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Innovative Method to Evaluate Halal Assurance System (HAS 23000) Audit Results using Single Value Neutrosophic Number

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Abstract. The Halal food industry in Indonesia has became an alternative and trend in the global market. The quality management system plays a role in maintaining company consistency in implementing a quality management system which continue to develop in the food industry such as the Halal Assurance System (HAS 23000) LPPOM MUI. Internal audit is a part of the verification tools carries out internally by the company to meet the eleven criteria such as procedures, work instructions and documentation has been implemented with consistency and integrity. However, there are many problems in assessing consistency and integrity, among others, expertise auditor factor and also the auditor's assessment as a human being tends to be doubtful related to standard interpretation, using a general impression in his assessment, incorrectly determining the classification/grading of findings, so the audit results has not produced a quantitative assessment. The research aims to use of the Neutrosophic Quality Audit (NQA) model. The proposed model uses Single Value Neutrosophic Numbers (SVNN). Simplified Neutrosophic Weighted Geometric Average Operator (SNWGAO) and cosine similarity degree. The result an innovative model will be reliable solution in improving the halal assurance system audit in the food industry. An illustrative example is provided to validate the proposed model.

1. Introduction

Halal food is defined as a product that does not contain raw materials (raw materials, additives, auxiliary ingredients, and genetic engineering products) issued by Islamic Sharia [1]. Religious belief influences food choices [2]. It certainly influences muslim customers who needs the halal quality assurance management system for food products [3]. Currently booming in the global world [4] style. Not only in countries that accept Muslims, but also countries that have non-Muslim populations. Global scale companies have implemented halal guarantee systems such as Qantas, Singapore Airlines, Japan Airlines, America Airlines, which provide halal menus [5].

Halal Assurance System 23000 issued by LPPOM MUI for the supply system. As shown in Figure 1, there are Eleven Halal criteria which are the basic requirements that must be agreed by the company to get halal recognition from LPPOM MUI (Now BPJPH) 11 following criteria [1]: Halal policy, Internal Halal Team, Education, Materials, Products, Production Facilities, Written Procedures for Critical Activities, Search Capability, handling of Products that are not in accordance with interests, Internal Audit, Management Review.

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Figure 1. Eleven Halal Criteria

According to BS EN ISO 9000: 2015 [6] the quality of products and services is not only a function of usability and performance, but also the value and benefits got by the customer. Based on above definition it can concluded that quality from the business side can be achieved when consumers are satisfied. Companies / organizations must be able to implement a halal guarantee system to an acceptable level (Figure 2). The emergence of Law Number 33th Year 2014 concerning Halal Product Guarantee (UUJPH) is an actualization the importance of halal guarantees chained to end-consumers [4].

A halal auditor is provided with an audit checklist (as in Figure 3) as material for conducting the audit process (including the HAS 23000 standard). Audit checklist is one of the tools used by the auditor and becomes an important element during the planning of the audit process. The checklist consists of a series of questions according to the standard referred to (HAS 23000). In addition, the halal auditor is emphasized in understanding the details of Islamic law related to halal-haram in accordance with the Qur'an and Hadith. The majority of questions are designed using closed questions that only require a Yes or No answer. Certainly answer closed questions on conditions of uncertainty, ambiguous environment and very difficult tasks for internal halal auditors.

Finding	Definition/ Impact	Action
Compliant	Conformity that occurs is in accordance with the requirements of HAS 23000 LPPOM MUI	√ Continue trend monitoring / indicators
Minor (M)	Low Risk, a finding that does not result in a halal certificate being not released. Does not affect judgment.	√ Review improvements made Monitor the trend / indicator if the improvements made are monitored
Improvement Need (IN)	Medium Risk, the agreed findings cause no halal certificates to be released, if not corrected.	Investigate root causes and implement corrective actions while checking the next audit schedule
Critical Weekness (CR)	High Risk, critical findings that did not release halal certificates.There is a failure in one of the 11 halal criteria	√ Make improvements responsively √ Investigate the root of the problem and determine corrective actions √ Re-audit is carried out for the verification process

