Revista Científica del ISSN: 2683-1562

Instituto Iberoamericano de Desarrollo Empresarial

INIDEM

Número 5

Volumen 1 Enero - Junio 2020

www.inidem.edu.mx

Revista Científica del Instituto Iberoamericano de Desarrollo Empresarial

Director:
Dr. Federico González Santoyo

Editor:
Dra. M. Beatriz Flores Romero

DR 2020
Reserva de Derechos al Uso Exclusivo
No. **04-2018-073111462600-102**, ISSN-2683-1562
www.inidem.edu.mx

Los artículos de esta revista están indizados en el Sistema Regional para Revistas Científicas de América Latina, El Caribe, España y Portugal (LATINDEX).
https:// www.latindex.org/ latindex/ficha?folio=29125

COMITÉ CIENTÍFICO

REVISTA CIENTÍFICA DEL INSTITUTO IBEROAMERICANO DE DESARROLLO EMPRESARIAL, año3, No. 5, Enero-Junio de 2020, es una publicación semestral editada por el **Instituto Iberoamericano de Desarrollo Empresarial**, Sidronio Sánchez Pineda # 78. Col. Nueva Chapultepec. C.P. 58280. Morelia Michoacán Tels. (443) 5065181, 5065182, www.inidem.edu.mx, Editor Responsable. Dr. Federico González Santoyo. Reserva de Derechos al Uso Exclusivo N0. **04-2018-073111462600-102**, ISSN-2683-1562, ambos otorgados por el Instituto Nacional de Derechos de Autor, Licitud de Título y contenido No- en trámite, otorgado por la Comisión Calificadora de Publicaciones y Revistas Ilustradas de la Secretaria de Gobernación. Permiso SEPOMEX No. En trámite. Impresa por talleres González Impresores, Av. General Santos Degollado No. 874 A. Colonia Industrial. C.P. 5130, Morelia, Michoacán, se terminó de imprimir el 29 de Junio, con un tiraje de 1000 ejemplares.

Revista Científica del Instituto Iberoamericano de Desarrollo Empresarial

INDICE

MODEL ESTIMATION ECOLOGICAL SECURITY AGGREGATE INDEX
G.Imanov, M.Murtuzaeva, S.Purriza. 1

APPLICATION OF FUZZY LOGIC FOR THE DETERMINATION OF THE INVENTORY IN THE ENTERPRISE
González Santoyo F., Flores Romero B., Gil Lafuente A.M. 11

SUBJECTIVE PREFERENCES ALGORITHM IN FINANCIAL SELECTION PROBLEMA
Anna Maria Gil Lafuente, Federico González Santoyo, Beatriz Flores 26

MARKETING: A BIBLIOMETRIC – BASED REVIEW
Ingrid Nineth Pinto López, Cynthia M. Montaudon Tomas 40

LA INCERTIDUMBRE DE LAS POLÍTICAS PÚBLICAS EN EL DESARROLLO SOSTENIBLE: MICROEMPRESAS POLIURETÁNICAS EN MÉXICO
Rubén Chávez Rivera, Rafael Ortiz Alvarado, Jesús Ricardo Ramos Sánchez 64

LOS NEGOCIOS ELECTRÓNICOS Y EL CONSUMISMO DE CONTENIDOS: PROPUESTA PARA MITIGAR EL CONTROL DE LA INFORMACIÓN
Rueda Chávez Rubén Fernando, Salgado Ortiz Francisco Javier, Montalvo Luna Ana Rosa 81

MODEL ESTIMATION ECOLOGICAL SECURITY AGGREGATE INDEX

G.Imanov*, M.Murtuzaeva, S.Purriza*****
Control Systems Institute of the National Academy of Science Azerbaijan
*korkmazi2000@gmail.com, **malaxat-55@rambler.ru, ***pqs@rambler.ru

Abstract. The concept of sustainable development requires system of measure to ensure ecological security. Ecological security is a level of protection of the biosphere and human society, and at the state level it represents the threat arising from anthropogenic and natural impacts on environment. The article discusses different approach to the analysis of the ecological security of Azerbaijan on the base of PSR conception. In order to develop model estimation of the ecological security aggregate index we have been used instruments of fuzzy set and fuzzy logic.

Keywords: the PSR conception, intuitionistic fuzzy set, entropy weight, ecological security aggregate index.

1. Introduction

Analysis of different definitions of "ecological security" concepts presented in the literature and the laws used in practice, show that until there is no single definition that reflects the meaning of this term. Some describe ecological security as a state of protection of human, society and the environment from the harmful effects of anthropogenic factors, natural disasters and catastrophes. Others define ecological security as a component of the environment. Still others equate this concept to the protection of natural environment. Furthermore, the concept of "ecological security" equals to the rational use of natural resources, their reproduction and quality improvement [1].

Ecological security is a condition where the ecological in the community meets the needs of its inhabitants, without diminishing its natural reserve.
Ecological security - the state of protection environment and the vital interests of a person from possible negative effects of economic and other activities, emergency situations of natural and technogenic character and their consequences.

Ecological security is implemented at the global, regional and local levels.

Global ecological security issues are studied by the UN, UNESCO, UNEP and other international organizations. International acts on ecological protection across biosphere, the implementation of interstate ecological programs, the establishment of inter-

governmental forces for elimination of ecological disasters with a natural or an anthropogenic character are accepted at this level.2
In order to assess level of ecological security at regional and local levels are used different methods. In this paper, for the purpose of analysis, the aggregated index of ecological security, calculated by classical methods, is studied and proposed fuzzy approach in formulation of the index.

2. Problem Statement

For realization the problem corresponding to the model, pressure-state-response concept is used. The structure of the PSR (pressure-state-response) has been proposed by Anthony Frendo and David Rapport [2]. The concept is used by the Organization for Economic Co-operation and Development (OECD) to analyze the state of natural environment [3].

PSR is based on the concept of causality: human activity puts pressure (P) on the environment, and changes its quality and quantity of natural resources (state (S)). Society responds (R) to these changes through ecological, general economic and retaliatory measures ("Social Responses"). With this in mind, we have established and placed in Table 1 a system of indicators which describe PSR conception for Azerbaijan during the period of 2010-2015 [7].

Table 1. Indicators of PSR conception for Azerbaijan

		Indicators	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
P	1	Population density (people per km^2 of land area)	105	107	108	109	111	111
	2	Population growth rate	12.5	13.5	13.0	12.8	12.2	11.7
	3	Oil and gas production (thsd. manats)	20198.7	26055.4	24747.0	23658.0	20977.0	14723.0
	4	Cost of construction work (thsd. manats)	4531384.9	6115011.1	7716020.2	8721165.0	8591861.7	7319551.9
	5	Number of cars	982553.0	1037626.0	1135936.0	1232678.0	1291008.0	1322610.0
	6	Number of cattle (thsd.)	10918.9	11025.0	11128.3	11254.1	11340.5	11349.0
	7	Carbon dioxide (CO_2) (thsd.ton)	14399.6	13809.4	12471.4	15135.8	16091.9	13980.8

S	8	Nitric oxide (N_2O) (thsd.ton)	11.8	25.9	15.8	5.0	4.7	7.0
	9	Methane (CH_4) (thsd.ton)	18.3	298.3	385.2	248.8	95.7	34.1
	10	Air polluting emissions from transportation (thsd.ton)	742	779	849	940	966	978
	11	Soil erosion (ha)	3743.5	3733.05	3722.53	3712.23	3701.87	3691.53
	12	Pollutants released into the atmosphere (thsd.ton)	214.8	224.0	226.5	197.3	189.3	178.0
	13	Emission of polluted water through waste water (mln.manat)	6005.0	5068.0	5365.0	5154.0	5347.0	5573.0
R	14	National parks (km^2)	8807.74	8807.74	8925.5	8925.5	8925.5	8925.5
	15	Investment to ecological protection (thsd. manat)	260673.8	320253.5	419317.9	398187.5	283414.6	141464.8
	16	Investment to science (thsd. manat)	92.8	106.1	116.7	117	124.2	131.7
	17	The share of energy supply from renewable energy in total amount of energy supply	3.1	2.4	1.8	2.0	1.8	1.9

As seen from Table 1, PSR indicators are of different dimensions, necessary to bring these to a common measurement. In order to estimate aggregate index of ecological security. For this purpose, we use the following formula of statistical normalization:

$$X_{tn} = \frac{X_t - \overline{X_t}}{\sigma_t}$$

where X_{tn} - normalized value of X indicator in the t-th year, $\overline{X_t}$- the average value of X indicator during the analyzed period, σ_t - standard deviation of X indicator during the period.

The normalized values of indicators for the period of 2010-2015-th years are given below in Table 2.

Table 2. Normalized value of indicators for the period of 2010-2015

		Indicators	2010	2011	2012	2013	2014	2015
P	1	Population density (people per km^2 of land area)	0	0.333	0.5	0.667	1	1
	2	Population growth rate	0.444	1	0.722	0.611	0.278	0
	3	Oil and gas production (thsd. manats)	0.483	1	0.885	0.788	0.552	0
	4	Cost of construction work (thsd. manats)	0	0.378	0.760	1	0.969	0.666
	5	Number of cars	0	0.162	0.45	0.736	0.907	1
	6	Number of cattle (thsd.)	0	0.247	0.487	0.779	0.98	1
S	7	Carbon dioxide (CO_2) (thsd.ton)	0.533	0.370	0	0.736	1	0.417
	8	Оксид азота (N_2O) (тыс. тонн)	0.335	1	0.524	0.014	0	0.109
	9	Methane (CH_4) (thsd.ton)	0	0.763	1	0.628	0.211	0.043
	10	Air polluting emissions from transportation (thsd.ton)	0	0.157	0.453	0.839	0.949	1
	11	Soil erosion (ha)	1	0.799	0.597	0.398	0.199	0
	12	Pollutants released into the atmosphere (thsd.ton)	0.759	0.949	1	0.398	0.233	0
R	13	Emission of polluted water through waste water (mln.manat)	1	1	0.317	0.092	0.298	0.539
	14	National parks (km^2)	1	1	0	0	0	0
	15	Investment to ecological protection (thsd. manat)	0.571	0.357	0	0.076	0.489	1
	16	Investment to science(thsd. manat)	1	0.658	0.386	0.378	0.193	0
	17	The share of energy supply from renewable energy in total amount of energy supply	0	0.539	1	0.846	1	0.923

Using the arithmetic mean for each year subsystem the values of PSR sub indices are calculated and given in Table 3.

Using the indicators in Table 3, aggregate index of ecological security is calculated by means of the following formula:

$$AESI = w_1 * P + w_2 * S + w_3 * R$$

where $w_i (i = 1,..,3)$ - weight of individual sub-indices, which are determined by an expert.

In order to calculate values of sub-indices' weights we use weights proposed in the study [4], which are, respectively:

$$w_1 = 0.37, w_2 = 0.33, w_3 = 0.30$$

Table 3. Values of indicators of Ecological Security Index obtained by classical method for 2010-2015.

	2010	2011	2012	2013	2014	2015
P	-1,0762	-0,09903	0,169742	0,48421	0,497342	0,023936
S	0,180529	0,267032	0,183229	-0,07203	-0,12579	-0,43297
R	-0,37054	-0,32514	0,301966	0,353513	0,102653	-0,06245
ESI	-0,48	-0,58	2,12	2,9	2,17	1,39

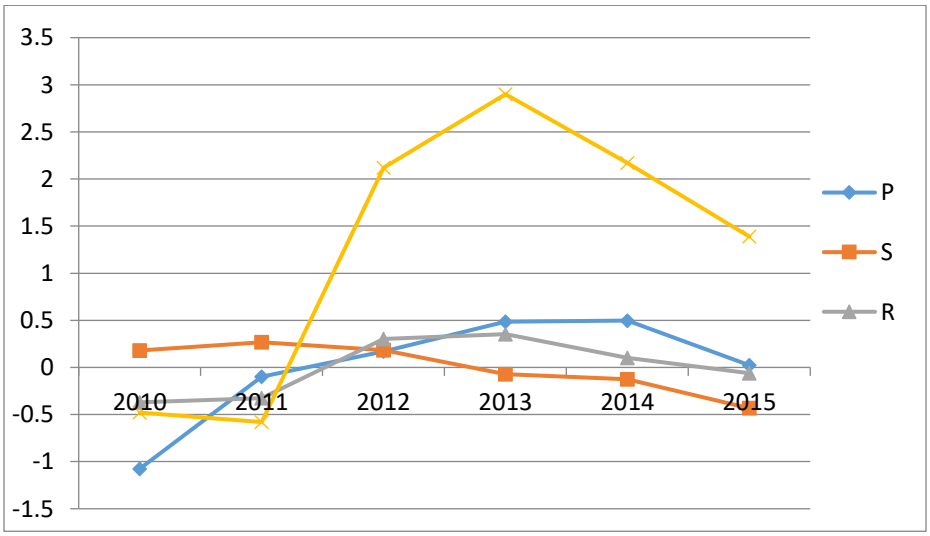


Fig.1 Graphical value of sub-indices and ESAI

The results of solution are given in a graphical form in Figure 1. As seen from the figure Aggregate index for the years of 2010 and 2011 are respectively -0.48 and -0.58. This shows a low level of security. In 2012 and 2013, security has increased and amounted to 2.12 and 2.9 respectively. However, in 2014 and 2015 again it decreased and amounted to 2.17 and 1.39, respectively.

It should be noted that determining the weights of sub indices' indicators has a particular importance in calculating these sub-indices. Generally expert opinion is used in order to determine the weights. In this work for defining the objective weights of individual sub-indices, we propose fuzzy approach and use instruments of fuzzy sets and fuzzy logic in determining ecological security aggregate index.

To determine the objective weights of the individual sub-indices, we propose a fuzzy approach of defining the aggregate index ecological security (FAESI).

3. Fuzzy Aggregate Index of Ecological Security

In a fuzzy approach to the aggregate index of financial stability, the obtained values of sub-indices for the years of 2010-2015 are divided into the following terms:

- Very low security - VL = (-1.98, -1.51, -1.03);

- Low Security - L = (-1.13, -0.69, -0.24);

- High security - H = (-0.34, 0.11, 0.55);

- Very high security - VH = (0.45; 0.9; 1.34)

Linguistic variables matrix for 2010-2015 are given in the following table 4.

Table 4. Values of linguistic variables of the Ecological Security Index for 2010-2015 years

	2010	**2011**	**2012**	**2013**	**2014**	**2015**
P	VL	H	H	VH	H	H
S	H	H	H	H	H	L
R	L	L	H	H	H	H

In determining the weights of the index expert estimates are mainly used. We have used instruments of intuitionistic fuzzy set in order to define the weights of individual sub-indices of aggregate index of ecological security.

The intuitionistic fuzzy set (IFS), suggested by K.Atanassov [5], is a generalization of L. Zadeh fuzzy set. The intuitionistic fuzzy set is defined as:

$$A = \{< x, \mu_A(x), \nu_A(x) > | x \in X\},$$

where

$$\mu_A: X \to [0,1] \nu_A: X \to [0,1]$$

if

$$0 \leq \mu_A(x) + \nu_A(x) \leq 1 \qquad \forall x \in X$$

$\mu_A(x), \nu_A(x) \in [0,1]$ numbers are respectively degrees of membership and non-membership of x to A.

For each of intuitionistic fuzzy set X, there is an intuitionistic index of x in A:

$$\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$$

Indicators of sub-indices of ecological security of Azerbaijan for 2010-2015 years, corresponding to the indicators of intuitionistic fuzzy set, are given in the following table 5.

Table 5. Indicators of intuitionistic fuzzy set

Sub-indices / Years	P			S			R		
	$\mu_1 t$	$\nu_1 t$	$\pi_1 t$	$\mu_2 t$	$\nu_2 t$	$\pi_2 t$	$\mu_3 t$	$\nu_3 t$	$\pi_3 t$
2010	0.05	0.95	0	0.84	0.16	0	0.29	0.71	0
2011	0.54	0.46	0	0.64	0.36	0	0.19	0.81	0
2012	0.86	0.14	0	0.83	0.17	0	0.56	0.44	0
2013	0.08	0.92	0	0.59	0.41	0	0.45	0.55	0
2014	0.11	0.89	0	0.48	0.52	0	0.98	0.02	0
2015	0.81	0.19	0	0.43	0.57	0	0.62	0.38	0

In this study, in order to define the weights of sub-indices of ecological security, we have used generalized entropy measure of intuitionistic fuzzy set F, composed of n elements, proposed by E.Szmidt andJ.Kacprzyk [6]:

$$E(A_i) = \frac{\max Count(A_i \cap A_i^c)}{\max Count(A_i \cup A_i^c)}, (i=1,\ldots,n).$$

The calculation of entropy of the individual sub-indices for 2014 are given below:

$$E(A_1) = \frac{(0.11,0.89,0) \cap (0.89,0.11,0)}{(0.11,0.89,0) \cup (0.89,0.11,0)} = \frac{0.11}{0.89} = 0.12$$

$$E(A_2) = \frac{(0.48,0.52,0) \cap (0.52,0.48,0)}{(0.48,0.52,0) \cup (0.52,0.48,0)} = \frac{0.48}{0.52} = 0.91$$
$$E(A_3) = \frac{(0.38,0.62,0) \cap (0.62,0.38,0)}{(0.38,0.62,0) \cup (0.62,0.38,0)} = \frac{0.38}{0.62} = 0.61$$

Entropy of the individual sub-indices for the years of 2010-2015 are as following:

$$2010 - E(A_1) = 0.05;\ E(A_2) = 0.19;\ E(A_3) = 0.36$$
$$2011 - E(A_1) = 0.85;\ E(A_2) = 0.56;\ E(A_3) = 0.24$$
$$2012 - E(A_1) = 0.17;\ E(A_2) = 0.20;\ E(A_3) = 0.79$$
$$2013 - E(A_1) = 0.09;\ E(A_2) = 0.68;\ E(A_3) = 0.82$$
$$2014 - E(A_1) = 0.12;\ E(A_2) = 0.91;\ E(A_3) = 0.61$$
$$2015 - E(A_1) = 0.24;\ E(A_2) = 0.75;\ E(A_3) = 0.61$$

Next, on the basis of the following formula the weights of individual sub-indices are defined:

$$w_i = \frac{1 - E(A_i)}{n - \sum_{i=1}^{n} E(A_i)}$$

For 2014, the weights of individual sub-indices are calculated as follows:

$$w_1(2014) = \frac{1 - 0.12}{3 - 1.64} = \frac{0.88}{1.36} = 0.65$$

$$w_2(2014) = \frac{1 - 0.91}{3 - 1.64} = \frac{0.09}{1.36} = 0.06$$

$$w_3(2014) = \frac{1 - 0.61}{3 - 1.64} = \frac{0.39}{1.36} = 0.29$$

Using the weights of individual sub-indices and their linguistic values (Table 3), aggregate index of ecological security is calculated for the year of 2014:

$$AIES(2014) = 0.65 * H + 0.06 * H + 0.29 * H$$
$$= 0.65 * (-0.34,0.11,0.55) + 0.06 * (-0.34,0.11,0.55) + 0.29 * (-0.34,0.11,0.55) =$$
$$= (-0.220,0.072,0.0.360) + (-0.020,0.007,0.030) + (-0.099,0.032,0.160) = (-0.34,0.11,0.55) = H$$

The values of sub-indices' weights and aggregate indices of ecological for the years of 2010-2015 are given in Table 6.

