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Neutrosophic AHP in the analysis of Business Plan for the company Rioandes bus tours

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Abstract: Tourism development represents a key area for the economy. Its development depends largely on the ability to capture new sources of income. The city of Riobamba of Ecuador has the problem of not having a comfortable route that meets the current demands of tourists, which causes low levels of income. This research aims to develop a method for the analysis of the business plan through the Hierarchical Neutrosophics Analytical Process. The proposal is implemented in the Rioandes Company from which it is achieved as a result that the proposed plan represents a satisfactory alternative for its implementation.

Keywords: Business Plan; AHP; Neutrosophic.

1 Introduction

Tourism is a competitive sector in the international market. Guaranteeing new forms of income for companies represents the way to sustain oneself in the market. At present, tourism represents for Ecuador the third activity in economic importance, after oil and bananas. It implies an average of 700,000 foreign visitors per year and around 800 million dollars enter the country for this concept [1], [2].

In all the parishes of the Riobamba canton it is possible to find places with tourist potential, which are still unknown even to the inhabitants of the canton. In general the resources of the canton constitute its great natural heritage with the presence of mountains and volcanoes, lagoons and the landscape together with the enormous cultural wealth of its people [3], [4].

The company RioAndes Bus Tours in the city of Riobamba in Ecuador, specializes in transportation to the different destinations in the area [5], [6]. However, there is no structured proposal for tourists to know the most important sites in the city through tourist circuits with guarantee and safety during the tour [7], [8].

The business plans allow to know the viability and profitability before starting a new business [9], [10]. The development of the plans represents a complex task that many companies tend to overlook [11], [12] . In general, a business plan has a set of criteria to consider in order assessing the feasibility. [13], [14], [15].

Based on the nature of the business plans, they can be modeled as a decision-making problem. A set of criteria that represent the inputs of the process to which an assessment is made based on a classification method is required and a weighting that represents your evaluation is obtained [16], [17]. Figure 1 shows a scheme that illustrates a business plan through a multi-criteria approach.

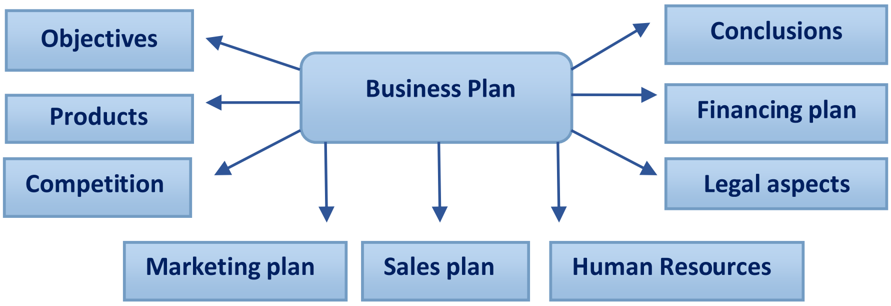

Figure 1. Scheme of a business plan with multi-criteria approach.

2 Preliminaries

This section introduces a study of the fundamental theoretical references associated with the problem being modeled. Business plans are defined as essential elements for the development of research which are modeled through a set of criteria. Multicriteria decision making problems are introduced using the Analytic Hierarchy Process (AHP) method. In addition, the theory of neutrophic numbers is presented as an extension of the AHP method.

2.1 Business Plan

A business plan represents a procedure where a business to be carried out is explained and described, as well as different aspects related to it, such as its objectives, the strategies that will be used to achieve these objectives, the production process, the required investment and expected return [18], [19], [20].

A typical structure that includes all the parts or sections that a business plan should have is as follows:

- The executive summary: the executive summary is a summary of the most important points of the other parts of the business plan.
- The business definition: the business definition describes the business to be carried out, as well as basic aspects related to it.
- The market study: the market study describes aspects related to the market in which the business will operate.
- The technical study: the technical study describes technical aspects related to the business.
- The organization of the business: in the organization of the business it is described how the business will be organized and how the different areas, departments or organic units that will comprise it will be related to each other.
- The study of investment and financing: in the study of investment and financing, the structure of investment and business financing is indicated.
- The study of income and expenses: the study of income and expenses shows an estimate of the income and expenses that the business will have.
- The financial evaluation: the financial evaluation shows the development of the financial evaluation performed on the business.