Figure 2. Audit Finding Categories

One who does not audit is the Auditor. Auditors who have diverse backgrounds and academic competencies certainly have an effect on expertise in producing quality findings or interpretations that are different from the standard. An expert is someone who has a background in a particular field and receives recognition from many people in specific technical areas [7]. There are 2 suggested experts, namely consistency and discrimination [8]. In addition, human instincts that have doubts when it comes to make decisions related to conduct an audit, incorrect determining classification, assessing the results of audits do not produce the correct. On the basis of this practical problem, it is demanded to find innovative methods to support quantitative quality management systems for food security. Accepting the proposed Single Value Neutroshopic Number (SVNN) which can provide quantitative results of audit findings that are generally still qualitative in nature [9].

Halal Internal Audit Checklist

Dept : Date :
Auditee : Auditor :
Please thick (√) in the audit result column in accordance with the conditions at the time of the audit

No	Audit Question	Audit Finding					Audit Evidence (Provide Reference to documented information to Justify Finding)	Opportunities For Improvement (Provide Suggestions for Process Improvement)
		Yes	CR	IN	M	NA		
1	Has Halal policy been established?							
2	Has the Halal policy been socialized to all employees?							

Figure 3. Halal Audit Checklist Sample

Neutrosophics are best suited to represent the uncertainties and uncertainties which are typical cases of the quality audit process, where the auditor is responsible for determining sharp or clear values for each question on the checklist as shown in the audit checklist of the sample list in Figure 3, whereas auditors in real life have many uncertainties regarding each question.

The remainder of this study is structured as follows: a literature review of the single value neutrosophic numbers and the degree of cosine similarity, Neutrosophic Weighted Average Operators in Section 2, Section 3 illustrates the basic definitions of the neutrosophic set, the proposed algorithm is presented in Section 4, numerical examples are illustrated in Section 5. Finally, Section 6 covers the conclusions of the study with future research projections.

2. Literature Review

Decision making based on more than one criterion (multi-criteria) is a method used to solve problems with many (complex) criteria and there are often conflicts between criteria [9]. This complexity is strengthened if there are qualitative and quantitative assessments of potential alternatives in relation to these criteria. Frequently justification is unclear and contradictory, and it significantly complicates the rationale and determination of operational support procedures. Unclearness often occurs in 6 conditions:

a. The words used have the potential for different meanings for different people.
b. The consequences of expert polls tend to be different [10].
c. There are justifications which are often heterogeneous to different degrees from experts [11].
d. Estimates of experts regarding important aspects are not always consistent.
e. There is a lack of detailed personal information [12].
f. Decision makers are not always sure of the results of justification of their own thinking [13].

The most commonly used methodology for representing and manipulating incorrect and uncertain information in multi-criteria is the Fuzzy Set (FS) theory. However, the focus of the level of membership (truthfulness and possibility) of parameters that are not clear, but the Fuzzy Set fails to consider the error (falsity) and uncertainty (indeterminacy) the magnitude of the measured response. In practice, the problem is projecting the uncertainty of multi-source and multivariate group decisions using mathematical models remains difficult in the case of Fuzzy Sets. In the late 90s, [14] introduced and developed the idea of Intuitionistic Fuzzy Sets (IFS), intuitionistic logic and intuitionistic algebra allowing for more complex thought construction and uncertainty. In addition, IFS considers non-membership level. However, IFS cannot handle all cases of uncertainty, especially the paradox. The paradox is the only true and false proposition at the same time in the same world, and not necessarily [13].

3. Prelimineries

Definition 3.1 The new concept is related to neutrosophy which addresses four fields: philosophy, logic, set theory and probabilities called Neutrosophics. Neutrosophics are the basis of neutrosophic logic, neutrosophic probabilities, neutrosophic sets, and neutrosophic statistical [15].