Table 6. The calculations results of sub-indices' weights and aggregate indices of ecological security for 2010-2015

	w_1	w_2	w_3	AESI
2010	0.40	0.34	0.26	(-1.22,-0.94,-0.29) **VL - L**
2011	0.11	0.33	0.56	(-0.79,-0.34,0.1) **L - H**
2012	0.46	0.48	0.10	(-0.35,0.12,0.57) **H - VH**
2013	0.64	0.23	0.13	(0.17,0.97,1.06) **H - VH**
2014	0.65	0.06	0.29	(-0.34,0.11,0.55) **H**
2015	0.55	0.17	0.28	(-0.48,-0.03,0.41) **L - H**

Table 6 shows weights of individual sub-indices for each year is changing dramatically. For instance, if the value of pressure sub-index (P) weights - in 2011 was 0.11, in 2014 it was 0.65. The weights of state sub-index (S) in 2014 was 0.06, and 0.48 in 2012. The weights of response sub-index (R) changed from 0.1 in 2012 to 0.56 in 2011.

4.Conclusion

The results of research can be used by decision-makers in the field of ecological governance for controlling individual indicators of socio-eco-economic system. It should be noted that the proposed work is not intended to be a complete study of the problem. In the future, in development of the model the maximum permissible concentration of individual elements in environment should be considered.

References

[1] N.Skiter, A.Rogachev, T.Mazaeva, ModellingEcologicalSecurity of a State, Mediterranean Journal of Social Sciences, MCSER Publishing, Roma, Italy, Vol.6, No 3 S6, June 2015, 185-192 pp.

[2] Rapport, David and Friend, Anthony (1979). "Towards a Comprehensive Framework for Environment Statistics: a Stress-response Approach", Ottawa, Statistics Canada

[3] OECD Ecological indicators, Development, Measurement and Use. Reference paper, 2003, 37 p.

[4] Pei Liang, Du Liming, Yue Guijie, Ecological Security Assessment of Beijing Based on PSR Model, Procedia Ecological Sciences, No2, 2010, 832-841 pp
[5] K.Atanassov, Intuitionistic fuzzy sets, Fuzzy Sets and Systems 20(1), 1986, 87-96 pp.
[6] E.Szmidt, J.Kacprzyk, Entropy for intuitionistic fuzzy sets.Fuzzy Sets and Systems,118, 2001, 467-477 pp.
[7] State Statistical Committee of Azerbaijan Republic, www.stat.gov.az.

APPLICATION OF FUZZY LOGIC FOR THE DETERMINATION OF THE INVENTORY IN THE ENTERPRISE

González Santoyo F.[1], Flores Romero B.[1], Gil Lafuente A.M.[2]
[1]Instituto Iberoamericano de Desarrollo Empresarial (INIDEM) – Universidad Michoacana de San Nicolás de Hidalgo (México)-
[2]Universidad de Barcelona, Spain
fegosa@inidem.edu.mx,betyf@umich.mx,amgil@ub.edu

Abstract.
This work presents a theoretical extension to the inventory model EOQ with and without production, representing all variables as crisp and fuzzy quantities. The model is compared against the classical EOQ model with and without production. In this comparison, crisp and fuzzy data were used, and the results and conclusions were contrasted. These representation and reasoning mechanisms enables strategic design for operational decision making in the enterprise, which will make the enterprise a world class company.

Keywords: Fuzzy Logic, Inventory, Decision Making, Crisp.

1. Introduction

In the production dynamics of a company, the production and inventory management requires flawless strategic planning (González et al. 2002), (González et al. 2010), (González et al. 2011), (González et al. 2013). This planning must include product demand forecast, optimal use of the plant capacity, and optimization of human resources, manufacture and acquisition times and amounts.

Kaufmann A. and Gil Aluja J. (Kaufmann and Gil, 1986) define the production process as the central nucleus of the production process. The enterprise's activity revolves around this nucleus, demanding raw material and finished products supply. That makes necessary the design of an efficient material delivery program. Otherwise, the plant may become inactive due to the lack of raw material. This situation leads to high cost levels, produced by operating the plant at levels below its capacity.

Managers keep raw material and finished product stocks, which represent static assets. These assets could be used in other productive activities. This situation arise for the following reasons:

- Productive activity makes impossible to maintain a given stock level.
- Uncertainty in future demand leads to keeping a minimum inventory level.
- Speculations arise when a sudden increase in prices is expected, or there is a high possibility of sales increase in the future.

Inventory control (Narasimhan et. al., 1996) is a critical aspect of successful management. When keeping inventories is costly, companies cannot have high stock volumes.

To minimize the stocks, the company must execute a flawless planning to match the offer and demand levels, seeking the condition where the stock amount be minimal. Inventory is an amount of stored materials to be used in production or to satisfy the consumers demand (Schroeder, 1993). Basic decisions to be made in stock management, among others, are:

- When to order?
- How much to order?

To answer these questions we need to know the behaviour of the company's expected demand for the period of time under analysis, annual stock cost **(h)**, generally a percentage of the item cost, the item cost (C), and service costs (S).

Stock management is one of the most important managerial functions, since it demands assets and if not performed properly, it can delay delivery of products to consumers. Optimal stock management has impact on production, marketing, and finance. The operational components found in stock management are: Financial. Seeks to keep low inventory levels, to avoid excessive stock levels and maintain low costs. Marketing. Seeks to keep high inventory levels, to assure supply and sales. Operating. Seeks to keep adequate stock levels to guarantee an efficient production and homogeneous usage levels.

A company needs strong stock management systems to balance the above requirements, whose ideal stock levels conflict. This leads to seeking an optimal stock level, which allows the company to satisfy the market needs using the least possible amount of financial resources.

In a stock system, there exists uncertainty in the offer-demand behaviour, and in the time required to complete the process until products reach consumers.

The problem addressed in this paper is the determination of how much to order to maintain a minimum stock level and still be able to face an uncertain demand. We also determine the time to order, when the company is or is not in production.

This paper is organized as follows: Section1 provides an introduction; Section 2 provides background knowledge on stock costs; Section 3 explains demand behaviour; Section 4 and 5 present the classical EOQ model with ad without production, respectively; Section 6 presents a case analysis; Section 7 presents the results; Sections 8 and 9 present the conclusions and recommendations.

2. Materials and Mehods

2.1. Stock Costs

The structure of inventory (Harris, 1915), (Bellman, R. E., Zadeh, L.A., 1979), (De S.K.,et al, 2008), (De S.K.,et al, 2003), (De S.K., 2013) costs et a includes the following types of costs: **Item cost.** The cost of purchasing and/or producing the stock items. Generally expressed as the unit cost times the stock capacity. **Ordering cost, preparation, or waste.** This cost is related to the purchase of a group or lot of items. This cost does not depend on the number of items. **Inventory cost.** This cost is related with storing items for a period of time. This cost is usually expressed as a percentage of the item value per unit of time.

Inventory costs normally have three components: **Equity cost.** This cost arises when items are stored and equity is not available for other purposes. This cost represents the cost of not performing other investments. **Storage cost.** This cost includes components that vary with space, insurance, and taxes. **Obsolescence, damage, and waste cost.** These costs are assigned to items that age or expire, the higher the risk to become unusable, the greater the cost rate. The costs of items that expire are added to aging costs. For instance, in some grocery items, the loss costs include stolen items and damage related to maintaining them in stock. **Out of stock cost.** This kind of cost reflects the consequences of running out of stock for each product in the inventory. It includes raw materials, finished products, etc. The lack of an item brings causes the loss of an opportunity to produce or sell a product.

2.2. Demand Behavior

Future demand in an enterprise can be classified according to what we know about it (Hariga, M.A.,1996), (Kumar, R.S., et al., 2012), (Kaufmann and Gil, 1986), (González and Flores, 2002): When the company knows exactly the demand's behavior with time. This fact represents deterministic or certain demand. When the company does not know exactly how demand behaves. This situation represents a probabilistic or stochastic behavior. When the company does not know the future levels of demand, but takes advantage of a set of experts' knowledge, expressed with uncertainty, and the reasoning framework to be used in fuzzy logic.

2.3. Classical Economic Order Quantity (EOQ) – No Production

F.W. Harris developed this methodology in 1915 (Harris, 1915), and it is still in use for inventory management when demand is an independent variable.

The basic assumptions of the model are: The demand rate is known and constant along time. Delivery time is constant and zero. Since demand and delivery are instantaneous, there is no stocking. Materials are bought or produced in groups or lots, and place in stock. Unit cost per item is constant and there is no discount for bulk sales. The cost to place an order is k monetary units. An item unit cost is c. The unit storage cost is h. There is no interaction between products. According to these assumptions, stock behaves as shown in Fig.1.

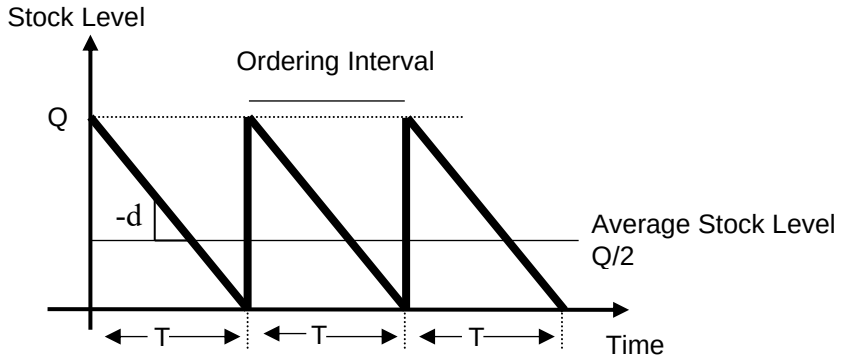


Figure 1: EOQ Model

where Q is the ordering amount (in number of units), d is demand (in number of units/time), K is the fixed cost, c is the cost per unit ($/unit), and h is the storage cost per unit = i %(c).

Figure 2 shows the behaviour of cost; as **Q** increases, the purchasing cost decreases, since we place less orders per year. At the same time, the stocking cost increases, since the stock level increases. Therefore, purchasing and stocking costs compensate, one decreases while the other one increases. To determine the value of **Q**, that minimizes **CP(Q)** we compute the partial derivative of **CP(Q)** and solve for **Q** when it is zero. The cost per period is given by Equation (1).

$$CT(Q) = k + cQ + h\left(\frac{Q}{2}\right)T \tag{1}$$

The optimal cost is given by Equation (2).

$$\mathrm{CP(Q)} = \lim_{n\to\infty}\left[\frac{n\,\mathrm{CT(Q)}}{n\,T}\right] = \frac{\mathrm{CT(Q)}}{T} = \frac{k+cQ+h\left(\frac{Q}{2}\right)T}{T} = \frac{k\,d}{Q} + c\,d + \frac{h\,Q}{2} \tag{2}$$

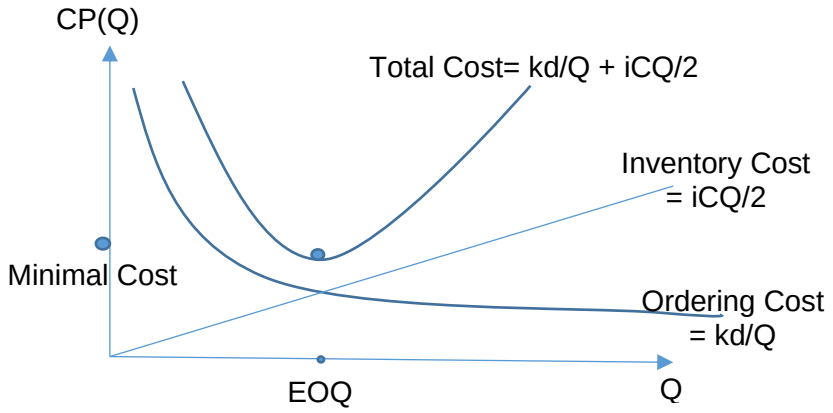


Fig. 2. Cost Behavior

But

$$T = \frac{Q}{d} \tag{3}$$

$$\frac{\partial\, CP(Q)}{\partial\, q} = 0 = -\frac{k\, d}{Q^2} + \frac{h}{2} = 0$$

$$\frac{k\, d}{Q^2} = \frac{h}{2}$$

$$Q^2 = \frac{2\, k\, d}{h}$$

Assuming $C_p = k$ and $C_h = h$, we obtain Equation (4).

$$Q = \sqrt{\frac{2\,k\,d}{h}} = \sqrt{\frac{2\,C_p d}{C_h}} \tag{4}$$

Q represents the ordering size that minimizes the stock average operation cost. Q is generally computed per year, but any time unit can be used. To determine the time required for the stock to reach zero, we use Equation (5).

$$T = \frac{Q}{d} = \sqrt{\frac{2\,C_p}{C_h d}} = \frac{1}{N} \tag{5}$$

The stock optimal average cost can be computed using Equation (6).

$$CP(Q) = \frac{kd}{Q} + cd + \left(\frac{hQ}{2}\right) \tag{6}$$

2.4. Classical Economic Order Quantity (EOQ) – with Production

In normal operation, the demand and consumption of produced units occur at a constant rate (González et al., 2002). Let us assume the production rate is greater than the demand rate. With any other assumption, stock will not accumulate and there will be a lack of products.

Let **p** be the production rate and **d** the demand rate (both considered constant). The objective function is a function of the total cost (Eq. (7)).

$$CIT = Ordering\ Cost\ + \text{Maintenance}\ Cost \tag{7}$$

The ordering cost is given by Equation (8).

$$C_p \left[\frac{d}{Q}\right] \tag{8}$$

The interpretation of the ordering cost while producing is known as start-up. This cost includes man-hours worked, material, and production loss cost (incurred while getting the production system ready for operation). It is a fixed cost for each production lot, independent of the number of items being produced. Start-up downtimes are integrated to the production plan development costs for each item, ordering formulation, all paperwork needed to prepare machinery and equipment, and the order flow control along the company's process. Maintenance cost is the unit cost to keep equipment running, times the mean stock level.

Since the production of the ordered amount (**Q**) takes place over a period of time defined by the production rate (**p**) and the parts enter the stock at the production rate, given a consumption rate, we obtain the inventory behavior shown in Figure 3. The maximum and mean inventory levels are a function of the lot size, de production rate (**p**) and the demand rate (**d**) (Guiffinda et al., 2010).

To determine the mean inventory level ($\mathbf{I_p}$), since items are being received and consumed simultaneously, we first compute the time ($\mathbf{t_p}$) required to produce the amount ***(Q)***. See Equation (9).

$$t_p = \frac{Q}{p} \tag{9}$$

where t_p is the time required to produce the ordered amount Q, given the supply rate p. The maximum Inventory level is given by Equation (10).

$$I_{max} = t_p(p - d) = (p - d)\left(\frac{Q}{p}\right) = Q\left(1 - \frac{d}{p}\right) \tag{10}$$

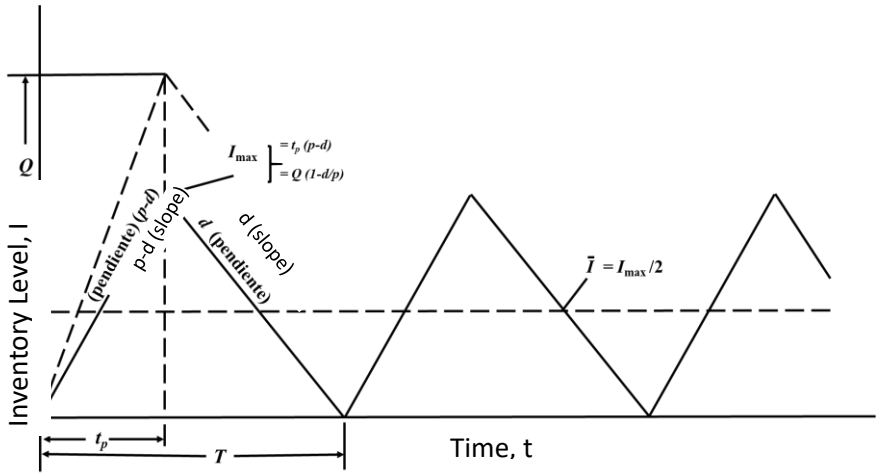


Fig. 3. Inventory Model with Production

where (p-d) is the stocking rate and t_p is the replenishing time (we assume p>d). Between replenishing times, stock decreases at a demand rate d.

To compute the total inventory cost, we need to express the maximum stock level in terms of the ordering amount (Gallagher et. al., 1982). The mean inventory level is given by Equation (11).

$$I_p = \frac{t_p(p-d)}{2} = \frac{I_{max}}{2} \tag{11}$$

Substituting Eq. (9) in Eq. (11), we obtain Equation (12).

$$I_p = \left[\frac{Q}{2}\right]\left[1 - \frac{d}{p}\right] \tag{12}$$

The annual maintenance cost **(CM_a)** and the total cost **(C_T)** are given by Equations (13) and (14), respectively.

$$CM_a = C_h\left(\frac{Q}{2}\right)\left[1 - \frac{d}{p}\right] \tag{13}$$

$$C_T = C_p\left(\frac{d}{Q}\right) + C_h\left(\frac{Q}{2}\right)\left(1 - \frac{d}{p}\right) \tag{14}$$

Since the ordering amount is given by Equation (15), the total cost can be expressed as in Equation (16).

$$Q^* = \sqrt{\frac{2C_p d}{C_h\left[1-\frac{d}{p}\right]}} \tag{15}$$

$$C_T^* = \sqrt{2C_p C_h d\left(1 - \frac{d}{p}\right)} \tag{16}$$

Finally, the optimal production lot size and optimal time between lots are given by Equations (17) and (18), respectively.

$$N^* = \frac{d}{Q^*} \tag{17}$$

$$T^* = \frac{1}{N^*} = \frac{Q^*}{d} \tag{18}$$

2.5. Case Analysis

To illustrate the application of the (EOQ) model, with and without production, both under certainty and uncertainty, we will use the case described in this section. The company El Zapato Dorado, is a world-class company that ships shoes world wide from León, Guanajuato, Mexico. According to its records, the total stock is 10,000 pairs of shoes. The mean cost per pair is $12.00, so the total inventory cost is $1,200,000.00. The equity cost is estimated as an annual rate of 5%, taxes, insurance, damages, wastes, and storage management costs are also 5%.

The most requested shoes in the market are type 1. A marketing research and statistics indicate that last year 10 orders of 1,000 pairs were placed per period (5 weeks), at a cost of $20.00 per pair. The manufacturer guarantees that each order is delivered in 3 days, which has been accomplished so far. The average demand is 200 pairs per week.

The company takes 30 minutes to process an order. The cost per order is $16.00 per hour. Other costs include office supplies, mailing, telephone, clerical work, and transportation amount to $1.00 per order. Given this, the total cost of ordering is $17.00.

The company faces the choice of keeping a small stock and order frequently, or keep a large stock and order infrequently. The first choice may produce excessive ordering costs, while the second one would imply a higher stocking cost. So, we need to obtain an optimal ordering amount, minimizing stocking costs and still satisfying all market requirements.

As **Q** grows, the stock management costs grow. This implies that the annual number of orders decreases non-linearly, tending to zero, asymptotically.

In the model that includes production, we assume the company installs a new production plant next to the main storage. Let us assume the plant's capacity (production rate) **p**=15,000 pairs per year, $\mathbf{C_h}$ = $2.00, and $\mathbf{C_p}$ = $ 9.00.