The elements that make up the structure are considered as criteria in the process of preparing the business plan. From which it can be modeled as a multi-criteria decision making problem.

2.2 Neutrosophic Analytic Hierarchy Process

The hierarchical analytical process was proposed by Thomas Saaty 1980 [21]. It is one of the most widespread methods in solving multi-criteria decision making problems. This technique models the problem that leads to the formation of a hierarchy representative of the associated decision-making scheme. This hierarchy presents at the upper level the goal pursued in solving the problem and at the lower level the different alternatives from which a decision must be taken are included. The intermediate levels detail the set of criteria and attributes considered [22], [23].

The process is based on several stages. The formulation of the decision-making problem in a hierarchical structure is the first and main stage. This stage is where the decision maker must break down the problem into its relevant components. The basic hierarchy is made up of: general goals or objectives, criteria and alternatives [24], [25, 26]. The hierarchy is constructed so that the elements are of the same order of magnitude and can be related to some of the next level.

In a typical hierarchy the highest level locates the problem of decision making. The elements that affect decision making are represented at the intermediate level, the criteria occupying the intermediate levels. At the lowest level the decision options are understood [27]. Figure 2 shows the hierarchical structure of AHP.

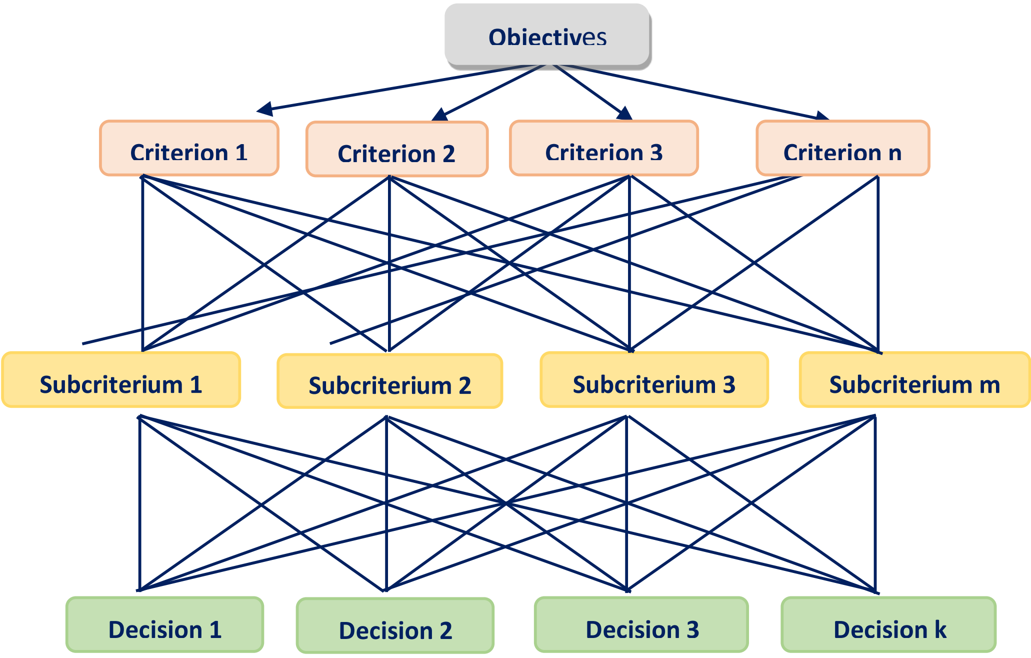

Figure 2. Scheme of a generic tree representing an Analytical Hierarchy Process.

2 Design a method for analyzing business plans

The method consists of three main processes. It begins with the selection of the criteria, then the multicriteria evaluation is carried out and finally the classification is carried out. The operation of the method is based on Neutrosophic Analytic Hierarchy Process (NAHP). Figure 3 shows the general structure of the proposed method.

