithm is represented as follows:

- Choose a vector and call it x_0. Set $i = 0$.
- Multiply to get the next approximation for x using the formula $x_{i+1} = Ax_i$.

- Divide every term in x_{i+1} by the last element of the vector and call it x'_{i+1}.
- Repeat steps 2 and 3 until x'_i and x'_{i+1} agree to the desired number of digits.
- The vector x obtained in step 4 is an approximate eigenvector corresponding to the dominant eigen value.
- An approximation to the dominant eigen value is $\frac{x^T Ax}{x^T x}$.

This is called the Rayleigh quotient of *x*.

- Power Method: This is also an iterative method and in its basic form the power method is applied as follows:

The algorithm is as follow:

Given n, A

Let x be an initial guess

While error > ∈ do

Y = Ax

r = ω (y) / ω(x)

x = y/||y||

adjust error

end while

- Test for Consistency: All Judgments in the matrix were not consistent. In eliciting judgments, redundancy comparisons was removed to improve the validity of the answer, given that respondents may be uncertain or may make poor judgments in comparing some of the elements. Redundancy gives rise to multiple comparisons of an element with other elements and hence to numerical inconsistencies.

CI was calculated as follows:

$$CI = (\lambda_{max} - n)/(n-1)$$

Where n is the dimension of the square matrix

CR=CI/RI.

Where CR = Consistency Ratio, RI = Random Index, CI = Consistency Index

4. Results

Table 3 shows the result for the cost analysis which depicts that ignoring sect and dialogue are the cheapest alternative to be taken while military intervension is the most expensive alternative.

Very important to perform the sensitivity analysis is to put into consideration the Benefit/cost anaylysis. From table 4, it can be right said that Dialogue still has the highest priority.

Benefits is positive merits, whereas Costs is negative. The overbalance of weights is negative for dialogue is negative and is positive for Military Intervension. As a result, in the current situation dialogue turns out to be the best alternative and Military Intervension is the worst. The alternatives are dicussed according the priority of benefits obtained. The graphical representation of Benefit/Cost analysis is shown in figure 2.

Taking into consideration the type of matrix used in this research , the following were inferred from the two methods employed in the numerical analysis:

- The rate of convergence is linear
- Both Rayleigh and Power method converges after a number of iterations
- Although, power method worked, but convergence is slower compared to Rayleigh
- Conclusively, Rayleigh's method is recommended as it has higher convergence.

5. Conclusion

Results of this research shows that :

- The alternative of Dialogue is the most superior in addressing the Boko Haram Crisis. It has an average priority of 43% . The option of Amnesty is next with an average priority of 27%.
- In terms of positively addressing all critical issues with respect to cost model, Military intervension turns out to be costly with an average percentage of 33% while Dialogue turns out to be the cheapest with an average percentage of 8%.
- The same alternative Dialogue still has the highest priority with respect to the benefit/cost ratio.

This research therefore concludes that for a lasting solution to the incessant Boko Haram Crisis and violent demonstration should be in the direction of **DIALOGUE.** This alternative should be centered on Imposition of Sharia Rule and Security as these two objectives has the highest priority with respect for the sect and Government Respectively.

Due to inaccessibility to the key actors, thus this paper is an illustrative use of the method and no real life conclusions should be drawn and as such should be taken as an hypothesis.