Fuzzy EOQ – No Production

To analyze the system under uncertainty, we use a fuzzy logic model, using triangular fuzzy numbers. (kao, C., Hsu, W. K., 2002), (Kazemi, N. et al., 2015), (Mahata G. et al., 2007), (Mahata G. et al., 2011), Mahata G. et al., 2013). Following the information provided by a panel of experts, using the Delphi, we have: $\tilde{d}$= (9 500, 10 000, 10 500), $\tilde{C}_p$ = (8.5, 9, 9.5), and $\tilde{C}_h$= (1.5, 2, 2.5). The analysis is performed using a 11-value scale for fuzzy linguistic terms. To each $\propto$-cut $[0 \leq \propto_k \leq 1]$, corresponds a confidence interval $[r_k^{\propto}, s_k^{\propto}]$ that can be expressed as a function of $\propto_k$ (see Equation (19)).

$$[r_k^{\propto}, s_k^{\propto}] = [r + (m - r) \propto_k, s - (s - m) \propto_k] \quad (19)$$

For demand $(\tilde{d})$, the confidence interval is expressed in Equation (20), which is evaluated for the different $\propto$-cuts as in Table 1.

$$[r_k^{\propto}, s_k^{\propto}] = [9500 + 500 \propto_k, 10\,500 - 500 \propto_k] \quad (20)$$

Table 1. Demand Confidence Intervals for different $\propto$-cuts

$\propto_k$	r_k	s_k
0	9500	10500
0.1	9550	10450
0.2	9600	10400
0.3	9650	10350
0.4	9700	10300
0.5	9750	10250
0.6	9800	10200
0.7	9850	10150
0.8	9900	10100
0.9	9950	10050
1	10000	10000

For $\tilde{C}_p$ = (8.5, 9, 9.5), the confidence interval is expressed in Equation (21), which is evaluated for the different $\propto$-cuts as in Table 2.

$$[r_k^{\propto}, s_k^{\propto}] = [8.5 + 0.5 \propto_k, 9.5 - 0.5 \propto_k] \quad (21)$$

Table 2. Ordering Cost Confidence Intervals for different ∝-cuts

$\propto_k$	r_k	s_k
0	8.5	9.5
0.1	8.55	9.45
0.2	8.6	9.4
0.3	8.65	9.35
0.4	8.7	9.3
0.5	8.75	9.25
0.6	8.8	9.2
0.7	8.85	9.15
0.8	8.9	9.1
0.9	8.95	9.5
1	9	9

For $\tilde{C}_h$ = (1.5, 2, 2.5), the confidence interval is expressed in Equation (22), which is evaluated for the different ∝-cuts as in Table 3.

$$[r_k^{\propto}, s_k^{\propto}] = [1.5 + 0.5 \propto_k, 2.5 - 0.5 \propto_k] \quad (22)$$

Table 3. $\widetilde{C}_h$ Cost Confidence Intervals for different ∝-cuts

$\propto_k$	r_k	s_k
0	1.5	2.5
0.1	1.55	2.45
0.2	1.6	2.4
0.3	1.65	2.35
0.4	1.7	2.3
0.5	1.75	2.25
0.6	1.8	2.20
0.7	1.85	2.15
0.8	1.9	2.1
0.9	1.95	2.05
1	2	2

The ordering quantity (**Q**) is determined by Equation (23):

$$\widetilde{Q} = \sqrt{\frac{2\widetilde{d}\widetilde{C_p}}{\widetilde{C_h}}} \quad (23)$$

$$\tilde{Q} = (254, 300, 364)$$

The Total Annual Cost ($\widetilde{CIT}$) is determined by Equation (24):

$$\widetilde{\mathrm{CIT}} = \sqrt{2\widetilde{\mathrm{C_p}}\widetilde{\mathrm{C_h}}\tilde{\mathrm{d}}} \tag{24}$$

$$\widetilde{CIT} = (492.18, 600, 706.22) \approx (492, 600, 706)$$

The Optimal Order Size or Number ($\widetilde{N}$) is determined by Equation (25):

$$\widetilde{\mathrm{N}} = \frac{\tilde{\mathrm{d}}}{\tilde{\mathrm{Q}}} \tag{25}$$

$$\widetilde{N} = (26, 33.33, 41.33)$$

The Ordering Pertiod ($\widetilde{T}$), is determined by Equation (26):

$$\widetilde{\mathrm{T}} = \frac{1}{\widetilde{\mathrm{N}}} \tag{26}$$

$$\widetilde{T} = (0.0241, 0.030, 0.0384)$$

Fuzzy EOQ Analysis – with Production

According to (Mahata C. G., 2015), (Kaufman A.,and Gil Aluja J. et al., 1986, 1994), following the opinion of a set of experts using the Delphi method, the behaviour of the involved variables was estimated as described below.

$$\tilde{\mathrm{d}} = (9\,500, 10\,000, 10\,500) \tag{27}$$

$$\widetilde{\mathrm{C_p}} = (8.5, 9, 9.5)$$

$$\widetilde{\mathrm{C_h}} = (1.5, 2, 2.5)$$

$$\tilde{\mathrm{p}} = (14\,500, 15\,000, 15\,500)$$

The fuzzy ordering amount ($\tilde{Q}$) is given by Equation (28)

$$\tilde{Q} = \sqrt{\frac{2\widetilde{C_p}\,\tilde{d}}{\widetilde{C_h}\left[1 - \frac{\tilde{d}}{\tilde{p}}\right]}} = \sqrt{\frac{2(8.5, 9, 9.5)(9500, 10000, 10500}{(1.5, 2, 2.5)\left[1 - \frac{(9500, 10000, 10500)}{(14500, 15000, 15500)}\right]}}$$

$$\tilde{\mathrm{Q}} = (409, 520, 694) \tag{28}$$

The Total Annual Cost ($\widetilde{CIT}$) is determined by Equation (29):

$$\widetilde{CIT} = \sqrt{2\widetilde{C_p}\,\widetilde{C_h}\tilde{d}\left(1-\frac{\tilde{d}}{\tilde{p}}\right)} \tag{29}$$

$$\widetilde{CIT} = (258.52, 346.44, 539.39)$$

The optimal number of lots of size (N) is determined by Equation (30):

$$\widetilde{N} = \frac{\tilde{d}}{\tilde{Q}} = \frac{(9\,500, 10\,000, 10500)}{(409,520,694)} \tag{30}$$
$$\widetilde{N} = (13.68, 19.23, 25.67)$$

The optimal Ordering Pertiod ($\widetilde{T}$), is determined by Equation (31):

$$\widetilde{T} = \frac{1}{\widetilde{N}} = \frac{\tilde{Q}}{\tilde{d}} = \frac{(409,520,694)}{(9\,500, 10\,000, 10\,500)} \tag{31}$$
$$\widetilde{T} = (0.038, 0.052, 0.073) \text{ years}$$

which expressed in days would be (12.25, 18.2, 25.55).

3. Results

Table 4 compares the results of the EOQ model without production in the classical and the fuzzy versions.

Table 4. Results of the classical and fuzzy EOQ models without production

Classical EOQ	**Fuzzy EOQ**
Q = 300 units	$\tilde{Q}$ = (254, **300**, 364)
CIT = $ 600.00	$\widetilde{CIT}$ = (492.18, 600, 706.22) ≈ (492, **600**, 706)
N = 33.33 ≈ 33 orders per year	$\widetilde{N}$ = (26, 33.33, 41.33)
T = 0.030 per year	$\widetilde{T}$= (0.0241, **0.030**, 0.0384)

Table 5 compares the results of the EOQ model with production in the classical and the fuzzy versions.

Table 5. Results of the classical and fuzzy EOQ models with production

Classical EOQ with Production	Fuzzy EOQ with Production
Q = 522 units	$\tilde{Q} = (409, \mathbf{520}, 694)$
CIT = $ 346.41	$\widetilde{CIT}$ = (258.52, **346.44**, 539.39)
N = 19.14 orders per year	$\tilde{N}$ = (13.68, **19.23**, 25.67)
T = 0.052 per year = 18.2 days	$\tilde{T}$ = (0.038, **0.052**, 0.073)

4. Conclusions

From the analysis performed, we conclude that it is necessary to increase the used market capability, taking into account a variation on the demand level of (9,500, 10,000, 10,500) pairs of shoes and the variation of costs (fixed and inventory management unit cost) $\tilde{C}_{\mathrm{p}}$ = (8.5, 9, 9.5) and $\tilde{C}_{\mathrm{h}}$= (1.5, 2, 2.5). For a company with the adequate conditions to produce directly the demand requirements, or seek external providers to satisfy the needs and turn into a marketer of products that designs and outsource. According to the obtained results, it is convenient for the company El Zapato Dorado to adopt the EOQ system with production. This conclusion is derived from the fact that when it operates with production, the annual operation cost (CIT) almost doubles for non-production conditions. Similarly, although the inventory level with production almost doubles the non-production scenario, it allows increasing the sales level and starting new markets. These new markets will allow the company to place that stock and increase its profit level.

5. Recommendations

Taking the conclusions as reference, we recommend to include fuzzy logic to the inventory operation analysis. We recommend the deployment of the EOQ model with production. This model will provide a competitive advantage in decision making when used under uncertainty. This is a consequence from the fact that classical theory hides information that the fuzzy theory reveals. Using this approach, we include higher quality information to the analysis scenario, which allows us to direct the strategic planning of the company, which leads to better financial results and an advantage in the market position for the company.

References

Bellman, R.E., Zadeh L.A. (1970). *Decision making in fuzzy environment.* Management Science 17, B141-B164.

De S. K, Kundu, P.K. et al. (2008). *Economic ordering policy of deteriore items with Shortage and fuzzy costo co-efficients for vendor and buyer.* Int. J. Fuzzy Systems and Rough Systemsn 1(2).

De S. K, Kundu, P.K. et al. (2003). *An economic production quantity inventory model involving fuzzy demand rate and fuzzy deterioration rate.* Journal of Applied Mathematics and Computing 12(1).

De, S.K (2013). *EOQ model with natural idle time and wrongly measured demand rate.*International Journal of Inventory Control and Management 3(1-2).

Gallagher Ch. A., et al., (1982). *Métodos cuantitativos para la toma de decisiones en la administración*. Mc. Graw Hill. Mexico.

González Santoyo. F., Flores Romero. B., Gil Lafuente. A. M., Flores Juan, (2013). "Uncertain optimal inventory as a strategy for enterprise global positioning". *In proceedings of the AMSE. Chania- Greece.*

González Santoyo F., Flores Romero B., Gil Lafuente A.M., (2011). *Procesos para la toma de decisiones en un entorno globalizado*. Editorial Universitaria Ramón Areces. Spain

González Santoyo F., Flores Romero B., Gil Lafuente A.M., (2010). *Modelos y teorías para la evaluación de inversiones empresariales*. FeGoSa-Ingeniería Administrativa S.A. de C.V., UMSNH, IAIDRES. Morelia, Mexico.

González Santoyo F., Flores Romero B., (2002). "Teoría de Inventarios en la empresa". Seminar notes. Doctoral program Economía y Empresa. Universitat Rovira i Virgili. Spain.

Guiffrida, Alfred L., Kent State University Kent, Ohaio, (2010). "Fuzzy inventory models in: Inventory Management: Non-Classical Views", in Jaber M.Y. (Ed.), CRC. Press, FL, Boca Raton, pp. 173-190.

Hariga, M.A. (1996). *Optimal EOQ models for deteriorating items with time-varying demand.* Joournal of Operational Research Society 47(10).

Harris F.W., (1915). *Operations and cost.* Factory Management Series. Chicago.

Kao, C., Hsu, W.K., (2002). *Lot size reorder point inventory model with fuzzy demands.* Computers and Mathematics with Applications 43.

Kaufmann A, Gil Aluja J., (1986). *Introducción de la teoría de subconjuntos borrosos a la gestión de las empresas*. Velograf S.A. Spain.

Kaufmann A, Gil Aluja J, Terceño G.A., (1994). "Matemáticas para la economía y la gestión de empresas". Working paper, Foro Científico. Barcelona, Spain.

Kazemi N., Shekarian E. et al. (2015). *Incorporating human learning into fuzzy EOQ inventory model with backorders*. Computer and Industrial Engineering 87.

Kumar, R.S. De S.K. et al (2012). *Fuzzy EOQ models with ramp type demand rate, partial backlogging and time dependent deterioration rate.* International Journal of Mathematics in Operational Research 4.

Love S. F., (1979). *Inventory Control.* Mc. Graw Hill. Tokyo Japan. 1979.

Mahata G., Goswami, A., (2007). *An EOQ model for deteriorating items under trade credit financing in the fuzzy sense*. Production Planning Control 18.

Mahata G., Goswami, A., (2013). *Fuzzy inventory models for items with imperfect quality and shortage backordering under crisp and fuzzy decision variables*. Computers and Industrial Engineering 64.

Mahata, G. C., (20015). *A production- inventory model with imperfect production process and partial backlogging under learning considerations in fuzzy random environments*. Journal of Intelligent Manufacturing, DOI 10.1.1007/s10845-014-1024-2

Mahata G., Mahata P., (2011). *Analysis of a fuzzy economic order quantity model for deteriorating items under retailer partial trade credit financing in a supply chain*. Mathematical and Computer Modelling 53.

Moskowitz H., Wright Gordon P., (1982). *Investigación de Operaciones*. Prentice Hall. Mexico.

Narasimhan S, Mc. Leavey D.W., Billington P., (1996). *Planeación de la producción y control de inventarios*. Prentice Hall. Mexico.

Schoeder Roger G., (1992). *Administración de operaciones. Toma de decisiones en la función de operaciones*. Mc. Graw Hill. Mexico.

SUBJECTIVE PREFERENCES ALGORITHM IN FINANCIAL SELECTION PROBLEM

Anna Maria Gil Lafuente, Federico González Santoyo, Beatriz Flores
Department of Business Administration, University of Barcelona,
Av. Diagonal 690, 08034, Barcelona, Spain

ABSTRACT

When the businessman it makes financial investments in the banking organizations, him is faced with the need to choose between apparently different products but which, when all is said and done, are very similar. The financial advisers have to offer an agile and well-qualified service to be able to continue counting on the confidence of their clients and to increase their results consequently. The new situation which we faced cannot be treated by means of the application of conventional models, since we were in the total uncertainty

Keywords: Finance, Subjective Preferences.

1. INTRODUCTION

We observed that most of the products offered by the set of financial organizations are sold in the market like differentiated from those of the competition, although if this point we observed it more at great length, we would see that the number of offered financial products would be finite and that the last offered new features wouldn't be more than existing products or to which to certain characteristics or advantages with the purpose of being able are added to him to arrive at the amplest fan of plaintiffs.

In an atomized financial market, where the organizations fight being reference in each segment, each community, each city, each town...., offering a differentiated and qualified service overturned in the client, therefore it is tolerated like consequence of a growth in the volume of managed resources and of the benefits obtained in the exercise.

For a choosing a financial product is fundamental determined business grants to each characteristic of the product relative to the rest. With the object of avoiding this inconvenience we are going to draw up a model that posses the possibility of operation for the treatment of the situation that current reality presents frequently . For this we are going to operate in the discontinuous functional field [11,12].

2. PROBLEM FORMULATION

We start out from the existence of a finite and re-countable number of financial products $P_1, P_2, ..., P_n$ which each posses certain determined characteristics $C_1, C_2, ..., C_m$ in such a way that for each characteristic it is possible to establish a quantified (objective

or subjective) relation of preferences. Therefore for C_j we have that: P_1 is preferred μ_1/μ_2 times over P_2, μ_1/μ_3 times over P_3, ..., μ_1/μ_n times over P_n, ..., P_n is preferred μ_n/μ_1 times over P_1, μ_n/μ_2 times over P_2, ..., μ_n/μ_{n-1} times over P_{n-1}.

With this we will be able to construct the following matrix, which will be reflexive and reciprocal by construction:

$$[C_{ij}]=\begin{bmatrix} 1 & \frac{\mu_1}{\mu_2} & \frac{\mu_1}{\mu_3} & \dots & \frac{\mu_1}{\mu_n} \\ \frac{\mu_2}{\mu_1} & 1 & \frac{\mu_2}{\mu_3} & \dots & \frac{\mu_2}{\mu_n} \\ \dots & \dots & \dots & \dots & \dots \\ \frac{\mu_n}{\mu_1} & \frac{\mu_n}{\mu_2} & \frac{\mu_n}{\mu_3} & \dots & 1 \end{bmatrix} \quad (1)$$

This matrix is also coherent or consistent since the following is complied with:

$$\forall i,j,k \in \{1,\ 2,\ ...,\ n\},\ \frac{\mu_i}{\mu_j}\cdot\frac{\mu_j}{\mu_k}=\frac{\mu_i}{\mu_k} \quad (2)$$

Now then, the condition of consistency is not always complied with in the treatment of financial phenomena [1]. For this reason we are going to consider certain properties [10] of positive matrices, that is, those in which all the elements that are members of R_0^+ (are positive):

a) A positive square matrix posses a dominant value of its own l real positive which is unique for which what is complied is that $\lambda \geq n$, where n is the order of the square matrix.

b) The vector that corresponds to the dominant own value is found also formed by positive terms and when normalised, is unique.

When λ is a number close to n it is said that the matrix is nearly coherent; on the contrary it will be necessary to make an adjustment between the elements of the matrix [2,3] if wanting to use this scheme correctly. It is considered that $\lambda - n$ or $\frac{\lambda - n}{n}$ is an index of coherence.

As is very well known, when a reciprocal matrix is also coherent it complies with:

$$[C_{ij}]\cdot[v_i]^T = n\cdot[v_i]^T \qquad (3)$$

where $[v_i]^T$ is the transpose of row i.

When the reciprocal matrix is not coherent, we write:

$$[C_{ij}]\cdot[v'_i]^T = \lambda\cdot[v'_i]^T$$

We accept $[v'_i]$ as the result when the index of coherence $\frac{\lambda - n}{n}$ is sufficiently small.

For each characteristic C_j, $j=1, 2, ..., m$ the corresponding reflexive and reciprocal matrix $[C_{ij}]$ is obtained. Once the m matrices are constructed the dominant own values λ_j and their corresponding vectors $\begin{bmatrix} Xij \\ ... \\ Xnj \end{bmatrix}$ must be found for each one, verifying if they posses sufficient consistency by means of the «index of coherence». The elements of each corresponding own vector will give rise to a fuzzy sub-set:

	P_1	P_2	P_3	...	P_n
X_j =	x_{1j}	x_{2j}	x_{3j}	...	x_{4j}

which once normalised in sum equal to one will be:

	P_1	P_2	P_3	...	P_n
D_j =	p_{1j}	p_{2j}	p_{3j}	...	p_{4j}

The *m* own vectors are regrouped forming a Matrix 1, the form of which will be:

Matrix 1

[Pij]=	C1	C2	C3	C4		Cm
P1	P11	P12	P13	P14	...	P1m
P2	P21	P22	P23	P24	...	P2m
P3	P31	P32	P33	P34	...	P3m
P4	P41	P42	P43	P44	...	P4m
	...	...	...	...		...
Pn	Pn1	Pn2	Pn3	Pn4	...	Pnm

Each column of this matrix brings to light the relative degree in which a characteristic is possessed by all the financial products. As we have already pointed out, this can be represented by a normalised fuzzy sub-set D_j. From this perspective there exist m fuzzy sub-sets [7]. On the other hand each row expressed, for one product, the degree in which it possess each one of the characteristics, which is also represented by a fuzzy sub-set Q_i such as:

	C_1	C_2	C_3	C_4	…	C_m
Q_i =	p_{i1}	p_{i2}	p_{i3}	p_{i4}	…	p_{im}

On the other hand, each business has a different appreciation of the importance that each characteristic has [4,5]. Evidently, this estimate can vary from one moment to another and its quantification has a basically subjective sense, therefore will be expressed by means of valuations. The establishment of these valuations can be done by means of a comparison between the relative importance of a characteristic in relation to the rest. Therefore, for example, it can be said that a characteristic is two times as important as another, or has half the importance of a third.