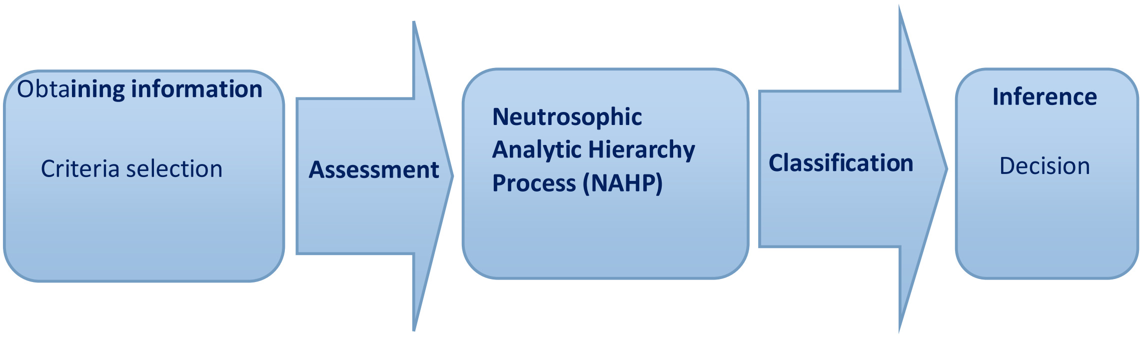

Figure 3. General structure of the proposed method.

The levels of importance or weighting of the criteria are estimated by means of paired comparisons between them. This comparison is carried out using a scale, as expressed in equation (1) [28].

$$S = \left\{\frac{1}{9},\frac{1}{8},\frac{1}{7},\frac{1}{6},\frac{1}{5},\frac{1}{4},\frac{1}{3},\frac{1}{2},1,2,3,4,5,6,7,8,9\right\} \tag{1}$$

In the case of n attributes, the paired comparison of the element i with the element j is placed in the aij position of the matrix A of paired comparisons, as shown in equation (2)

$$\tilde{A} = \left| \begin{matrix} \vdots & \ddots & \vdots \end{matrix} \right| \quad (2)$$

The reciprocal values of these comparisons are placed in the aji position of A, in order to preserve the consistency of the judgment. The participating decision maker must compare the relative importance of an element with respect to a second, using the 9-point scale shown in table 1. For example, if element 1 was rated with strong dominance over element 2, then in position a12 a 5 is placed and reciprocally in position of a21, 1/5 is placed.

Table 1. Saaty's scale translated to a neutrosophic triangular scale.

Saaty scale	Definition	Neutrosophic Triangular Scale
1	Equally influential	$\tilde{1} = \langle(1,1,1); 0.50, 0.50, 0.50\rangle$
3	Slightly influential	$\tilde{3} = \langle(2,3,4); 0.30, 0.75, 0.70\rangle$
5	Strongly influential	$\tilde{5} = \langle(4,5,6); 0.80, 0.15, 0.20\rangle$
7	Very stronglyinfluential	$\tilde{7} = \langle(6,7,8); 0.90, 0.10, 0.10\rangle$
9	Absolutely influential	$\tilde{9} = \langle(9,9,9); 1.00, 1.00, 1.00\rangle$
2, 4, 6, 8	Sporadic values between two close scales	$\tilde{2} = \langle(1,2,3); 0.40, 0.65, 0.60\rangle$
		$\tilde{4} = \langle(3,4,5); 0.60, 0.35, 0.40\rangle$
		$\tilde{6} = \langle(5,6,7); 0.70, 0.25, 0.30\rangle$
		$\tilde{8} = \langle(7,8,9); 0.85, 0.10, 0.15\rangle$

On the other hand, Saaty established that Consistency Index (CI) should depend on λmax, the maximum eigenvalue of the matrix. He defined the equation $CI = \frac{\lambda_{max} - n}{n-1}$, where n is the order of the matrix. Additionally, he defined the Consistency Ratio (CR) with equation CR = CI/RI, where RI is given in Table 2.

Table 2. RI associated to every order.

Order (n)	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

If CR≤0.1 we can consider that experts' evaluation is sufficiently consistent and hence we can proceed to use AHP.

AHP aims to score criteria, sub-criteria and alternatives, and to rank every alternative according to these scores. For more details about this technique can be consulted [29-31].

AHP can also be used in group assessment. In such a case, the final value is calculated by the weighted geometric mean, see Equations 1 and 2.

$$\bar{x} = \left(\prod_{i=1}^{n} x_i^{w_i}\right)^{1/\sum_{i=1}^{n} w_i} \quad (1)$$

If expert's weights sum up one, i.e. $\sum_{i=1}^{n} w_i = 1$., Equation 1 converts to Equation 2,

$$\bar{x} = \prod_{i=1}^{n} x_i^{w_i} \quad (2)$$

3 Result and discussions

To demonstrate the applicability of the proposed method, a case study was introduced for the analysis of Business Plan for the company Rioandes bus tours. The main elements that describe the implementation are described below.