Definition 3.2 Single Value Neutrosophic Set (SVNS) N_e more than X according to the equation [16]:

$$A = \{(x, T_{Ne}(x), I_{Ne}(x), F_{Ne}(x)\} \tag{3.1}$$

Definition 3.3 Let A is SVNN numbers $A = (T_A, I_A, F_A)$ the simplified neutrosophic weighted geometric average operator is defined by:

$$SNWGAO = (1-\prod_{jm1}^{n}(1-T_{xj})^{wj}, (1-\prod_{jm1}^{n}(1-I_{xj})^{wj}, (1-\prod_{jm1}^{n}(1-F_{xj})^{wj} \tag{3.2}$$

Definition 3.4 In order to compare two SVNNs, [17] proposed a method based on the cosine similarity measure for a SVNN x (T, I, F) to ideal solution (1, 0, 0). The cosine similarity degree is defined as [18]:

$$\cos(x) = \frac{T}{\sqrt{T^2 + I^2 + F^2}} \tag{3.3}$$

While humans may prefer using words by means of linguistic labels or terms to articulate their preferences, theratings of each alternative with respect to each attribute are given as linguistic variables characterized by SVNN in the evaluation process as shown in Table 1, domain experts can replace its values according to the terms used in Quality Audit, in the same time the auditor has the ability to write the value of SVNN form that reflect the corresponding value.

Table 1. Linguistic Terms and SVNN Environment Values

Linguistic terms	Prefix	Equivalent SVNN Values
Extremely good	EG	(1, 0, 0)
Very very good	VVG	(09, 0.1, 0.1)
Very good	VG	(0.8, 0.15, 0.20)
Good	G	(0.7, 0.25, 0.30)
medium good	MG	(0.6, 0.35, 0.40)
Medium	M	(0.50, 0.50, 0.50)
Medium bad	MB	(0.40, 0.65, 0.60)
Bad	B	(0.30, 0.75, 0.70)
Very bad	VB	(0.20, 0.85, 0.80)
Very very bad	VVB	(0.10, 0.90, 0.90)
Extremely bad	EB	(0, 1, 1)

4. Proposed Algoritm

In this session we can draw the following algorithm conclusions[10]:

a. Step 1, consider each checklist on the Neutrosophic Quality Audit (NQA) / neutrosophic quality audit as SVNS using the equation:

$$A = \{[(x_i, T_{Ne}(x_i), I_{Ne}(x_i), F_{Ne}(x_i)]; x_i \in X \ \} \tag{4.1}$$

b. Step 2, The next step, the expert must give weight to each question on the checklist. The total weight must be equal to one corresponding equation [11]:

$$SNWGAO(x_1,...,x_{2n}) = (1-\prod_{jm1}^{n}(1-T_{xj})^{wj}, (1-\prod_{jm1}^{n}(1-I_{xj})^{wj}, (1-\prod_{jm1}^{n}(1-F_{xj})^{wj} \quad (4.2)$$

c. Step 3, The auditor must be able to determine the trust value of T_{Ne} (x), the uncertainty value of I_{Ne} (x), and the error value of F_{Ne} (x) on each question in the NQA checklist.
d. Step 4, The auditor is able to use the linguistic terms created by the expert, if not if not, write the SVNN value that reflects the appropriate value.
e. Step 5, If the auditor can determine linguistic terms, they must be replaced with SVNN values in accordance with the table made by the expert.
f. Step 6, calculate the cosine equation using equation [11]

$$\cos(x) = \frac{T}{\sqrt{T^2 + I^2 + F^2}} \quad (4.3)$$

g. Step 7, For each question, each cosine equation is less than one (or less than the target set by the expert) means that there is a mismatch, an opportunity for improvement, or non-compliance detected in that question and a specific action is needed according to the cosine calculation value.
h. Step 8, Then calculate the Simplified Neutrosophic Weighted Geometric Average Operator SNWGAO Using Equations (4.2) which refers to the overall audit results.
i. Step 9, Calculate a measure of cosine similarity for SNWGAO using Equations (4.3).
j. Step 10, If the results of the cosine equation measure for SNWGAO that represent the overall audit results are less than one (or less than a predetermined target determined by the expert) means that the organization is considered to have failed to pass the audit process. It can be interpreted that overall audit performance is acceptable if all nonconformities are made remedial actions such as step 7.