In this way we can construct a Matrix 2, that obviously will be square, reflexive and anti-symmetrical. Since there are n products, its order will be $m \times m$:

Matrix 2

[Pij]=	C1	C2	C3	C4		Cm
C1	1	a12	a13	a14	…	a1m
C2	a21	1	a23	a24	…	a2m
C3	a31	a32	1	a34	…	a3m
C4	a41	a42	a43	1	…	a4m
	…	…	…	…		…
Cm	am1	am2	am3	am4	…	1

Due to the condition of asymmetry the following will be complied with:

$$a_{ij} = \frac{1}{a_{ij}}$$

Once the matrix 2 has been determined, we proceed to obtain the corresponding dominant value and vector. This vector will bring to light the preferences of the business relative to the characteristics:

$$y_j = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \dots \\ y_m \end{bmatrix}$$

In order for this vector to be susceptible to being used as a weighting element, we are going to convert it into another that possesses the property that the sum of its elements be equal to the unit. For this we do:

$$b_j = \frac{y_j}{\sum_{j=1}^{m} y_j}, \quad j=1, 2, \dots, m$$

With which we arrive at:

$$b_j = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ \dots \\ b_m \end{bmatrix}$$

We are now in a position finally to arrive at the sought after result, by taking matrix $[p_{ij}]$ and multiplying it to the right by vector $[b_j]$. The result will be another vector, which will express the relative importance of each financial product for the business, taking into account its preferences for each one of the characteristics:

$$\begin{bmatrix} p_{11} & p_{12} & p_{13} & \dots & p_{1m} \\ p_{21} & p_{22} & p_{23} & \dots & p_{2m} \\ p_{31} & p_{32} & p_{33} & \dots & p_{3m} \\ \dots & \dots & \dots & \dots & \dots \\ p_{n1} & p_{n2} & p_{n3} & \dots & p_{nm} \end{bmatrix} \cdot \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ \dots \\ b_m \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ \dots \\ d_m \end{bmatrix} \tag{4}$$

The result can also be expressed by means of a normal fuzzy sub-set, by doing:

$$H = \begin{array}{|c|c|c|c|c|c|} \hline P_1 & P_2 & P_3 & P_4 & \dots & P_m \\ \hline h_1 & h_2 & h_3 & h_4 & \dots & h_m \\ \hline \end{array}$$

At least one $h_j = 1$ will exist.

This model on the contrary to all those that use as the only basis for selection, the price of the money, has as its greatest advantage the possibility of incorporating a wide range of elements that, in the reality of businesses, at times play a decisive role at the time of taking the decision to select a financial product from among those offered on the market. These elements normally do not have the same weight at the time of making a valuation.

As has been seen, this circumstance is included in this scheme, in this way gaining sufficient flexibility and adaptability in order to be used in business reality with a high degree of generality.

2. APPLICATION OF THE PROPOSED MODEL

With the object of illustrating the model a case has been considered which we have linked to the one shown, in order to cover certain financial requirements, resorts to three credit institutions which propose as the most adequate, one financial product each. Therefore there is a choice between three products P_1, P_2, P_3.

The characteristics of these products makes them different, but in certain aspects some are more attractive, but in others these are less favourable. Obviously, in the eyes of the businessman not all the characteristics have the same weight at the time of deciding to accept one or another [8,9]. The five characteristics mentioned previously were considered as important: price of the money, payback period, possibilities for renewal, fractioning repayments, speed of granting.

1. With regard to the price of the money the following data is considered: for P_1 20%, for P_2 22% and for P_3 18%. This then is objective data and it is logical to think that the preference would be for the lowest price in a proportional manner. Therefore P_1 to P_2 would be preferred 22/20 and P_1 to P_3 18/20. P_2 to P_3 would be preferable 18/22. In this way the following matrix can be constructed:

	P_1	P_2	P_3
P_1	1	11/10	9/10
P_2	10/11	1	9/11
P_3	10/9	11/9	1

Once this matrix has been constructed the corresponding dominant own value and vector must be obtained. Among the various procedures existing we are going to use the following:

$$\begin{bmatrix} 1 & 1,1 & 0,9 \\ 0,9090 & 1 & 0,8181 \\ 1,1111 & 1,2222 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 2,7271 \\ 3,3333 \end{bmatrix} = 3,3333 \cdot \begin{bmatrix} 0,9 \\ 0,8181 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1,1 & 0,9 \\ 0,9090 & 1 & 0,8181 \\ 1,1111 & 1,2222 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0,9 \\ 0,8181 \\ 1 \end{bmatrix} = \begin{bmatrix} 2,6999 \\ 2,4543 \\ 2,9998 \end{bmatrix} = 2,9998 \cdot \begin{bmatrix} 0,9 \\ 0,8181 \\ 1 \end{bmatrix}$$

From here it can be deduced that:

$$\lambda_1 = 2,9998 \qquad [X_{i1}] = \begin{bmatrix} 0,9 \\ 0,8181 \\ 1 \end{bmatrix}$$

For normalisation of the sum equal to 1 we do:

$$\frac{X_{11}}{\sum_{i=1}^{3} X_{i1}} = \frac{0,9}{2,7181} = 0,3311 \qquad \frac{X_{21}}{\sum_{i=1}^{3} X_{i1}} = \frac{0,8181}{2,7181} = 0,3009 \qquad \frac{X_{31}}{\sum_{i=1}^{3} X_{i1}} = \frac{1}{2,7181} = 0,3679$$

In this way arriving at:

$$[p_{i1}] = \begin{array}{c|c} P_1 & 0,3311 \\ \hline P_2 & 0,3009 \\ \hline P_3 & 0,3679 \end{array}$$

2. The payback periods established for each product are as follows: 5 years for P_1; 6 years for P_2 and 4 years for P_3. The business establishes a clear preference for the products with a longer payback period and this preference, on being able to be presented by a proportionality we arrive at the following matrix:

	P_1	P_2	P_3
P_1	1	5/6	5/4
P_2	6/5	1	6/4
P_3	4/5	4/6	1

We follow the same process for arriving at the corresponding dominant own value and vector. Therefore:

$$\begin{bmatrix} 1 & 0,8333 & 1,25 \\ 1,2 & 1 & 1,5 \\ 0,8 & 0,6666 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 3.0833 \\ 3,7 \\ 2,4666 \end{bmatrix} = 3,7 \cdot \begin{bmatrix} 0,8333 \\ 1 \\ 0,6666 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0,8333 & 1,25 \\ 1,2 & 1 & 1,5 \\ 0,8 & 0,6666 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0,8333 \\ 1 \\ 0,6666 \end{bmatrix} = \begin{bmatrix} 2,4998 \\ 2,9998 \\ 1,9998 \end{bmatrix} = 2,9998 \cdot \begin{bmatrix} 0,8333 \\ 1 \\ 0,6666 \end{bmatrix}$$

Therefore:

$$\lambda_2 = 2,9998 \qquad [X_{i2}] = \begin{bmatrix} 0,8333 \\ 1 \\ 0,6666 \end{bmatrix}$$

For normalisation of the sum equal to one:

$$\frac{X_{12}}{\sum_{i=1}^{3} X_{i2}} = \frac{0,8333}{2,4999} = 0,3333 \qquad \frac{X_{22}}{\sum_{i=1}^{3} X_{i2}} = \frac{1}{2,4999} = 0,4 \qquad \frac{X_{32}}{\sum_{i=1}^{3} X_{i2}} = \frac{0,6666}{2,4999} = 2,2666$$

Arriving at:

$$[P_{i2}] = \begin{bmatrix} 0,3333 \\ 0,4 \\ 0,2666 \end{bmatrix}$$

3. The possibilities of obtaining renewal of the credit at its expiry are different for each of the financial products. There are double the possibilities of renewal of P_2 than for P_1

and three times the possibilities of renewal of P_3 than for P_1. The possibilities of renewing P_2 appear to be less in 4/5 relative to P_3.[1] We construct the following matrix:

	P_1	P_2	P_3
P_1	1	1/2	1/3
P_2	2	1	4/5
P_3	3	5/4	1

and arrive at the corresponding dominant own value and vector:

$$\lambda_3 = 3,0036 \qquad [X_{i3}] = \begin{bmatrix} 0,3542 \\ 0,7528 \\ 1 \end{bmatrix}$$

Then we do the normalisation in sum equal to 1 arriving at:

$$[P_{i3}] = \begin{bmatrix} 0,1681 \\ 0,3572 \\ 0,4746 \end{bmatrix}$$

4. Repayment of the loan must be done quarterly for financial products P_1 and P_3 and monthly for P_2. A proportional preference is established for the quarterly expiry over the monthly one. The matrix will be:

	P_1	P_2	P_3
P_1	1	3	1
P_2	1/3	1	1/3
P_3	1	3	1

[1] It will be seen that in this characteristic, of a clear subjective meaning, a variation has been introduced which consists of breaking up the total consistency in order to give more generality to the example. In fact it will be seen that:

$$\frac{1}{2} \cdot \frac{4}{5} \neq \frac{1}{3}$$

the corresponding dominant own value and vector:

$$\lambda_4 = 2,9999 \qquad [X_{i4}] = \begin{bmatrix} 1 \\ 0,3333 \\ 1 \end{bmatrix}$$

We then do the normalisation in sum equal to one:

$$[P_{i4}] = \begin{bmatrix} 0,4285 \\ 0,1428 \\ 0,4285 \end{bmatrix}$$

5. Experience leads us to think that financial product P_1 will be obtained very quickly, P_2 with relative speed and this factor for P_3 will be slow. Based on these feelings it is estimated that P_1 is preferred 3 times over P_2 and 5 times over P_3, while P_2 is preferred 2 times over P_3.[2] We obtain the following matrix:

	P_1	P_2	P_3
P_1	1	3	5
P_2	1/3	1	2
P_3	1/5	1/2	1

The corresponding dominant own value and vector are:

$$\lambda_5 = 3,0028 \qquad [X_{i5}] = \begin{bmatrix} 1 \\ 0,3542 \\ 0,1881 \end{bmatrix}$$

and when we do the normalisation in sum equal to one we arrive at:

$$[P_{i5}] = \begin{bmatrix} 0,6483 \\ 0,2296 \\ 0,1219 \end{bmatrix}$$

[2] Also for this characteristic we have avoided total consistency.

Once we have obtained these five vectors $[p_{ij}]$, $j=1,2,3,4,5$, we group them and form the following matrix:

$[p_{ij}]=$

	C_1	C_2	C_3	C_4	C_5
P_1	0,3311	0,3333	0,1681	0,4285	0,6483
P_2	0,3009	0,4000	0,3572	0,1428	0,2296
P_3	0,3679	0,2666	0,4746	0,4285	0,1219

We now move on to analyse the other side of the problem. This is to bring to light how a business considers each one of these characteristics relative to the others. In this case the following comparisons have been established:

- The first characteristic is worth 2 times the second, 6 times the third, 8 times the fourth and 4 times the fifth.
- The second characteristic is worth 4 times the third, 6 times the fourth and 2 times the fifth.
- The third characteristic is worth 3 times the fourth and 1/2 the fifth.
- The fourth characteristic is worth 1/3 the fifth.

With the following square, reflexive and reciprocal matrix can be arrived at:

	C_1	C_2	C_3	C_4	C_5
C_1	1	2	6	8	4
C_2	1/2	1	4	6	2
C_3	1/6	1/4	1	3	1/2
C_4	1/8	1/6	1/3	1	1/3
C_5	1/4	1/2	2	3	1

In order to obtain the corresponding dominant own value and vector the same process can be used as followed before. In this way we find:

$\lambda_c = 5,0842$

$$[y_j]=\begin{bmatrix} 1 \\ 0,5709 \\ 0,1779 \\ 0,0916 \\ 0,2854 \end{bmatrix}$$

and with the normalisation in sum equal to one:

$$[b_j] = \begin{bmatrix} 0,4704 \\ 0,2685 \\ 0,0836 \\ 0,0430 \\ 0,1342 \end{bmatrix}$$

Finally, if we take matrix $[p_{ij}]$ and multiply to the right by vector $[b_j]$, which in short constitutes a weighting, we arrive at:

$$[d_j] = \begin{bmatrix} 0,3311 & 0,3333 & 0,1681 & 0,4285 & 0,6483 \\ 0,3009 & 0,4000 & 0,3572 & 0,1428 & 0,2296 \\ 0,3679 & 0,2666 & 0,4746 & 0,4285 & 0,1219 \end{bmatrix} \cdot \begin{bmatrix} 0,4704 \\ 0,2685 \\ 0,0836 \\ 0,0430 \\ 0,1342 \end{bmatrix} = \begin{bmatrix} 0,3647 \\ 0,3157 \\ 0,3191 \end{bmatrix}$$

Taking into account that we have only considered four decimal points and the last one has not been rounded up, the sum of the elements of the last matrix does not give the unit as the result, which would have occurred if the rounding up were to have been done.

The result we have arrived at can also be expressed by means of a normal fuzzy sub-set, as follows:

	P_1	P_2	P_3
P =	1,0000	0,8656	0,8749

It will be seen in this fuzzy sub-set that financial product P_1 is preferable to products P_2 and P_3, although not too much. There is very little difference between P_2 and P_3.

3. CONCLUSIONS

In this paper, we have studied an example could be taken as typical since it shows what happens often in financial reality, when the businessman is faced with the need to choose between apparently different products but which, when all is said and done, are very similar. This situation should not come as a surprise to us if it is thought that financial institutions attempt to compensate certain disadvantages of a product relative to other of the competition, by means of incentives to certain aspects that make it more attractive and allow in this way for its placing in the market under conditions of competitiveness.

4 . REFERENCES

[1] D. Dubois, H. Prade. Fuzzy Relation Equations and Causal Reasoning, Fuzzy Sets and Systems, 75; (1995). p. 119-134.

[2] J. Gil-Aluja, Elements for a Theory of Decisión in Uncertainty, Kluwer Academic Publishers. Dordrecht, Boston, London; 1999. p.321-342

[3] J. Gil-Aluja, The Interactive Management of Human Resources in Uncertainty, Kluwer Academic Publishers. Dordrecht, Netherlands. Kluwer Academic Publishers; 1997. p. 170-173

[4] A.M. Gil Lafuente, Nuevas Estrategias para el análisis financiero en la empresa, Ariel Economía, (2001), 356-368.

[5] A.M. Gil Lafuente, Fuzzy logic in financial analysis. Springer; 2005, p.318-335.

[6] J. Gil Lafuente, Algoritmos para la excelencia. Claves para el éxito en la gestión deportiva. Editorial Milladoiro. Vigo, (2002), 91-123.

[7] C. Kao, S.T. Liu, "Fraccional programming approach to fuzzy weighted average". Fuzzy Sets and Systems, 120, pp. (2001), 435-444.

[8] A. Kaufmann, J. Gil Aluja, Las matemáticas del azar y de la incertidumbre. Editorial Ceura, Madrid, (1990), 125-142.

[9] A. Kaufmann, J. Gil Aluja, Técnicas operativas de gestión para el tratamiento de la incertidumbre. Editorial Hispano Europea, Barcelona, (1987). 225.

[10] W. B. Vasantha Kandasamy, Elementary Fuzzy Matrix Theory and Fuzzy Models for Social Scientists. Indian space research. USA, (2007). p. 72-90

[11] L. Zadeh, Fuzzy Sets. Information and Control, 8; 1965. p. 338-353.

[12] L. Zadeh, Similarity Relations and Fuzzy Orderings, Inform Sci. 3; 1971. p.177-200.

MARKETING: A BIBLIOMETRIC – BASED REVIEW

Ingrid Nineth Pinto López, Cynthia M. Montaudon Tomas
Department of Business Intelligence, Business School, UPAEP University.
ingrid.pinto@upaep.mx, cynthiamaria.montaudon@upaep.mx

Abstract. Marketing is based on consumption principles, customer behavior, and a business perspective. It is grounded on activities, groups of institutions, and processes to create, communicate, deliver, and exchange value. This article analyzes contributions in the field of Marketing using a series of bibliometric indicators that include citations and H-index. VOS viewer and Excel were used to identify trend maps. Scientific articles, journals, authors, institutions, and countries were considered. The United States has been the leader in research in the field in terms of the number of publications, citations, and universities in which studies are being performed. Recently, Europe, Oceania, and Asia have increased their productivity. Interest in marketing has enormous potential, especially in uncertain and highly competitive global environments.

JEL Codes: M31, M30, C02
Keywords: Marketing, bibliometric analysis, Web of Science, VOS viewer

INTRODUCTION

Marketing is based on the principles of consumption along with the understanding of consumer behavior and how these elements connect with the general business strategy (Silva et al., 2014), affecting various stakeholders, including organizations, industrial sectors, and society as a whole (Kerin & Hartley, 2018).
The study of Marketing as a business methodology emerged around the 1950s, and by the end of the decade, it became an essential function in organizations (Valenzuela et al., 2006). Definitions and notions related to marketing abound (Mullins, 2007; Saren, 2007; Jobber, 1998; Hoffman, 2007; Stanton, et.al., 2007; Kotler & Armstrong, 2007, AMA, 2007; Lamb, et.al, 2013; Kotler & Keller, 2012; Ferrel & Hartline, 2012; Kerin, et.al., 2018).

The Marketing Association (AMA) considers marketing as an activity, institutions, and processes to create, communicate, deliver and exchange value among different stakeholders, including consumers, clients, associates, and the entire society (AMA, 2007), implying that marketing is much more than advertising, as it is usually considered because it delivers authentic advantages and creates value (Kerin et al., 2018).

The objective of this article is to perform a bibliometric analysis of research surrounding the concept of Marketing. Bibliometric analysis became the methodological support of

the study through the usage of the scientific repository, such as the ISI Web of Knowledge, as the source of information. The most relevant aspects of the notion of Marketing were identified by analyzing bibliometric indicators; mainly, most cited articles, authors, institutions, keywords, and countries, which in the period from 1975 to 2019, became essential for research in the field.

The study also considers Similarities Visualizations (VOS) by using VOS viewer software (Van, Eck & Waltman., 2014). This allows the development of bibliometric maps analyzing specific items such as co-authorship (Dejian et al., 2018), bibliographic coupling (Merigó, et al., 2017), co-citation (Blanco-Mesa, et al., 2017), and keywords (Pinto, et al., 2019). Bibliometric networks, as developed by VOS viewer, operate on distances. Each network consists of a large number of nodes mapped in a two-dimensional space based on "visualization of similarities." Borders can be added between nodes for additional visualizations. Each node represents one publication, author, or notion, among other criteria. The size of the node indicates the co-occurrence or occurrence value, while the distance between two nodes represents their close relatedness (Van Eck & Waltman., 2014). VOS Viewer software is also used to create clusters according to the close relatedness between nodes, which can be identified in different colors (Van Eck & Waltman, 2014; Dejian et al., 2018).