The information gathering stage uses a multi-expert multicriteria approach, expressed by:

The set of criteria that describe the nature of the decision-making problem such that:

$$C = \{c_1, c_2, \ldots, c_m\}, m \geq 1 \quad ,$$

where: $\forall C_m \notin \phi, 1 \leq m \leq i$.

The group of experts involved in the decision-making problem such that:

$E = \{e_1, e_2, \ldots, e_n\}, n \geq 1$,

where: $\forall E_m \notin \phi, 1 \leq n \leq i$.

The set of decision alternatives for the proposed decision-making problem such that:

$A = \{a_1, a_2, \ldots, a_k\}, k \geq 1$,

where: $\forall A_k \notin \phi, 1 \leq k \leq i$

From the analysis carried out in section 2.1, the main criteria to be taken into account are obtained.

The alternative for evaluating are the following:

A_1: The proposal is viable for its implementation.

A_2: The proposal is not viable for its implementation.

The criteria for evaluating are the following:

C_1: The executive summary

C_2: The definition of the business.

C_3: The market study.

C_4: The technical study

C_5: The organization of the business.

C_6: The study of investment and financing.

C_7: The study of income and expenses.

C_8: The financial evaluation

The evaluation stage is described below:

The three obtained pair-wise matrices corresponding to criteria, one per expert are summarized in Tables 3, 4 and 5. Let us note that the values are expressed in form of the scale given in Table 1.

Table 3: Comparison pairs corresponding to the criteria given by the expert 1.

Criteria	A_1	A_2
A_1	$\tilde{1}$	$\tilde{3}$
A_2	$\tilde{3}^{-1}$	$\tilde{1}$

Table 4: Comparison pairs corresponding to the criteria given by the expert 2.

Criteria	A_1	A_2
A_1	$\tilde{1}$	$\tilde{3}$
A_2	$\tilde{3}^{-1}$	$\tilde{1}$

Table 5: Comparison pairs corresponding to the criteria given by the expert 3.

Criteria	A_1	A_2
A_1	$\tilde{1}$	$\tilde{3}$
A_2	$\tilde{3}^{-1}$	$\tilde{1}$

Tables 6, 7 and 8, contain the average evaluation for the total of experts corresponding to the Requirements, one per each criterion.

Table 6: Average crisp pair-wise matrix corresponding to requirements given by the experts according to criterion C_1.

Requirement	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
R_1	1	0.28	0.26	0.20	0.98	1.99	1.76	2.24
R_2	3.42	1	0.83	0.83	2.25	2.94	2.53	2.94
R_3	3.78	1.20	1	0.98	2.94	3.42	2.94	3.97
R_4	4.84	1.20	0.98	1	3.42	3.78	3.78	3.96
R_5	0.98	0.44	0.34	0.29	1	1.99	1.99	2.94
R_6	0.50	0.34	0.29	0.26	0.43	1	0.70	1.99
R_7	0.56	0.39	0.34	0.26	0.43	1.43	1	1.62
R_8	0.45	0.34	0.26	0.25	0.34	0.50	0.62	1

Table 7: Average crisp pair-wise matrix corresponding to requirements given by the experts according to criterion C_2.

Requirement	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
R_1	1	0.29	0.26	0.20	0.98	1.99	1.76	2.25
R_2	3.42	1	0.83	0.83	2.25	2.94	2.53	2.94
R_3	3.78	1.20	1	0.98	2.94	3.42	2.94	3.97
R_4	4.84	1.20	0.98	1	3.42	3.78	3.78	3.96
R_5	0.98	0.44	0.34	0.29	1	1.99	1.99	2.94
R_6	0.50	0.34	0.29	0.26	0.43	1	0.70	1.99
R_7	0.56	0.39	0.34	0.26	0.43	1.43	1	1.62
R_8	0.44	0.34	0.25	0.25	0.34	0.50	0.62	1

Table 8: Average crisp pair-wise matrix corresponding to requirements given by the experts according to criterion C_2.