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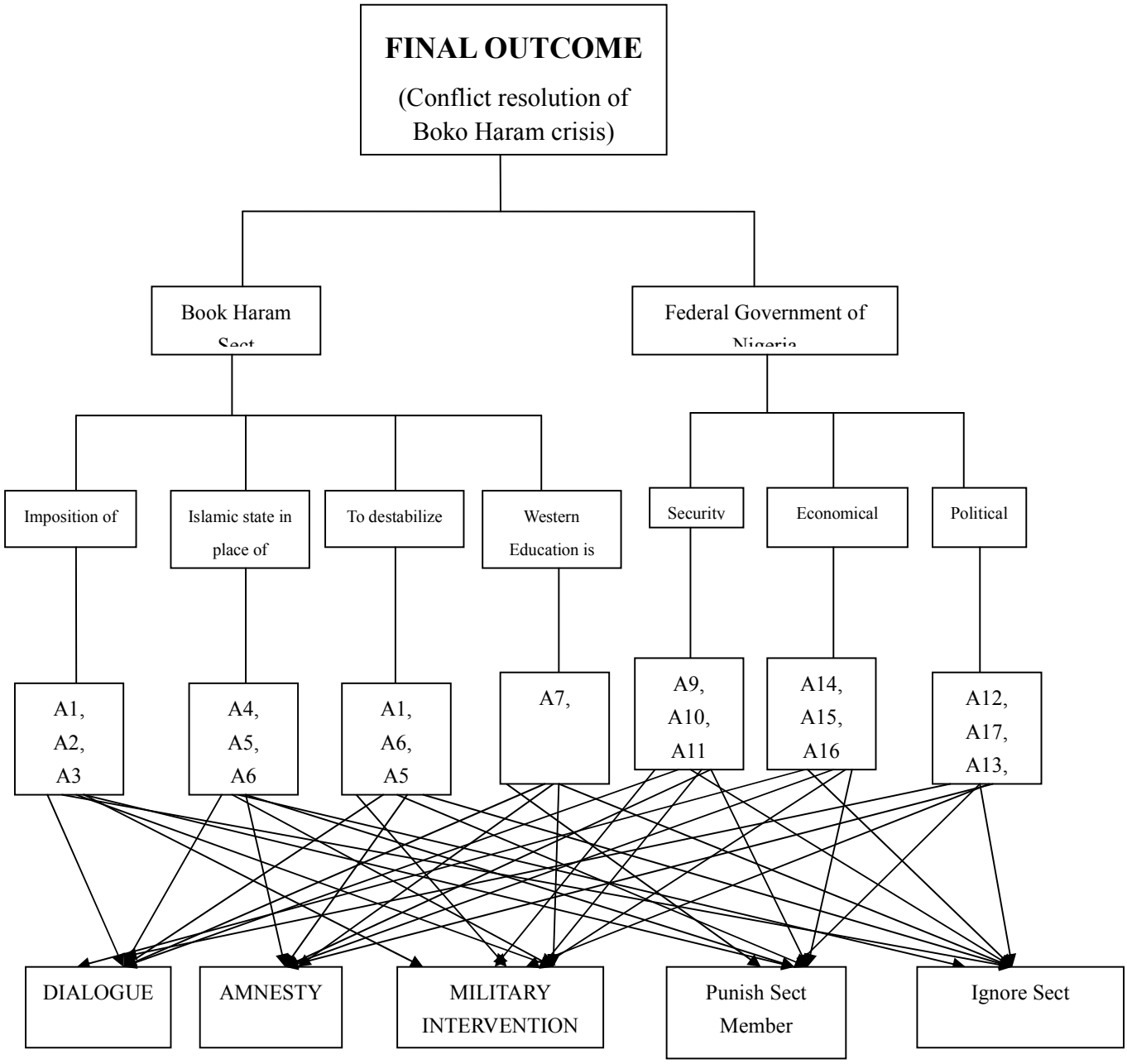

Figure 1: Hierarchical Structure of AHP

Criterias

A1. Support from ALQUEDA terrorist group

A2. Use of bombs / explosives

A3. Reorientation of muslim youth

A4. Attack towards government officals

A5. Attack towards the arm forces of Nigeria

A6. Creation of political unrest in the country

A7. Attact against Western education

A8. Restructuring Nigeria

A9. Tactical security measures

A10. Porous borders

A11. Budgetary allocation to equip law enforcement

A12. Northern Leaders

A13 Support from international organisation

A14. War against Poverty in the Northern part

A15. Infrastructural Development in the North

A16. Vocational training

A17. War against corruption by Trial of former public office holders who embezzled funds.

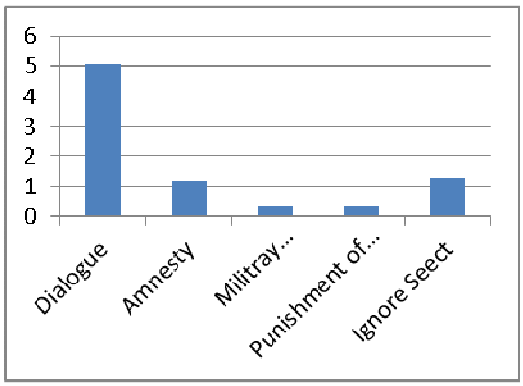

Figure 2: Graphical Representation of Benefit/ Cost Analysis

Table 1. Relative importance of factors

Relative Importance	Description
1	Equal importance of i and j
2	Moderate importance of i over j
3	Strong importance of i over j
4	Very strong importance of i over j
5	Extremely importance of i over j

Table 2. Random Index

Number of Factors	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Table 3: Result for the Cost Analysis (λ_{max} **= 5.17754 CR= 0.03963)**

COST ANALYSIS	**NORMALISED EIGEN VECTOR**	**OVREALL PRIORITY**
Dialogue	0.08506	0.08506
Amnesty	0.22357	0.22357
Military Intervension	0.32668	0.32668
Punishment of Sect Members	0.29382	0.29382
Ignore Sect	0.07087	0.07087

Table 4: Result for the Benefit/Cost Analysis

BENEFIT/COST ANALYSIS	**BENEFIT/ COST**
Dialogue	5.03571
Amnesty	1.21174
Military Intervension	0.33018
Punishment of Sect Members	0.34571
Ignore Sect	1.28839

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