This article is organized as follows. Section 2 presents the bibliometric methods used; section 3 is integrated by the different analyses performed and the results obtained. Section 4 presents a brief conclusion along with the possibilities for further studies, while section 5 contains the references.

METHODOLOGY

Bibliometric is a branch of scientometry that allows the study of scientific activity. Scientific articles are the unit of analysis. Bibliometric analyses have been defined as the application of statistical and mathematical methods to books and other means of written communication (Pritchar, 1969; Romaní, 2011; Pinto-López & Malcón-Cervera, 2018).

Mathematical processes and statistical methods are applied to written sources to conduct bibliometric analysis, considering elements such as authors, publication title, document type, language, abstract or summary, and keywords or descriptors (Solano et al., 2009; Romaní, 2011; Pinto-López & Malcón-Cervera, 2018). The impact or influence on the quality and productivity of scientific publications through bibliometric indicators is analyzed by considering publications, citations, journals, authors, institutions, language, and country of publication of a specific line of research (Blanco-Mesa et al., 2017).

The information used to perform bibliometric analysis comes from specific databases such as ISI Web of Science (WoS), which comprises valuable information about high-quality multidisciplinary research that has been published in leading journals across the globe in

sciences, social sciences, arts, and humanities. By identifying and creating indexes of the most relevant publications and providing bibliographic information allows the evaluation and analysis of the productivity and the scientific quality of research (Chen et al., 2012). This database incorporates other databases into the WoS' primary collection. It includes scientific articles from all areas of science in more than 15,000 specialized journals and 50,000,000 classified articles in over 250 categories and 151 areas of research (Blanco-Mesa et al., 2017).

RESULTS AND DISCUSSION

The data analyzed was obtained from the WoS in 2019, specifically on October 23rd, 24th, and 25th. The keyword for the search strategy was "Marketing." The selected time frame considered all publications from 1975 to October 2019. The analysis of the selected bibliometric indicators is shown in the following sections.

Number of published articles

Several coincidences were found for "Marketing." From the 76,251 articles that were retrieved, 13,697 (17.96%) were identified as open access. The frequency related to the selected articles is shown in Fig. 1. It is important to notice that during the last decade, there was an important growth in the research of this field. The first articles related to the Marketing concept were found in 1975. 0.07% of all registered articles were published from 1975 to 1980. In the following decades, production increased as follows: 5.23% from 1980 to 1989; 11.75% from 1990 to 1999; 23.15% from 2000 to 2009; and 59.78% from October 2010 to October 2019, respectively. Currently, around 6885 articles have been published each year.

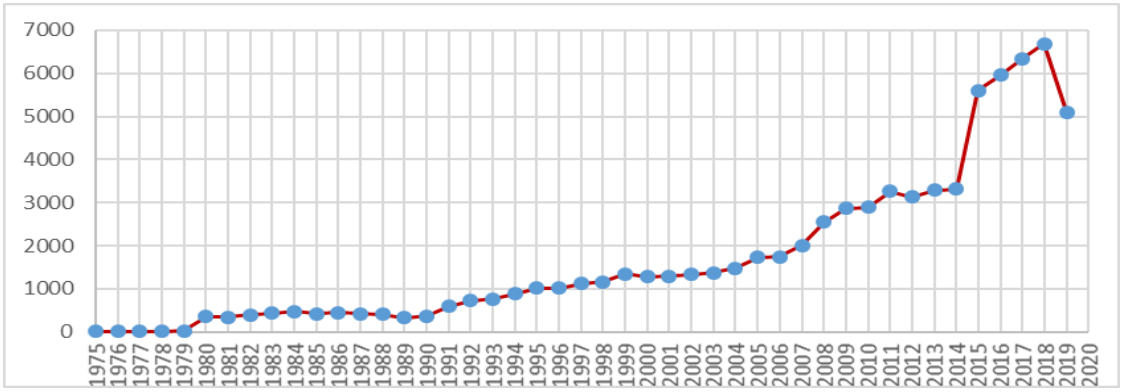


Fig 1. Number of annual publications in the WoS since 1975

General structure of citations

One of the markers that shows the relevance of published works is the number of citations. This helps identify the influence and popularity of the articles in a field when analyzing the distribution of the number of citations per year. From 1975 to October

2019, research on Marketing had 1,428,677 citations, with an average of citations per article of 18.74. Table 1 presents the detail of published articles (TP) and total citations (TC). The number of articles that obtained citations each year is also presented (Fig. 2). It is relevant to notice that 33.81% of the articles have 25 to 49; 4.94% have 50 to 99 citations; 3.34% have 100 to 499; 0.18% have 500 to 999 citations; 0.06% have 1000 to 4999, and the remaining 0.002% have 5000 citations or more.

In terms of the distribution of citations by decade, in the period between 1975 and 1979, it was only 0.01%; in between 1980 and 1989, it increased to 2.73%; from 1990 to 1999, it reached 19.97%; more than doubling in the years 2000 to 2009, reaching 45.51%. Finally, from 2010 to October 2019, the distribution of citations was 31.78%. Still, 29% of articles have not been cited yet.

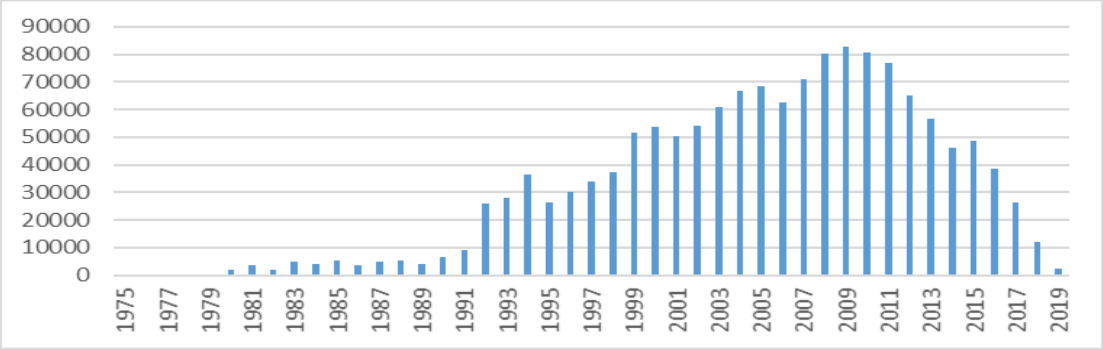


Fig. 2. Number of annual citations in the WoS since 1975

Table 1. Annual citation structure in the field of marketing research

Year	TP	TC	≥5000	≥1000	≥500	≥100	≥50	≥25	≥10	≥1
1975	10	19	0	0	0	0	0	0	1	1
1976	5	4	0	0	0	0	0	0	0	1
1977	10	5	0	0	0	0	0	0	0	2
1978	10	68	0	0	0	0	0	1	1	0
1979	20	51	0	0	0	0	0	1	0	4
1980	356	1949	0	0	0	6	4	5	12	90
1981	336	3482	0	0	1	9	7	11	13	70
1982	388	1852	0	0	0	4	1	13	15	97
1983	426	4951	0	1	1	12	5	6	18	88
1984	476	4084	0	1	0	5	8	7	21	107
1985	419	5338	0	0	2	10	8	11	20	101
1986	446	3415	0	0	0	9	6	10	23	119
1987	423	4901	0	0	0	16	7	12	23	99
1988	400	5148	0	0	1	13	10	13	18	97
1989	321	3822	0	0	1	10	5	10	21	89
1990	362	6703	0	1	2	9	9	17	24	113
1991	592	8949	0	0	1	18	29	33	74	184
1992	719	25767	0	4	4	45	41	68	96	240
1993	763	28054	0	3	7	42	41	65	103	251
1994	877	36467	1	2	5	61	40	78	128	347

1995	1015	26326	0	1	5	50	73	92	170	336
1996	1014	30130	0	2	3	56	85	75	161	328
1997	1117	33927	0	1	6	66	83	118	180	330
1998	1154	37327	0	2	4	84	79	127	205	350
1999	1350	51656	0	5	5	109	144	142	247	362
2000	1278	53637	0	4	11	108	125	160	227	356
2001	1297	50248	0	1	6	122	141	190	259	348
2002	1333	53959	0	3	6	122	150	188	240	365
2003	1378	60723	1	2	3	127	151	201	263	378
2004	1472	66787	0	1	10	132	173	281	269	403
2005	1735	68541	0	1	6	177	221	294	338	446
2006	1741	62601	0	1	4	138	212	271	374	444
2007	2007	71022	0	3	5	160	237	297	431	585
2008	2546	80082	0	3	6	158	252	401	564	796
2009	2869	82616	0	0	11	144	264	439	691	952
2010	2896	80868	0	0	10	138	250	475	729	927
2011	3262	76853	0	0	4	135	258	491	765	1170
2012	3125	65275	0	2	2	89	188	446	811	1128
2013	3294	56491	0	0	0	73	172	410	901	1338
2014	3310	46206	0	0	0	44	114	342	862	1549
2015	5606	48820	0	0	2	24	96	325	1041	2912
2016	5964	38688	0	0	0	16	53	188	907	3305
2017	6341	26357	0	0	0	7	24	113	552	3609
2018	6685	12140	0	0	0	2	5	19	183	3250
2019	5103	2368	0	0	0	0	0	3	18	1143
Total	**76251**	**1428677**	**2**	**44**	**134**	**2550**	**3771**	**6449**	**11999**	**29210**

Source: Own elaboration based on WoS 2019. Abbreviations: TP: Total papers, TC: Total citations; ≥5000, ≥1000, ≥500, ≥100, ≥50, ≥25, ≥10, ≥1 = Number of papers with equal or more than 5000, 1000, 500, 100, 50, 25, 10 and 1 citations.

The 50 most cited papers in the field of marketing research

The analysis of scientific research is essential to identify the impact of research in a specific field, notion, or topic (Merigó et al., 2017), such as Marketing. Table 2 shows the 50 most cited articles in research on Marketing. The list is led by an article called "User acceptance of information technology: Toward a unified view," which already has 8237 citations, receiving an average of 514.81 citations per year. The article reviews user acceptance of IT. It discusses and compares eight prominent models, and formulates a unified model that integrates elements from the earlier models, being empirically validated (Venkatesh et al., 2003). The second most cited article is called "The commitment-trust theory of relationship marketing." It has received 7272 citations with an average of 290 citations per year.

This article deals with the conceptualization of relationship marketing theorizing that successful relationship marketing requires commitment and trust, which are critical mediating variables in a proposed model. The model is tested using data from automobile tire retailers (Morgan, Hunt., 1994).

Another relevant point to analyze the structure of published documents in research on Marketing is co-citations. Fig. 3 presents the influences of existing work-connections

based on co-citations. The map portrays the importance and impact of the works of authors such as Morgan, Hunt, Anderson, Keller, Armstrong, Davis, Kumar, and Kerin. These authors are located in the largest circles and are considered as the drivers of the topic. The map shows five clusters along with interrelations within the same cluster and with other clusters.

Table 2. The 50 most cited papers in the field of marketing research

R	Title	Author/s	J	Year	TC	C/Y
1	User acceptance of information technology: Toward a unified view (Venkatesh, et.al., 2003).	Venkatesh, V; Morris, MG; Davis, GB; Davis, FD.	MQ	2003	8237	514.81
2	The commitment-trust theory of relationship marketing (Morgan & Hunt, 1994).	Morgan, RM; Hunt, SD.	JM	1994	7272	290.88
3	Evolving to a new dominant logic for marketing (Vargo & Lush, 2004).	Vargo, SL., Lusch, RF.	JM	2004	4931	325.73
4	Conceptualizing, measuring, and managing customer-based brand equity (Keller, 1993).	Keller, KL.	JM	1993	4137	159.11
5	Whence consumer loyalty? (Oliver, 1999).	Oliver, RL.	JM	1999	2826	141.3
6	Consumers and their brands: Developing relationship theory in consumer research (Fournier, 1998).	Fournier, S.	JCR	1998	2523	120.14
7	Determinants of long-term orientation in buyer-seller relationships (Ganesan, 1994).	Ganesan, S.	JM	1994	2444	97.76
8	Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments (Cronin, et.al., 2000).	Cronin, JJ., Brady, MK., Hult, GTM.	JR	2000	2311	121.63
9	Service-dominant logic: continuing the evolution (Vargo, et.al., 2008).	Vargo, Stephen L., Lusch, Robert, F.	JAMS	2008	2237	203.36
10	Servicescapes – the impact of the physical surroundings on customers and employees (Bitner, 1992).	Bitner, MJ.	JM	1992	2233	82.70
11	A critical review of construct indicators and measurement model misspecification in marketing and consumer research (Jarvis, et.al., 2003).	Jarvis, CB., MacKenzie, SB., Podsakoff, PM.	JCR	2003	2185	136.56
12	The price of innovation: new estimates of drug development costs (DiMasi, et.al., 2003).	DiMasi, JA; Hansen, RW; Grabowski, HG.	JHE	2003	2175	135.93
13	Index construction with formative indicators: An alternative to scale development (Diamantopoulos & Winklhofer, 2001).	Diamantopoulos, A; Winklhofer, HM.	JMR	2001	1963	109.05
14	Marketing in hypermedia computer-mediated environments: Conceptual foundations (Hoffman & Novak, 1996).	Hoffman, DL; Novak, TP.	JM	1996	1872	81.39
15	The different roles of satisfaction, trust, and commitment in customer relationships	Garbarino, E; Jhonson, MS.	JM	1999	1730	86.5
16	Corporate culture, customer orientation, and innovativeness in Japanese firms – a quadrate analysis (Deshpande, et.al., 1993).	Deshpande, R; Farley, JU; Webster, FE.	JM	1993	1659	63.80
17	Relationships between providers and users of market – research – the dynamics of trust within and between organizations (Moorman, et.al., 1992).	Moorman, C; Zaltman, G; Deshpande, R.	JMR	1992	1653	61.22
18	A service quality model and its marketing implications (Gronroos, 1984).	Gronroos, C.	EJM	1984	1639	46.82

19	The American customer satisfaction index: Nature, purpose, and findings (Fornell, et.al., 1996).	Fornell, C; Johnson, MD; Anderson, EW; et Ál..	JM	1996	1534	66.69
20	The use of pledges to build and sustain commitment in distribution channels (Anderson & Weitz, 1992).	Anderson, E; Weitz, B.	JMR	1992	1511	55.96
21	The company and the product: Corporate associations and consumer product responses (Brown & Dacin, 1997).	Brown, TJ; Dacin, PA.	JM.	1997	1483	67.40
22	Critical questions for Big Data Provocations for a cultural, technological, and scholarly phenomenon (Boyd & Crawford, 2012).	Boyd, Danah; Crawford, Kate.	ICS	2012	1447	206.71
23	An assessment of the use of partial least squares structural equation modeling in marketing research (Hair, et.al., 2012).	Hair, Joe F.; Sarstedt, Marko; Ringle, Christian M.; er ál..	JAMS	2012	1441	205.85
24	The Dynamics of Viral Marketing (Leskovec, et.al., 2007).	Leskovec, Jure; Adamic, Lada A.; Huberman, Bernardo A.	ACM TW	2007	1384	115.33
25	Characteristics of partnership success – partnership attributes, communication behavior, and conflict – resolution techniques (Mohr & Spekman, 1994).	Mohr, J; Spekman, R.	SMJ	1994	1369	54.76
26	A critical look at technological innovation typology and innovativeness terminology: a literature review (Garcia & Calantone, 2002).	Garcia, R; Calantone, R.	JPIM	2002	1225	72.05
27	The field behind the screen: Using netnography for marketing research in online communities (Kozinets, 2002).	Kozinets, RV.	JMR	2002	1197	70.41
28	Managing the co-creation of value (Payne, et.al., 2008).	Payne, Adrian F.; Storbacka, Kaj; Frow, Pennie.	JAMS	2008	1190	108.18
29	The constructive, destructive and reconstructive power of social norms (Schultz, et.al., 2007).	Schultz, P. Wesley; Nolan, Jessica M.; Cialdini, Robert B.; et al..	PS	2007	1148	95.66
30	Conducting interorganizational research using key informants (Kumar, et.al., 1993).	Kumar, N; Stern, LW; Anderson, JC	AMJ	1993	1127	43.34
31	Applying the technology acceptance model and flow theory to online consumer behavior (Koufaris, 2002).	Koufaris, M.	ISR	2002	1120	65.88
32	Measuring the customer experience in online environments: A structural modeling approach (Novak, et.al., 2000).	Novak, TP; Hoffman, DL; Yung, YF.	MS	2000	1120	58.94
33	Do norms matter in marketing relationships (Heide & John, 1992).	Heide, JB; John, G.	JM	1992	1093	40.48
34	The predictive validity of multiple-item versus single – item measures of the same constructs (Bergkvist & Rossiter, 2007).	Bergkvist, Lars; Rossiter, Jhon R.	JMR	2007	1081	90.08
35	A model of customer satisfaction with service encounters involving failure and recovery (Smith, et.al., 1999).	Smith, AK; Bolton, RN; Wagner, J.	JMR	1999	1066	53.3
36	The role of emotions in marketing (Bagozzi, et.al., 1999).	Bagozzi, RP; Gopinath, M; Nyer, PU.	JMR	1999	1066	53.3
37	Struggling with the creative class (Peck, 2005).	Peck, J.	IJURR	2005	1061	75.78
38	Cluster – analysis in marketing – research – review and suggestions for application	Punj, G; Stewart, DW.	JMR	1983	1057	29.36
39	A model of destination image formation (Baloglu & McCleary, 1999).	Baloglu, S; McCleary, KW.	ATR	1999	1054	52.7

40	Factors influencing the effectiveness of relationship marketing: A meta-analysis (Palmatier, et.al., 2006).	Palmatier, Robert W.; Dant, Rajiv R.; Grewal, Dhruv, et ál..	JM	2006	1052	80.92
41	Conjoint – analysis in marketing - new developments with implications for research and practice (Green & Srinivasan, 1990).	Green, PE; Srinivasan, V.	JM	1990	1049	36.17
42	Progress in information technology and tourism management: 20 years on and 10 years after the Internet – The state of e-tourism research (Buhalis & Law, 2008).	Buhalis, Dimitrios; Law, Rob.	TM	2008	1048	95.27
43	Customer switching behavior in-service industries – an exploratory – study (Keaveney, 1995).	Keaveney, SM.	JM	1995	1031	42.95
44	Customer evaluations of service complaint experience: Implications for relationship marketing (Tax, et.al., 1998).	Tax, SS; Brown, SW; Chandrashekaran, M.	JM	1998	1009	48.04
45	Marketing the competitive destination of the future (Buhalis, 2000).	Buhalis, D.	TM	2000	1003	52.78
46	Issues in supply chain management (Lambert & Cooper, 2000).	Lambert, DM; Cooper, MC	IMM	2000	1001	52.68
47	Cyclooxygenase isozymes: The biology of prostaglandin synthesis and inhibition (Simmons, et.al., 2004).	Simmons, DL; Botting, RM; Hla, T.	PR	2004	997	66.46
48	Innovation, organizational capabilities, and the born – global firm (Knight & Cavusgil, 2004).	Knight, GA; Cavusgil, ST.	JIBS	2004	990	66
49	New product diffusion-model in marketing – review and directions for research (Mahajan, et.al., 1990).	Mahajan, V; Muller, E; Bass, FM.	JM	1990	986	34
50	Interorganizational governance in marketing channels (Heide, 1994).	Heide, JB.	JM	1994	979	39.16

Source: Own elaboration based on WoS 2019. Abbreviations: R: Ranking; J: Journal; TC: Total citations; C/Y: Citations per year; MQ: Mis Quarterly; JM: Journal of Marketing; JAMS: Journal of the Academy of Marketing Science; JCR: Journal of Consumer Research, JHE: Journal of Health Economics; JMR: Journal of Marketing Research; EJM: European Journal of Marketing; ICS: Information Communication & Society;JR: Journal of Retailing; ACM TW: ACM Transactions on the Web; SMJ: Strategic Management Journal; JPIM: Journal of Product Innovation Management; PS: Psychological Science; AMJ: Academy of Management Journal; ISR: Information Systems Research; MS: Marketing Science; IJURR: International Journal of Urban and Regional Research; ATR: Annals of Tourism Research, TM: Tourism Management; IMM: Industrial Marketing Management; PR: Pharmacological Reviews, JIBS: Journal of International Business Studies, ATR: Annals of Tourism Research.