Requirement	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
R_1	1	0.27	0.26	0.20	0.98	1.99	1.76	2.23
R_2	3.42	1	0.83	0.83	2.25	2.94	2.53	2.94
R_3	3.78	1.20	1	0.98	2.94	3.42	2.94	3.97
R_4	4.84	1.20	0.98	1	3.42	3.78	3.78	3.96
R_5	0.98	0.44	0.34	0.29	1	1.99	1.99	2.94
R_6	0.50	0.34	0.29	0.26	0.43	1	0.70	1.99
R_7	0.56	0.39	0.34	0.26	0.43	1.43	1	1.62
R_8	0.43	0.34	0.24	0.25	0.34	0.50	0.62	1

The classification stage is described below:

From the application of equation 1, let us remark that we shall apply formula 8 for converting the pair-wise matrices in crisp matrices. The obtained CRs were 0.0014, 0.0243, and 0.0034 for Expert 1, Expert 2 and Expert 3, respectively, which are smaller than 0.1. Whereas, for the matrices of Requirements we obtained the CRs are smaller than 0.1 respect to every expert and every criterion.

Table 9 summarizes the priority vectors of the three experts for the criteria, applying Equation 2 with weights wi = 1/3 for i = 1, 2, 3.

Table 9: Average of priority vectors obtained for every criterion over the experts and their order.

Criteria	Average over experts of Criteria Priority Vectors	Order
A_1	0.62	1
A_2	0.38	2

From which it is concluded that: The proposal is viable for its implementation.

Table 10 summarizes the weights for every requirement and the final order.

Table 10: The requirements priority vectors and the final order of requirements.

Requirement\Criterion	A_1(0.62)	A_2(0.38)	Requirements Priority Vector	Order
R_1	0.05	0.08	0.06	8
R_2	0.10	0.06	0.09	4
R_3	0.21	0.03	0.17	1
R_4	0.19	0.03	0.15	2
R_5	0.08	0.05	0.08	5
R_6	0.16	0.04	0.14	3

R_7	0.06	0.10	0.07	7
R_8	0.04	0.16	0.07	6

According to the results summarized in Table 10 the requirements are ordered as follows:

$R_2 \succ R_4 \succ R_6 \succ R_2 \succ R_5 \succ R_8 \succ R_7 \succ R_1$.

5 Conclusions

The present investigation proposed a method for the feasibility analysis of business plans. The Neutrosophical Hierarchical Analytical Process was applied for the development of the proposal. The research was applied to the analysis of Business Plan for the company Rioandes bus tours. Among the main results obtained, it was shown that the proposed business plan according to the inference method applied represents a viable solution for its implementation.

References

[1] N. I. S. Chávez, A. J. R. Fernández, and G. A. Á. Gómez, "Actualidad y proyecciones de desarrollo del turismo internacional en Ecuador," *Revista UNIANDES Episteme*, vol. 4, no. 3, pp. 276-287, 2017.

[2] F. M. M. Ramos, "Análisis de las políticas para el turismo en Ecuador con énfasis en el turismo rural comunitario," *Revista San Gregorio*, no. 15, pp. 122-127, 2016.

[3] R. C. Feijóo, "Poder local entre la colonia y la república. Riobamba, 1750-1812," *HISTORIA*, vol. 22, no. 1, pp. 229-236, 2017.

[4] H. S. Wynne, "4 Wynnes Boating Manufacturing Company: A Market Analysis and Business Plan for Northwest Arkansas," 2016.

[5] R. S. R. Khan, and E. R. Baloch, "STRATEGIC FINANCIAL PLANNING AND FORECASTING OF EVENT MANAGEMENT COMPANY," Bahria University Karachi Campus, 2019.

[6] N. Garg, "Xenic insurance company: ethical dilemma of an employee," *Rajagiri Management Journal*, 2019.

[7] A. M. Goulielmos, "Plan the Business of a Vessel of a Tramp Shipping Company," *Modern Economy*, vol. 10, no. 6, pp. 1633-1653, 2019.

[8] M. TOMASSONI, "Development of a business plan for the expansion of CESI's operations on the IFI hydropower market," 2019.

[9] E. Forkner, M. Jenkins, T. McCartney, and S. Padgett, "MU Grocery Delivery Business Plan," 2018.

[10] R. O'Donnell, and S. Dahl-Popolizio, "Business Entrepreneurship: The Integrated Behavioral Health Business Plan," *Training to Deliver Integrated Care*, pp. 143-159: Springer, 2018.