5. Ilustrastive Example

To explain the proposed approach accordingly, we complete from the sample numbers, the solution steps are clearly determined, to simplify and we take 6 questions as follows:

a. Has Halal policy been determined? ($x1$)
b. Has the Halal policy been socialized to all employees? ($x2$)
c. Has a halal management team been formed? ($x3$)
d. Has the halal management team formed involved all the teams involved and who are responsible for all production processes? ($x4$)
e. Are the duties and responsibilities of the halal management team clearly defined? ($x5$)
f. Are there written procedures for installing products that are already made from materials and facilities that do not meet the criteria? ($x6$)

6. Applying the proposed algorithm

1. The first step we consider each question as SVNN and ask the auditor about the results of each value of each question.
2. The second step is to ask the auditor regarding the weighting of the audit checklist. The total weight of the entire checklist must be equal to one.
3. The next step, justification from the auditor refers to the numerical value as listed.
4. Then, we use the linguistic provisions and SVNN correspondence values to replace the linguistics with equivalent neutrosophic values as in Table 1.
5. Next, calculate the value of the cosine equation using the cosine equation
6. Compare the cosine equation values with the expert definition values in Table 4.

7. Based on Tables 2 and 3, the issue raised in question 4 ($x4$) the result of the cosine equation is 0.61, including the category Improvement Needed findings that are required to investigate the root of the problem, the implementation of corrective actions. Question 2 ($x2$), 5 ($x5$), and 6 ($x6$) categories of minor findings that require to review the results of improvements that have been made. Whereas questions 1 ($x1$) and 3 ($x3$) are complaint with no need for correction nor preventive actions.

Table 2. Equivalent SVNN

Question	SVNN
(x1)	(0.8, 0.15, 0, 0.20)
(x2)	(0.7, 0.25, 0.30)
(x3)	(0.8, 0.15, 0, 0.20)
(x4)	(0.4, 0.1, 0.5)
(x5)	(0.6,0.25, 0.125)
(x6)	(0.7, 0.25, 0.30)

Table 3. Calculated Cosine Similiarity

Question	Cosine Similiarity
(x1)	0.954479978
(x2)	0.873296006
(x3)	0.954479978
(x4)	0.6172134
(x5)	0.90646749
(x6)	0.873296006

Table 4. Expert Predefined Cosine Similiarity

Expected Decision	Predefined Cosine Similiarity
Compliant	0.97
Minor	0.95
Improvement Needed	0.85
Critical Weekness	0.55

8. Using equation (4.2) and obtained results SNWGAO = (0.69856, 0.19739, 0.28657).

9. Using Equation (4.3) to calculate cosine similiarity for SNWGAO = 0.890943 for overall the questions in NQA Checklist that means the overall performance regarding the audit a review must be made regarding the improvements to be review again so that the halal certificate can be released by the certification body.

7. Conclusion and Future work

Through this paper, choosing the Innovative Method to Evaluate Halal Assurance System 23000 Audit Result uses a single value neutrosophic number to improve the audit process by increasing the auditor's confidence when justifying the audit findings. The concept of neutrosophic and using cosine equations as a measurement tool and using Simplified Neutrosophic Weighted Geometric Average Operators as an aggregation step. We also display examples of simple number calculations that are easy to understand to show the effectiveness of this method. The recommendation for further research is to use a multi-value neutrosophic number so that it can provide a touch of natural nuances in everyday life that can be a dynamic representation of human feelings.

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