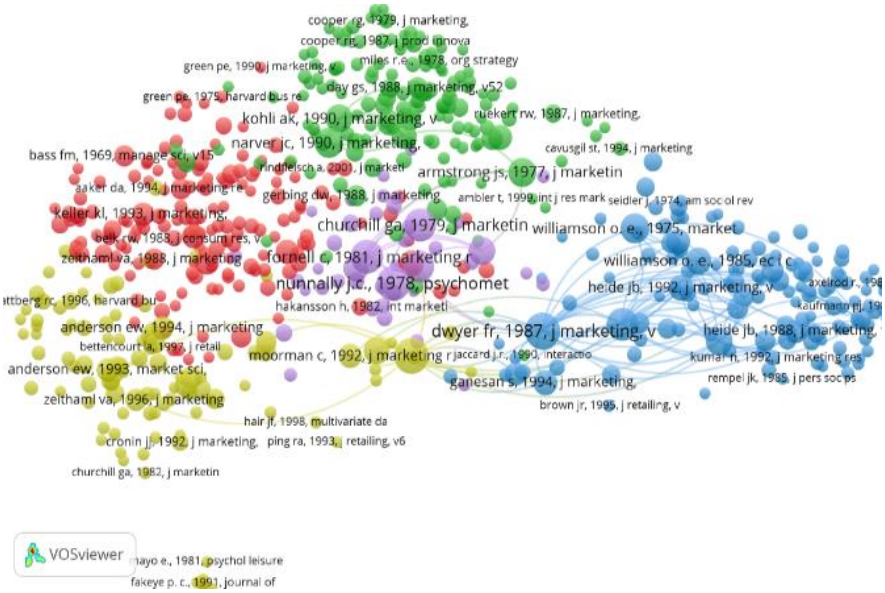


Fig. 3. Bibliometric mapping of articles co-citations with a threshold of 626 citations and the 100 most representative connections.

Keywords

Fig. 4 shows the bibliometric map with the proximity relations of the keywords. Fourteen clusters were identified, showing the connections between "Marketing" and other keywords. The most relevant notions are innovation, value creation, market orientation, consumer behavior, social media, internet, service, dominant logic, among others.

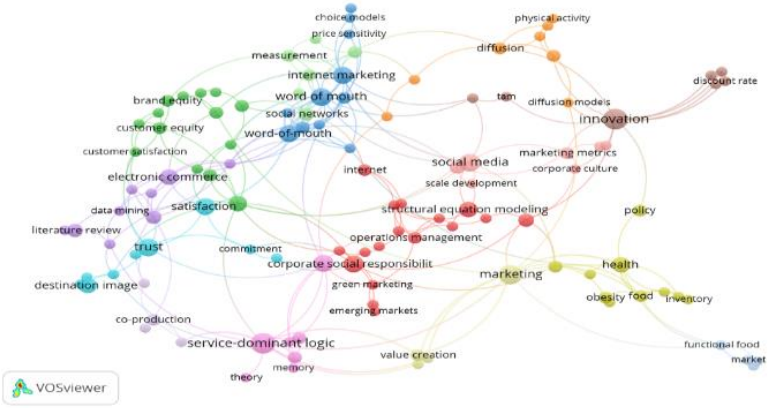


Fig. 4. Bibliometric mapping of Co-occurrence of author keyword of documents published in Marketing with a threshold of 123 and the 100 most representative connections.

The most productive authors in marketing

Table 3 shows the 30 most productive and influential authors in research about marketing. This table is organized, considering the total number of publications (TP). It also shows the number of citations per author (TC), the average citations per paper (C/P) and the number of articles per author, which are grouped in three intervals based on the number of citations. These intervals are: articles between 50 and 99 citations; articles between 100 and 199 citations, and those 200 citations and over. The H-index associated with each author is also shown. The H-index is used to represent the importance of a group of articles, and can also be applied to journals, authors, countries, and universities (Blanco-Mesa, et.al., 2017).

Table 3. The 30 most-cited authors in the field of marketing research

R	Name	TP	TC	C/P	H-index	≥ 200	≥100	≥ 50
1	Kumar, V.	112	5897	52.65	36	9	6	17
2	Kelly, B.	62	1280	20.64	20	0	1	3
3	Cavusgil, ST.	51	4831	94.72	26	4	10	4
4	Law, R.	51	2167	42.49	20	1	2	2
5	Chapman, K.	50	1062	21.24	19	1	0	3
6	Chintagunta, PK.	50	2497	49.94	27	1	5	12
7	Calantone, RJ.	48	2150	44.79	25	0	4	12
8	Rundle-Thiele, S.	45	459	10.20	13	0	0	1
9	De Ruyter, K.	42	1829	43.54	21	1	5	4
10	Hult, GTM.	42	5242	124.81	24	4	4	9
11	Desarbo, WS.	40	1681	42.02	18	3	1	2
12	Woodside, AG.	39	1592	40.82	19	1	1	7
13	Homburg, C.	38	4286	112.78	30	5	11	11
14	Brown, S.	37	315	8.51	10	0	0	1
15	Hunt, SD.	37	10146	274.22	23	4	8	7
16	Johnston, WJ.	37	1598	43.19	17	3	1	2
17	Cornwell, TB.	36	1412	39.22	18	1	4	4
18	Verhoef, P.	36	3290	91.39	26	7	2	10
19	Cummings, KM.	35	1387	39.63	19	0	4	4
20	Steenkamp, JB.	35	6681	190.88	33	8	15	6
21	Dolnicar, S.	34	1027	30.20	15	0	2	4
22	Hill, RP.	34	1320	38.82	17	1	0	2
23	Lindgreen, A.	34	1062	31.23	16	1	1	4
24	Allenby, G.	33	2050	62.12	18	3	6	4
25	Dekimpe, M.	33	2055	62.27	20	2	5	9
26	Evans, WD.	33	515	15.60	15	0	0	1
27	Griffith, D.	33	1811	54.88	23	0	5	4
28	Harris, JL.	33	1413	42.82	19	1	2	5
29	Katsikeas, CS.	33	3319	100.57	25	5	7	5
30	Ling, PM.	32	2014	62.94	22	2	3	9

Source: Own elaboration based on WoS 2019. Abbreviations R: Ranking, TP: Total publications, TC: Total citations, C/P: Cites per paper; ≥200, ≥100, ≥50 = Number of papers with equal or more than 200, 100 and 50 citations.

Fig. 5 shows the connection between productivity and author impact. Productivity can be understood as the number of publications and impact as an average of citations per article. In Figure 3, the three most productive authors are identified. These are Kumar,

Kelly & Cavusgil. The three authors with the highest impact are also acknowledged: Hunt, Steenkamp & Hult.

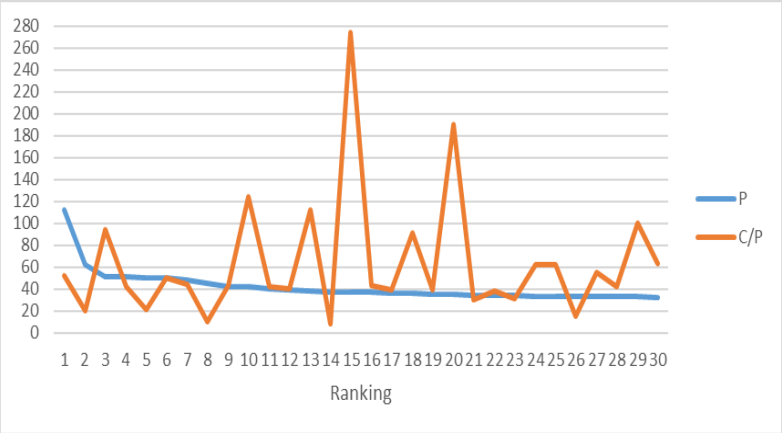


Fig. 5. Relation Productivity / Impact; P: Publications, C/P: Citations per year

The bibliometric map presented in Fig. 6 depicts the connection between authors. Eight clusters are identified, showing the clear leadership of Hunt, Steenkamp & Hult.

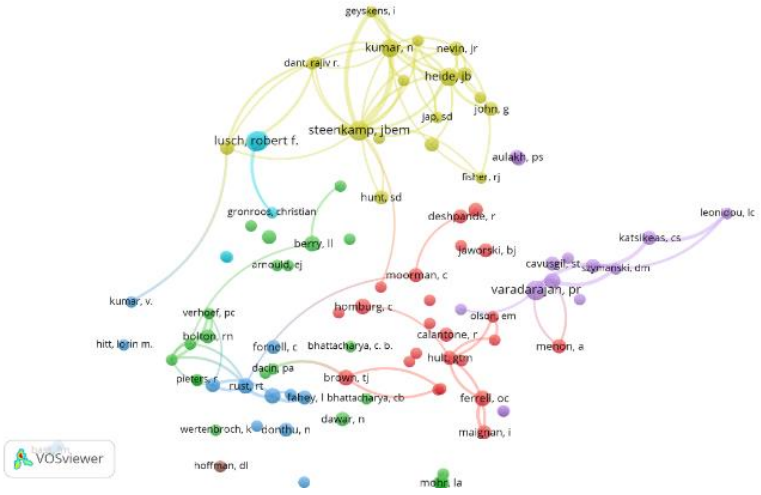


Fig. 6. Bibliometric mapping of authors with at least 20 bibliographic couplings and the 100 most representative connections.

The most influential journals in the field of marketing research

Research about marketing is published in a large number of journals, some of which are discipline-specific while others are multidisciplinary. In Table 4, the ranking of the 30 journals with more publications on the topic can be observed. This information is organized based on the total number of publications (TP). It also shows the total citations of each journal, the average citations per year, the number of articles published by journal which have been classified according to the number of citations in five intervals

considering those with 50 to 99 citations, from 100 to 199 citations, 200 to 499 citations, 500 to 999 citations and articles with 1000 citations or more.

Table 4. The most cited journals in the field of marketing research

R	Journal	TP	TC	C/P	≥1000	≥500	≥200	≥100	≥50	H-index
1	JBR	1369	47930	35.01	0	3	35	86	136	108
2	IMM	1138	34105	29.97	1	0	15	46	132	86
3	EJM	872	19547	24.42	1	0	6	28	63	65
4	JM	839	128181	152.78	16	35	114	119	108	181
5	JMR	656	58647	89.40	7	14	55	75	99	123
6	MS	599	35292	58.92	1	7	26	52	102	95
7	JAMS	517	37900	63.27	4	4	36	64	65	103
8	IMR	496	12851	25.91	0	0	2	17	66	60
9	JBIM	484	4832	9.98	0	0	0	1	6	32
10	JBE	463	18725	40.44	0	2	10	24	68	68
11	TM	463	28741	62.07	2	3	25	49	77	88
12	PM	419	13216	31.61	0	1	7	23	41	61
13	JPPM	376	10223	27.19	0	0	8	11	33	50
14	IJRM	366	14767	40.35	0	3	7	21	35	57
15	EJOR	343	8352	24.35	0	0	0	18	31	49
16	JMM	340	2659	7.82	0	0	1	0	8	26
17	BFJ	339	3485	10.28	0	0	0	1	11	28
18	MS	327	18588	56.84	0	3	16	27	63	73
19	HBR	321	9067	28.25	0	0	9	19	28	53
20	JAR	317	6953	21.93	0	0	3	11	24	44
21	JPIM	306	18695	61.09	1	2	13	33	68	75
22	AJAE	297	2720	9.16	0	0	1	2	13	28
23	JIM	292	11355	38.89	0	1	10	20	33	57
24	S	287	8296	29.95	0	0	3	10	28	43
25	ESA	277	786	2.84	0	0	0	0	0	13
26	JINM	275	8723	31.72	0	0	3	11	44	53
27	JTTM	256	4194	16.38	0	0	0	6	11	34
28	SIJ	254	3473	13.67	0	0	0	1	13	30
29	JSM	244	3276	13.43	0	0	0	0	8	29
30	TC	230	6826	29.68	0	0	1	11	29	45

Source: Own elaboration based on WoS 2019. Abbreviations: R: Ranking; TP: Total publications; TC: Total citations; C/Y: Citations per year; ≥ 1000, ≥500, ≥200, ≥100, ≥50 = Number of journals with equal or more than 1000, 500, 200, 100 and 50 citations. JBR: Journal of Business Research; IMM: Industrial Marketing Management; EJM: European Journal of Marketing; JM: Journal of Marketing; JMR: Journal of Marketing Research; MS: Marketing Science; JAMS: Journal of the Academy of Marketing Science; IMR: International Marketing Review; JBIM: Journal of Business Industrial Marketing; TM: Tourism Management; JBE: Journal of Business Ethics; PM: Psychology Marketing; JPPM: Journal of Public Policy Marketing; IJRM: International Journal of Research in Marketing; EJOR: European Journal of Operational Research; JMM: Journal of Macromarketing; BFJ: British Food Journal; MS: Management Science; HBR: Harvard Business Review; JAR: Journal of Advertising Research; JPIM: Journal of Product Innovation Management; AJAE: American Journal of Agricultural Economics; JIM: Journal of Interactive Marketing; S: Sustainability; ESA: Expert Systems with Applications; JINM: Journal of International Marketing; JTTM: Journal of Travel Tourism Marketing; SIJ: Service Industries Journal; JSM: Journal of Services Marketing; TC: Tobacco Control.

In Fig. 7, the journals' productivity and impact are presented. The three most productive journals are the Journal of Business Research, the Industrial Marketing Management Journal, and the European Journal of Marketing. The three journals with the highest impact are the Journal of Marketing, the Journal of Marketing Research, and the Journal of the Academy of Marketing Science.

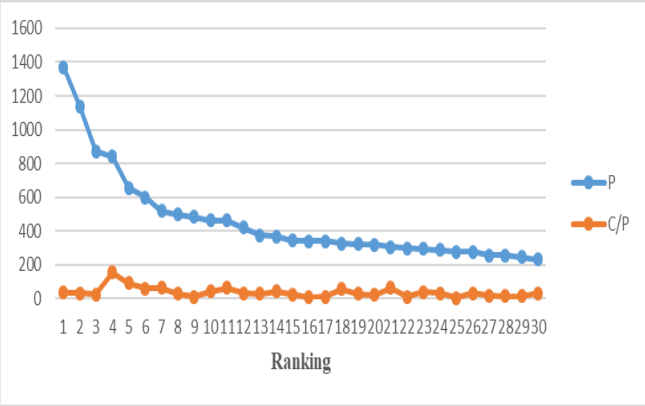


Fig. 7. Relation Productivity / Impact. P: Publications, C/P: Citations per year

To determine how journals are structured in the field of Marketing, citations, and the way they connect with others were analyzed. The first analysis is focused on bibliometric coupling (Bibcoup) (see Fig. 8). This map shows the connection between journals and the influence of research in the field. In this analysis, eight relevant clusters are identified, being the most significant journals the Journal of Marketing, the Journal of Marketing Research, and the Journal of the Academy of Marketing Science.

The second analysis identifies co-citations between journals (see Fig. 9). The map shows the influence of research in detail. Co-citation helps identify the possibility of documents B and C being cited in document A dealing with the same topic. Results show that articles published in the Journal of Marketing, the Journal of Marketing Research, and the Journal of the Academy of Marketing Science, are co-cited on the topic of marketing.

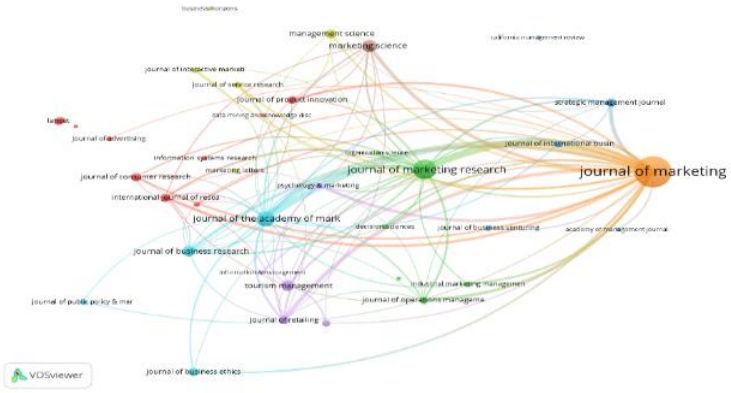


Fig. 8. Bibliometric mapping of journals. Bibliographic coupling with a threshold of 48 and considering the 100 most influential connections.

Fig. 9. Bibliometric mapping of journal co-citations with a threshold of 501 and considering the 100 most influential connections.

The most influential universities in the field of marketing research

Scientific publications are not only dependent on the number of researchers in a field and their productivity, but also in higher education institutions (Blanco-Mesa, et.al., 2017). It is within universities that researchers can pursue their interest in a scientific field. Table 5 shows the 30 most essential universities in terms of relevant publications in the area of marketing. Universities are ranked considering the number of publications. The total number of citations was also considered, along with the H-index and average citations per year.

Table 5. The most influential universities in the field of marketing research

R	Institution	Country	TP	TC	H	C/P	≥500	≥250	≥100	≥50
1	University of London	ENG	920	23758	73	25.82	2	8	37	72
2	University of North Carolina	USA	862	28168	83	32.68	4	15	48	81
3	Harvard University	USA	702	33267	84	47.39	8	17	48	65
4	University of Pennsylvania	USA	567	31400	89	55.38	8	17	51	73
5	Penn State University	USA	537	16408	58	30.55	3	8	25	36
6	Michigan State University	USA	534	24231	73	45.38	6	9	39	57
7	Texas A M University College Station	USA	483	21760	76	45.05	7	11	38	39
8	University of Minnesota Twin Cities	USA	464	26712	65	57.57	6	9	25	47
9	University of Florida	USA	456	12202	56	26.76	2	3	18	39
10	University of North Carolina Chapel Hill	USA	447	17318	67	38.74	3	10	29	51

11	United States Department of Agriculture USDA	USA	422	8465	43	20.06	1	1	17	18
12	University of Michigan	USA	411	21261	69	51.73	5	9	36	44
13	University of Sydney	AUS	409	9704	45	23.73	2	2	12	24
14	Columbia University	USA	400	16842	64	42.10	3	9	26	45
15	Hong Kong Polytechnic University	CHN	400	11687	50	29.22	1	4	21	24
16	Ohio State University	USA	389	14162	58	36.41	3	10	21	38
17	University of Queensland	AUS	372	9016	50	24.24	0	4	14	32
18	University of Washington	USA	372	13129	62	35.29	1	6	26	42
19	Cornell University	USA	371	12395	53	33.41	2	8	17	30
20	University of Texas Austin	USA	368	18130	69	49.27	4	13	27	47
21	Erasmus University Rotterdam	NET	355	14208	62	40.02	2	6	26	52
22	University of New South Wales Sydney	AUS	354	13277	46	37.50	2	4	11	27
23	John Hopkins University	USA	352	9431	48	26.79	0	6	14	27
24	Stanford University	USA	351	18576	63	52.92	4	6	23	44
25	University of California Los Angeles	USA	351	12452	60	35.47	1	3	24	44
26	University of Toronto	CAN	349	7518	39	21.54	1	2	10	16
27	Purdue University	USA	344	8669	47	25.20	1	2	21	19
28	New York University	USA	342	12561	65	36.73	0	5	36	38
29	Monash University	AUS	340	6145	40	18.07	0	0	7	22
30	University of Georgia	USA	336	8471	46	26.01	1	5	13	23

Source: Own elaboration based on WoS 2019. Abbreviations R: Ranking, TP: Total publications, TC: Total citations, H: H-index; C/P: Cites per paper; ≥500, ≥250, ≥100, ≥50 = Number of papers with equal or more than 500, 200, 100 and 50 citations.