[11] T. McKay, K. Rodríguez, and M. Coll i LLauradó, "Eco Salud: a non-profit ultrasound clinic in Guatemala: business plan," 2018.

[14] I. P. Theodorakopoulos, "Business plan MB Gold Mining Company in Madagascar," 2019.

[15] J. Estupiñan Ricardo, M. E. Llumiguano Poma, A. M. Argüello Pazmiño, A. D. Albán Navarro, L. Martín Estévez, and N. Batista Hernandez, "Neutrosophic model to determine the degree of comprehension of higher education students in Ecuador," *Neutrosophic Sets & Systems*, vol. 26, 2019.

[16] C. P. Ríos, "Guía para el análisis de problemas y toma de decisiones," *Educatio Siglo XXI*, vol. 36, no. 3 Noviembr, pp. 523-526, 2018.

[17] Y. R. Cruz, "Gestión de Información y del Conocimiento para la toma de decisiones organizacionales," *Bibliotecas. Anales de Investigación*, no. 11, pp. 150-163, 2018.

[18] A. Wali, "BUSINESS PLAN OF DIGITAL SERVICES FOR RESTAURANT IN FINLAND," 2018.

[19] C. L. Whitmore, "BUSINESS PLAN FOR CLUBHUB101. COM LLC," Kent State University, 2018.

[20] N. B. Hernandez, M. B. Ruilova Cueva, and B. N. Mazacón, "Prospective analysis of public management scenarios modeled by the Fuzzy Delphi method," *Neutrosophic Sets and Systems*, vol. 26, no. 1, pp. 17, 2019.

[21] T. L. Saaty, *Toma de decisiones para líderes*: RWS Publications, 2014.

[22] A. Arquero, M. Alvarez, and E. Martinez, "Decision Management making by AHP (analytical hierarchy process) trought GIS data," *IEEE Latin America Transactions*, vol. 7, no. 1, pp. 101-106, 2009.

[23] O. Mar, I. Santana, and J. Gulín, "Competency assessment model for a virtual laboratory system and distance using fuzzy cognitive map," *Revista Investigación Operacional* vol. 38, no. 2, pp. 170-178, 2017.

[24] S. E. López Cuenca, "Análisis de factibilidad y pertinencia del programa de Maestría en Administración de Empresas con mención en Innovación mediante el modelo AHP difuso," Universidad de las Fuerzas Armadas ESPE. Carrera de Ingeniería Comercial., 2017.

[25] O. Mar, I. Santana, and J. Gulín, "Algoritmo para determinar y eliminar nodos neutrales en Mapa Cognitivo Neutrosófico," *Neutrosophic Computing and Machine Learning,* vol. 8, pp. 4-11, 2019.

[26] M. Leyva-Vázquez, and F. Smarandache, *Inteligencia Artificial: retos, perspectivas y papel de la Neutrosofía*: Infinite Study, 2018.

[27] C. Tubet Abramo, "Diseño de una metodología de evaluación de la sostenibilidad del Mix Eléctrico Nacional, basada en el Proceso Analítico Jerárquico (AHP)," 2016.

[28] W. Ho, and X. Ma, "The state-of-the-art integrations and applications of the analytic hierarchy process," *European Journal of Operational Research,* vol. 267, no. 2, pp. 399-414, 2018.

[29] M. L. Vázquez, and F. Smarandache, *Neutrosofía: Nuevos avances en el tratamiento de la incertidumbre*: Infinite Study, 2018.

[30] M. L. VÁZQUEZ, N. B. HERNANDEZ, and F. SMARANDACHE, *MÉTODOS MULTICRITERIOS PARA DETERMINACIÓN DE LA EFECTIVIDAD DE LA GESTIÓN PÚBLICA Y EL ANÁLISIS DE LA TRASPARENCIA*: Infinite Study.

[31] M. F. Cruz, E. B. Salinas, R. M. P. Salazar, G. J. C. Castillo, G. R. T. Arcos, and J. E. Ricardo, "ESTUDIO SITUACIONAL PARA DETERMINAR ESTRATEGIAS FORMATIVAS EN LA ATENCIÓN A ESCOLARES CON NECESIDADES EDUCATIVAS ESPECIALES EN LA ZONA 5 DEL ECUADOR," *Investigación Operacional,* vol. 40, no. 2, pp. 255-266, 2019.

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