According to the number of citations, articles were divided into the following intervals: those with 50 to 99 citations, 100 to 249 citations, 250 to 499 citations, and 500 citations or more. North American universities are among the most influential in the area of marketing, with the United States leading the list with 77.33% of the 30 universities that were identified, followed by Canadian institutions with 13.33%.

The most productive universities in terms of productivity and impact (see Fig. 10) are the University of London, the University of North Carolina, and Harvard University, while those with the highest impact are the University of Minnesota Twin Cities, the University of Pennsylvania and Stanford University.

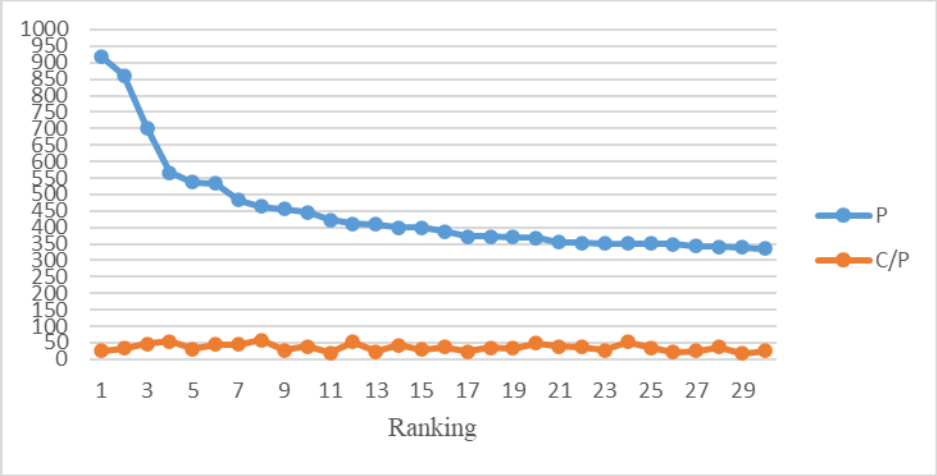


Fig. 10. Productivity and impact ratio; P: Publications, C/P: Citations per year

A bibliometric Bibcoup analysis was performed to determine the way in which universities are structured around research in the field of marketing (see Fig. 11) and the connection citation-institutions (see Fig. 12). In the first analysis, six significant clusters were identified. The most relevant institutions in the clusters are Harvard University, Wisconsin, Minnesota, Duke, Penn, and Connecticut. In a secondary analysis, 9 clusters were identified. The universities leading these groups are Minnesota, Wisconsin, Harvard University, Carolina, Texas, California, Michigan, Arizona, and Columbia.

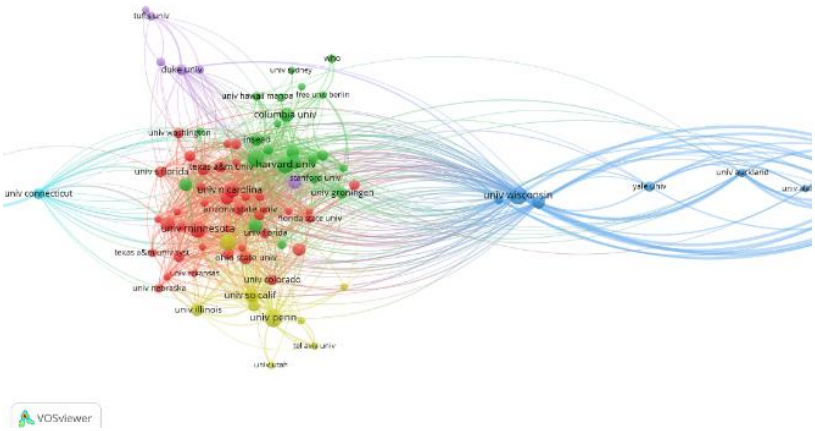


Fig. 11. Bibliometric mapping of universities with more than 25 bibliographic couplings considering the 1000 most influential connections.

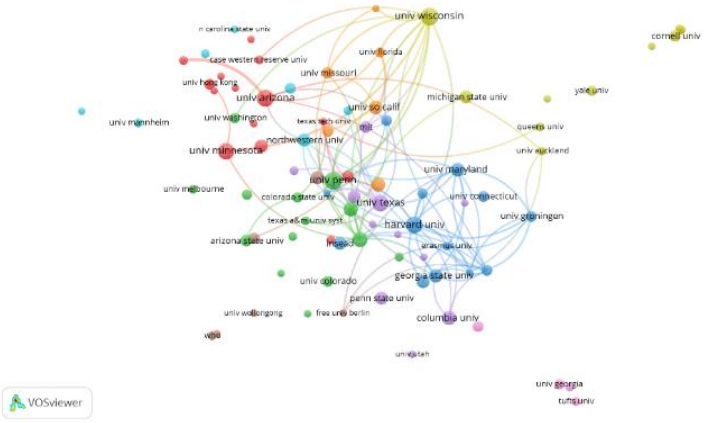


Fig. 12. Bibliometric mapping of universities citations with a threshold of 91 and the 100 most influential connections.

The most influential countries in the field of marketing research

Analyzing countries in which publications are made is another fundamental criteria by analyzing research in a specific field. Fig. 13 shows the global distribution of countries/territories in which research in the area of marketing has been performed. Countries are grouped based on the number of citations in publications associated with each country. As can be observed, marketing has been analyzed, particularly in the United States. In that country, productivity adds up to 28483 publications, followed by England with 146321 and Australia with 89427 published articles.

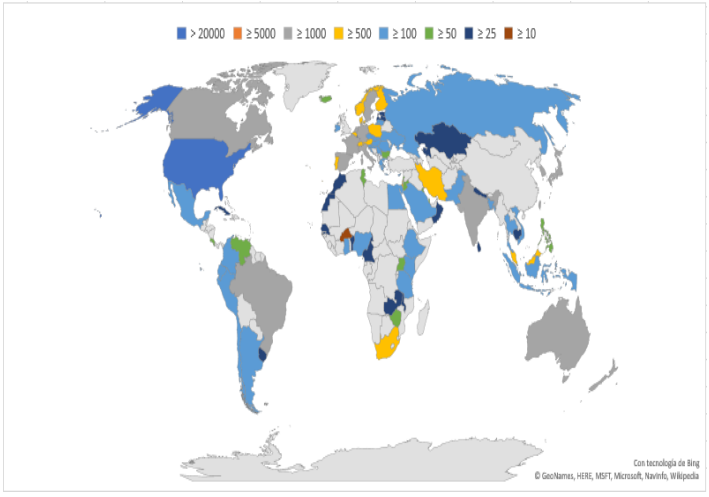


Fig. 13. Global distribution of countries/territories analyzing Marketing according to the WoS, 2019.

Table 6 shows the 30 countries with the highest number of publications on the topic of marketing. The countries have been ranked according to the number of publications (TC). The total number of citations is also included (C/P) along with the number of publications that have between 50 and 99 citations, 100 to 249, 250 to 499, 500 to 999, and 1000 citations and over. Additional information includes the number of publications by country based on total population (P/P_o) and the average of citations per country considering the total population in that country (C/P_o).

Table 6. The most productive and influential countries in research on the topic of marketing

R	Country	TC	TP	H	C/P	1000	500	250	100	50	P/Po	C/Po
1	USA	846840	28423	283	29.79	40	78	393	1271	2088	86.87	2588.14
2	England	146321	7209	143	20.30	3	7	33	219	494	108.16	2195.36
3	Australia	89427	4530	114	19.74	4	4	24	106	263	179.98	3552.92
4	Germany	63913	3584	108	17.83	1	5	23	90	188	42.74	769.85
5	Canada	75733	3502	116	21.62	1	3	35	115	223	94.67	2047.39
6	China	54075	3400	97	15.90	1	5	13	72	143	2.43	38.75
7	Spain	34832	2620	78	13.29	0	2	6	48	90	55.83	742.21
8	France	44797	2540	99	17.64	0	5	15	78	106	37.89	668.31
9	Italy	33087	2109	75	15.69	0	0	13	38	102	34.94	548.16
10	Netherlands	65890	2020	116	32.62	1	11	32	95	279	117.58	3835.27
11	India	14636	1983	49	7.38	0	0	4	18	27	1.47	10.82
12	Taiwan	29043	1822	74	15.94	0	1	5	31	37	77.23	1231.16
13	South Korea	23391	1527	71	15.32	0	1	5	32	75	29.57	453.05
14	Brazil	9378	1459	41	6.43	0	0	4	12	15	6.97	44.77
15	Japan	10606	1163	48	9.12	0	0	0	7	38	9.19	83.82
16	New Zealand	20787	1162	67	17.89	0	1	5	24	74	235.70	4216.83
17	Sweden	21659	1114	67	19.44	0	0	8	35	55	108.90	2117.20
18	Turkey	12762	1018	50	12.54	0	2	5	13	32	12.41	155.63
19	South Africa	9754	974	42	10.01	0	0	3	7	24	16.81	168.35
20	Switzerland	22148	940	69	23.56	0	4	10	28	64	110.07	2593.44
21	Belgium	26598	904	78	29.42	1	4	7	45	79	78.81	2328.92
22	Scotland	17969	892	61	20.14	0	2	3	27	58	163.97	3303.12
23	Finland	18286	845	65	21.64	0	0	13	21	52	153.08	3312.68
24	Denmark	14828	703	58	21.09	0	0	7	23	35	120.99	2552.15
25	Malaysia	6405	648	35	9.88	0	1	2	4	15	19.33	197.81

26	Portugal	10480	626	51	16.74	0	1	3	16	37	60.89	1019.45
27	Iran	3591	622	25	5.77	0	0	1	3	7	7.55	43.60
28	Norway	12622	606	57	20.83	0	0	3	23	40	113.69	2368.10
29	Israel	13982	593	58	23.58	0	2	2	22	47	66.78	1574.54
30	Austria	11778	588	52	20.03	0	2	1	24	29	66.36	1330.47

Source: Own elaboration based on WoS 2019. Abbreviations R: Ranking, TP: Total publications, TC: Total citations, H: H-index; C/P: Cites per paper; ≥1000, ≥500, ≥250, ≥100, ≥50 = Number of papers with equal or more than 1000, 500, 200, 100 and 50 citations, P/P_o and C/P_o = Papers and cites per million inhabitants.

In the same table, it is possible to observe the productivity/impact connection considering TP and C/P. The United States are the world leaders in scientific publications on marketing, followed by England and Australia. This fact can be corroborated in the bibliometric map, which establishes bibliographic coupling (see Fig. 14). In terms of impact, the Netherlands, the United States and Belgium are the leading countries. Nevertheless, when analyzing the productivity /impact connection, considering P/Po and C/P_o, taking into account the total population of inhabitants per country, the countries with the highest productivity are Australia, Scotland, and Finland, while those with the highest impact are New Zealand, the Netherlands, and Australia.

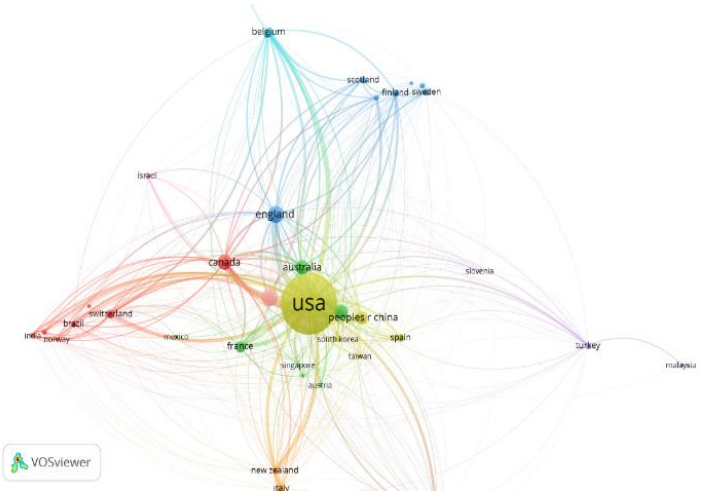


Fig. 14. Bibliometric mapping bibliographic couplings of countries considering the 1000 most influential connections.

CONCLUSION

In this study, 76,251 published in the area of Marketing were analyzed from multiple perspectives, combining bibliometric analysis with information obtained from ISI Web of Knowledge and software tools such as VOS viewer for bibliometric maps and Excel were used for figures and tables.

This type of analysis helps understand the evolution of research in a specific field and its potential for the future, presenting a general picture of the state of research in a specific time frame. As has been observed through the analysis that was performed, research on Marketing presents a sustained growth.

The research has certain limitations because the scientific publications analyzed were obtained from the WoS. Other sources of information are available, but they could not be considered. Nevertheless, the scope and reach of this article provide valuable insights into the study of marketing.

Further studies, including additional sources of information, are underway.

REFERENCES

American Marketing Association AMA. (2007). *Definition of Marketing*. Retrieved of http:// www.marketingpower.com/About AMA /Pages/DefinitionofMarketing.aspx

Anderson, E., Weitz, B. (1992). The use of pledges to build and sustain commitment in distribution channels. *Journal of Marketing Research,* 29(1), 18-34.

Bagozzi, RP., Gopinath, M., Nyer, PU. (1999). The role of emotions in marketing. *Journal of the Academy of Marketing Science,* 27(2), 184-206.

Baloglu, S., McCleary, KW. (1999). A model of destination image formation. *Annals of Tourism Research,* 26(4), 868-897.

Bergkvist, L., Rossiter, JR. (2007). The predictive validity of multiple-item versus single – item measures of the same constructs. *Journal of Marketing Research,* 44(2), 175-184.

Bitner, MJ. (1992). Servicescapes – the impact of the physical surroundings on customers and employees. *Journal of Marketing,* 56(2), 57-71.

Blanco-Mesa, F., Merigó, JM., Gil-Lafuente, AM. (2017). Fuzzy decision making: A bibliometric-based review. *Journal of Intelligent & Fuzzy Systems*, 32(3), 2033-2050.

Boyd, D., Crawford, K. (2012). Critical questions for Big Data Provocations for a cultural, technological, and scholarly phenomenon. *Information Communication & Society,* 15(5), 662-679.

Brown, TJ., Dacin, PA. (1997). The company and the product: Corporate associations and consumer product responses. *Journal of Marketing,* 61(1), 68-84.

Buhalis, D. (2000). Marketing the competitive destination of the future. *Tourism, Management,* 21(1), 97-116.

Buhalis, D., Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet – The state of eTourism research. *Tourism Management,* 29(4), 609-623.

Chen, H., Chiang, R., Storey, V (2012). Business Intelligence and Analytics: From Big Data to Big Impact, *Mis Quarterly,* 36 (4), 1165-1188.

Cronin, JJ., Brady, MK., Hult, GTM. (2000). Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments. *Journal of Retailing*, 76(2), 193-218.

Dejian, Y., Wanru, W., Wenyu, Z., Shuai, Z. (2018). A bibliometric analysis of research on multiple criteria decision making. *Current Science,* 114(4), 747-758.

Deshpande, R., Farley, JU., Webster, FE. (1993). Corporate culture, customer orientation, and innovativeness in Japanese firms – a quadrate analysis. *Journal of Marketing*, 57(1), 23-27.

Diamantopoulos, A., Winklhofer, HM. (2001). Index construction with formative indicators: An alternative to scale development. *Journal of Marketing Research,* 38(2), 269-277.

DiMasi, JA., Hansen, RW., Grabowski, HG. (2003). The Price of innovation: new estimates of drug development costs. *Journal of Health Economics,* 22(2), 151-185.

Ferrel, O., Hartline, M. (2012). *Estrategia de Marketing*. Cengage Learning.

Fornell, C., Johnson, MD., Anderson, EW., Cha, JS., Bryant, BE. (1996). The American customer satisfaction index: Nature, purpose, and findings. *Journal of Marketing*, 60(4), 7-18.

Fournier, S. (1998). Consumers and their brands: Developing relationship theory in consumer research. *Journal of Consumer Research,* 24(4), 343-373.

Ganesan, S. (1994). Determinants of long-term orientation in buyer-seller relationships, *Journal of Marketing*, 58(2), 1-19.

Garbarino, E., Jhonson, MS. (1999). The different roles of satisfaction, trust, and commitment in customer relationships. *Journal of Marketing,* 63(2), 70-87.

Garcia, R., Calantone, R. (2002). A critical look at technological innovation typology and innovativeness terminology: a literature review. *Journal of Product Innovation Management*, 19(2), 110-132.

Green, PE., Srinivasan, V. (1990). Conjoint – analysis in marketing – new developments with implications for research and practice. *Journal of Marketing,* 54(4), 3-19.

Gronroos, C. (1984). A service quality model and its marketing implications. *European Journal of Marketing,* 18(4), 36-44.

Hair, JF., Sarstedt, M., Ringle, CM., Mena, JA. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science,* 40(3), 414-433.

Heide, JB. (1994). Interorganizational governance in marketing channels. *Journal of Marketing*, 58(1), 71-85.

Heide, JB., John, G. (1992). Do norms matter in marketing relationships. *Journal of Marketing,* 56(2), 32-44.

Hoffman, DL., Novak, TP. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. *Journal of Marketing,* 60(3), 50-68.

Hoffman, K. (2007). *Principios de Marketing*. Thompson Learning.

Jarvis, CB., MacKenzie, SB., Podsakoff, PM. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of Consumer Research,* 30(2), 199-218.

Jobber, D. (1988). *Principles and practice of marketing*. Mc Graw Hill.

Keaveney, SM. (1995). Customer switching behavior in –service industries- an exploratory-study. *Journal of Marketing,* 59(2), 71-82.

Keller, KL. (1993). Conceptualizing, measuring, and managing customer-based brand equity. *Journal of Marketing,* 57(1), 1-22.

Kerin, R. & Hartley, S. (2018). *Marketing*. Mc Graw Hill.

Knight, GA., Cavusgil, ST. (2004). Innovation, organizational capabilities, and the born – global firm. *Journal of International Business Studies,* 35(2), 124-141.

Kotler, Ph., Armstrong, G. (2007). *Marketing*. Pearson Education.

Kotler, Ph., Keller, KL. (2012). *Dirección de marketing*. Pearson Education.

Koufaris, M. (2002). Applying the technology acceptance model and flow theory to online consumer behavior. *Information Systems Research,* 13(2), 205-223.

Kozinets, RV. (2002). The field behind the screen: Using netnography for marketing research in online communities. *Journal of Marketing Research,* 39(1), 61-72.

Kumar, N., Stern, LW., Anderson, JC. (1993). Conducting interorganizacional research using key informants. *Academy of Management Journal,* 36(6), 1633-1651.

Lamb. C., Hair, J., McDaniel, C. (2013). *MKTG 6*. Cengage Learning.

Lambert, DM., Cooper, MC. (2000). Issues in supply chain management. *Industrial Marketing, Management,* 29(1), 65-83.

Leskovec, J., Adamic, LA., Huberman, BA. (2007). The Dynamics of Viral Marketing. *ACM Transactions on the Web,* 1(1).

Mahajan, V., Muller, E., Bass, FM. (1990). New product diffusion-model in marketing-review and directions for research. *Journal of Marketing,* 58(1), 71-85.

Merigó, J., Pedrycz, W., de la Sotta, C. (2017). Fifty years of Information Sciences: A bibliometric overview. *Information Sciences,* 432, 245-268.

Mohr, J., Spekman, R. (1994). Characteristics of partnership success – partnership attributes, communication behavior, and conflict – resolution techniques. *Strategic Management Journal,* 15(2), 135-152.

Morgan, RM., Hunt, SD. (1994). The Commitment-trust Theory of Relationship Marketing. *Journal of Marketing,* 58(3), 2038.

Moorman, C., Zaltman, G., Deshpande, R. (1992). Relationships between providers and users of market – research – the dynamics of trust within and between organizations. *Journal of Marketing Research,* 29(3), 314-328.

Mullins, J., Walker, O., Boyd, H., Larréché, JC. (2007). *Administración del marketing: un enfoque en la toma estratégica de decisiones*. Mc Graw Hill.

Novak, TP., Hoffman, DL., Yung, YF. (2000). Measuring the customer experience in online environments: A structural modeling approach. *Marketing Science,* 19(1), 22-42.

Oliver, RL. (1999). Whence consumer loyalty?. *Journal of Marketing*, 63, 33-44.

Palmatier, RW., Dant, RR., Grewal, D., Evans, KR. (2006). Factors influencing the effectiveness of relationship marketing: A meta-analysis. *Journal of Marketing*, 70(4), 136-153.

Payne, AF., Storbacka, K., Frow, P. (2008). Managing the co-creation of value. *Journal of the Academic of Marketing Science,* 36(1), 83-96.

Peck, J. (2005). Struggling with the creative class. *International Journal of Urban and Regional Research,* 29(4), 740.

Pinto López, IN., Malcón-Cervera, C. (2018). Inteligencia de negocios e inteligencia competitiva como elementos detonadores para la toma de decisión informada: Un análisis bibliométrico. *RIIIT Revista Internacional de Investigación e Innovación Tecnológica*, 6, (31).

Pinto-López, IN., Montaudon-Tomas, CM., Gil Lafuente, AM. (2019). *Análisis bibliométrico sobre Competitividad Empresarial*. En F. González (Ed.), Desarrollo y posicionamiento de las Empresas Mexicanas (pp. 1972-1985). México: Ilustre Academia Iberoamericana de Doctores.

Pritchard, A. (1969) Statistical Bibliography or Bibliometrics. *Journal of Documentation, 2*5.

Punj, G., Stewart, DW. (1983). Cluster – analysis in marketing – research – review and suggestions for application. *Journal of Marketing Research,* 20(2), 134-148.

Romaní, F. (2011). Estudios Bibliométricos como línea de investigación en las ciencias biomédicas: una aproximación para el pregrado. *CIMEL Ciencia e Investigación Médica Estudiantil Latinoamericana, 16* (1), 1.

Saren, M. (2007). *Marketing en grafiti*. Patria

Schultz, PW., Nolan, JM., Cialdini, RB., Goldstein, NJ., Griskevicius, V. (2007). The constructive, destructive and reconstructive power of social norms. *Psychological Science,* 18(5), 429-434.

Silva, H., González, J., Martínez, D., Giraldo, M., Juliao, D., Ortiz, M. (2014). *Marketing Conceptos y aplicaciones*. Editorial Universidad del Norte.

Simmons, DL., Botting, RM., Hla, T. (2004). Cyclooxygenase isozymes: The biology of prostaglandin synthesis and inhibition. *Pharmacological Reviews,* 56(3), 387-437.

Smith, AK., Bolton, RN., Wagner, J. (1999). A model of customer satisfaction with service encounters involving failure and recovery. *Journal of Marketing Research,* 36(3), 356-372.

Solano, E., Castellanos, S., López, M., Hernández, J. (2009) Bibliometry, an eficcient to assess the postgraduate scientific activity. *Revista Electrónica de las Ciencias Médicas en Cienfuegos*, 7 (4), 59-62.

Stanton, W., Etzel, M., Walker, B. (2007). *Fundamentos de marketing*. Mc Graw Hill.

Tax, SS., Brown, SW., Chandrashekaran, M. (1998). Customer evaluations of service complaint experience: Implications for relationship marketing. *Journal of Marketing,* 62(2), 60-76.

Valenzuela, LM., García de Madariaga, J., Blasco, MF. (2006). Evolución del marketing hacia la gestión orientada al valor del cliente: Revisión y análisis. *Theoria,* 15(2), 99-105.

Van Eck, NJ., Waltman, L. (2014). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics,* 84, 523-538.

Van, Eck, NJ., Waltman, L. (2014). Visualizing bibliometric networks. *Springer International Publishing*, 285-320.

Vargo, SL., Lusch, RF. (2008). Service-dominant logic: continuing the evolution. Journal of the Academy of Marketing Science, 36(1), 1-10.

Vargo, SL., Lusch, RF. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing*, 68(1), 1-17.

Venkatesh, V., Morris, MG., Davis, GB. (2003). User acceptance of information technology: Toward a unified view. *Mis Quarterly*, 27(3), 425-478.

LA INCERTIDUMBRE DE LAS POLÍTICAS PÚBLICAS EN EL DESARROLLO SOSTENIBLE: MICROEMPRESAS POLIURETÁNICAS EN MÉXICO

Rubén Chávez Rivera[1], Rafael Ortiz Alvarado[2], Jesús Ricardo Ramos Sánchez[3]
Universidad Michoacana de San Nicolás de Hidalgo, Secretaría de Educación de Tamaulipas
pintachavez@gmail.com, rortizalvarado@gmail.com, lic.ramoss@hotmail.com

Resumen: El objetivo simular la toma decisiones por parte de gobierno regional para crear puentes de desarrollo local. Para el caso de microempresas poliuretánicas en centro de México, el problema se agudiza más aún, cuando la rentabilidad en la mayoría de estas se encuentra ligeramente por encima del punto de equilibrio y con las nuevas decisiones políticas generadoras de gran incertidumbre. El enfoque "desde adentro" (Sunkel, 1991) se hace la flexibilidad productiva mediante la programación lineal difusa (PLD) con el "modelo de conjunto factible difuso" y la parte holística se realiza a través de mapas cognitivos difusos (MCD) en sus causalidades generadas por las imposiciones fiscales y las decisiones del gobierno populistas generadores de alta incertidumbre adversa al desarrollo y bienestar social.

Palabras clave: desarrollo local, lógica difusa, microempresas, políticas públicas.

1. Introducción

Actualmente en México se vive momentos críticos debido a la pandemia del Covid-19, aunado a las decisiones de la administración pública cerrada a la inversión de capitales como fuentes alternas de energía y la comunidad empresarial en general; y nuevas imposiciones fiscales. El estudio en este trabajo se enfoca en la flexibilidad producto-económica y su impacto con el bienestar social. La relación costo-beneficio está ligada a la maximización de las utilidades en función con el entorno social. El modelo de programación lineal difusa (PLD) es flexible en rango de decisiones respecto a la capacidad instalada y rango disponible de recursos materiales (restricciones) y los agentes involucrados en la sociedad y su consecuente bienestar.

En el caso de la industria de los poliuretanos la importancia de la catálisis de las reacciones de poliol con toluen-isocianato en la formación de poliuretanos en sus diferentes modalidades: elastómeros, espumas, adhesivos o pinturas están sujeta a mecanismos de reacción bien controlado para obtener una calidad satisfactoria, (Engels, et al, 2013). El efecto multifuncional y complejo entre los diferentes grupos reactivos en la formación de monómeros uretánicos pueden estar ubicados en los extremos de la cadena molecular

cuyas características de tamaño, estructura y naturaleza no influyen en la síntesis. Sin embargo, son estos grupos reactivos son los percusores que le contribuyen en las propiedades mecánicas de cierto poliuretano específico, y la posibilidad de modificar sus propiedades y calidad del producto, (Subramani, et al. 2003; Kim et al, 2010; Amin, 2016). En general cada componente (dioles del tipo éster o éter (poliol), diisociantos aromáticos o alifáticos, y sus suplementos: silicones, aminas, catalizadores metálicos, entre otros según sea el producto) influye directamente el mecanismo de reacción, y control sobre: tamaño de celda, soporte a la carga, densidad, coloración, envejecimiento, resistencia a la elongación, velocidad de reacción, etc, (Subramani, et al. 2003; Amin, 2016; Chávez et al 2019). No obstante, la estequiometría de la reacción será fundamental para garantizar que el poliuretano cumpla con las especificaciones de calidad. Con lo anterior obliga a buscar mecanismos y herramientas flexibles que permitan predecir los sistemas económicos, lo cual, nos lleva a la aplicación de lógica difusa.

La estructura de este trabajo se compone del marco teórico se compone en forma breve de los diferentes teóricos sobre el desarrollo sostenible y bienestar, y sus principales dimensiones; seguido por la lógica difusa en la PL y los mapas cognitivos difusos. En la metodología se propone un mecanismo de análisis en el que interviene la PLD para conocer la flexibilidad productiva en función a la capacidad instalada, la cual permite responder a las causalidades holísticas con fuerte carga de incertidumbre sobre todo por parte de administración públicas. El caso de aplicación es en diez microempresas poliuretánicas en el estado de México, las cuales fueron encuestas al igual que otros expertos para saber la percepción de las últimas decisiones tomas por el gobierno federal respecto a la inversión privada desarrolladas con MCD para conocer el impacto de estas.

2. Marco teórico

2.1 Desarrollo, sostenibilidad y bienestar

El desarrollo sostenible tiene su justificación en la medida en que está anclado al bienestar individual y social, (Pena, 2004). El bienestar es multidimensional fundamentado en dos vertientes: el ingreso económico y su impacto en el desarrollo social, Chasco (2003). El desarrollo social, sería la mejora en el bienestar colectivo como esperanza de vida, ingreso disponible, acceso a servicios, mayor participación de bienes de consumo y más compromiso por los embates de la naturaleza y enfermedades, (Uribe, 2004; Boltvinik, 2005). El medio ambiente influye en la salud, a menudo resulta ordenar la calidad del medio ambiente sobre una base universal (Gallopin, 1980). La salud en función a la nutrición, constituye la base del crecimiento y desarrollo humano; la nutrición y la productividad económica son parte del proceso de desarrollo socioeconómico (Solimano y Chapin, 1981).

Las teorías de desarrollo fundamentadas en la teoría de los polos de desarrollo de Perroux de 1955, la teoría circular acumulativa o teoría de desarrollo desigual de Myrdal de 1957, la teoría de desarrollo regional de Boisier de 1996, la teoría de desarrollo regional de Boudeville de 1966, teoría de etapas del desarrollo de Rostow de 1960, entre otras. Así, la acumulación del capital factor del crecimiento, aunque se consolida en una visión holística e integral en las dimensiones: la salud, la educación, tecnología, bienestar y el PIB por habitante, (Sen, 1996; Oriol, 2006).

Sunkel (1991) propone una nueva estrategia de ¨desarrollo desde adentro¨ que no es más que un esfuerzo creativo interno por configurar una estructura productiva que sea funciona a las carencias y potencialidades especificas nacionales. El desarrollo endógeno considera la acumulación de capital y progreso tecnológico como la clave del crecimiento económico y vía de desarrollo auto sostenido, (Vázquez, 1999).

2.2 Programación lineal difusa: modelo de conjunto factible difuso.

La evolución de la PL primero fue tratada por Bellman, & Zadeh, (1970), posteriormente Tanaka, Okuda & Asai (1974), seguido por Zimmermann (1976), Negoitia & Sulari (1976), quienes dieron origen a la PLD. Los criterios según Verdegay, (1999) y Lai & Hwang. (1992) son: el conjunto factible difuso (restricciones difusas), modelos con metas difusas, modelos con coeficientes de la función objetivo difusos, modelos con coeficientes de la matriz tecnológica y recursos difusos, y modelos completamente difusos, Vergara, (1999). De acuerdo con Dantzig, (1957) el modelo tradicional admite la valoración interna sobre los costos de utilidad y los valores marginales de los recursos. Así como la manera de minimizar los costos de utilidad y la prevención de eventos críticos, que permite estar consciente de la decisión más aproximadas los sucesos futuros, (Sydsaeter et al, 2012, p.611). Por otra parte, la flexibilidad de las operaciones a través de programación lineal difusa (PLD) fortalece la toma de decisiones, (Tanaka, Okuda & Asai, 1974; Vergara,1999). Así como Zimmermann, (1976), Negoitia & Sulari (1976), quienes transformaron la PLD y definiciones sobre las metas del modelo, (Lai, & Hwang, 1992; Vergara, 1995, 1995; Verdegay, 1995). El modelo por su flexibilidad sobre metas difusas en los límites máximo y mínimo requeridos por el decisor sobre la función objetivo. Así tenemos:

$$M\tilde{a}x\ z = \sum cx \tag{1}$$

$$s.a: \sum Ax_i \leq b_i \ , \ \ \forall x \geq 0 \tag{2}$$

Para contemplar una programación lineal flexible en que se pueda aumentar la utilidad se debe considerar q_o a la cantidad máxima en la función objetivo, la cual incide sobre la

meta mínima c_o, entonces, para cada vector x se le asocia un $\mu_0(x)$ con la función de densidad de la meta:

$$\mu_0(x)\begin{cases} 1 & c_x > c_o \\ f(x) & c_o - q_o \leq cx \leq c_o \\ 0 & cx \leq c_o - q_o \end{cases} \quad (3)$$

Donde:
$f(.) \in [0,1]$

De acuerdo a la teoría de conjuntos borrosos las definiciones básicas están relacionadas con los siguientes criterios, de modo que el subconjunto difuso (x) es equivalente a la función $\mu_0(x): X \to [0,1]$, en el que $\mu_0(x)$ representa el grado de pertenencia cuando $y \subseteq R$ y $\mu_0(x)$ tomando valores de 0 a 1. El nivel mayor de pertenencia cuando $\mu_0(x) = 1$, caso, contrario para cuando $\mu_0(x) = 0$. En un intervalo $0 \leq \mu_0(x) \leq 1$, contemplando que $X \subseteq R \; y \; x \in X$ (López O, Restrepo L. 2008).

Sea μ un subconjunto difuso de X, donde $0 \leq \lambda \leq 1$, en el dominio:

$$\mu_0(x) = \{x \in X: \mu_0(x) \geq \lambda\} \quad (4)$$

Para el caso que $\lambda = 0$, se tiene que $\mu_0(x) = X$ la intersección de conjuntos difusos (Buckley & Esfandiar, 2002), μ_i son conjuntos difusos de X, y para la intersección:

$$\Lambda_{i-1}^{n} \mu_i = \text{Min}\,\{\mu_1, \mu_2, \ldots \mu_n\} \quad (5)$$

Por consecuencia, la unión de conjuntos difusos será:

$$\mathrm{V}_{i-1}^{n} \mu_i = \text{Max}\,\{\mu_1, \mu_2, \ldots \mu_n\} \quad (6)$$

Con estos conjuntos difusos permite modelar la flexibilidad de restricciones. De acuerdo con Cárdenas, Verdegay, (1999) y Jaroslav, (2001), la programación lineal flexible se puede entonces representar como:

$$\text{Max}\, z(x) =_f \sum_{i=1}^{n} c_i \, x_i \quad (7)$$

Sujeto a:

$$\sum_{i=1}^{n} a_{ij} x_i \leq_f b_i \quad (8)$$

$$\sum_{i=1}^{n} d_{ki} x_j \leq_f e_k, r: \leq_f x_i \leq_f w_i, \; i = 1, \ldots, n \; , j = 1, \ldots, m, k = 1, \ldots, l \quad (9)$$

Para una función objetivo difusa (flexible) se asignará un valor $a_o \in$ R, del cual se espera un valor óptimo x* para z, de modo que z(x*)$\geq a_o$. Pueden existir muchos casos en los que no satisfaga las condiciones requeridas para funciones objetivo, por lo que, se acepta $z(x^*) < a_o$, para el cual se asigna un valor de b_o que define el grado de mínimo de pertenencia. Z(x)$\leq$ a_o-b_o, se dice que tiene un grado de cumplimiento de 0. Así como: Si $z(x) \geq a_o$ para el grado de pertenencia=1. El porcentaje de cumplimiento o pertenencia, se da como:

$$1 - \frac{a_o z(x)}{b_o} \tag{10}$$

Consecuentemente, la función objetivo será:

$$\text{Max}\,\lambda \tag{11}$$

Sujeto a:

$$\mu_z = [\sum_{i=1}^{n} c_i x_i] \geq \lambda, x \in X, \lambda \in [0,1] \tag{12}$$

De acuerdo con (Jaroslav, 2001, López O & Restrepo, 2008) la ecuación anterior se resuelve para la optimización de los parámetros de (λ* y x*).

$$\text{Max}\,\lambda \tag{13}$$

Sujeto a:

$$\sum_{i=1}^{n} c_i x_i \geq a_o - b_o(1-\lambda),\ x \in X, \lambda \in [0,1] \tag{14}$$

2.3 Mapas cognitivos difusos

Las redes entre nodos conformadas por causalidades positivas y negativas entre los agentes participantes es un proceso de iteraciones consecutivas hasta encontrar el equilibrio de todas fuerzas. El manejo de conceptos y sus relaciones se vinculan usualmente a través de mapas cognitivos, las intensidades representadas de manera lingüísticas describen las relaciones entre conceptos en los mapas cognitivos difusos (MCD). Las intensidades, o bien, los pesos en las conexiones, w_{ij} para los números borrosos pueden ser considerados, (Kosko, 1986, 1997; Carlsson, 1996; Peláez & Bowles, 1995).

Las opiniones de los expertos se concentran en la matriz de asignación o pesos, w. De acuerdo al procedimiento iterativo, el vector concepto C_t se actualiza con el producto (R) entre vector C_t y la matriz w resultando: C_{t+1}.

$$C_{t+1} = f(C_t, w) \tag{15}$$

Donde:

$$R = C_t w = vector\ resultante\ de\ conceptos\ en\ la\ etapa, t+1.$$

Los valores de la función toman saltos unitarios entre 0 y 1. Es decir, adquiere valores iguales a cero, si el argumento es menor de 0; por otra parte, toma valores de 1, si el argumento es mayor o igual a cero. La función de salto unitario, se considera la evaluación del concepto a lo largo del tiempo en iteraciones sucesivas, se recurre a la función de identidad.

3. Metodología

Con los balances diferenciales se conocen los tiempos de llenado en las máquinas espumadora y las restricciones de la ecuación objetivo en la PLD (con restricciones difusas) para obtener una nueva zona factible de aplicación. De acuerdo, al contexto donde no se tiene la precisión de los recursos b, pero se acepta la posibilidad de un tope máximo $b + t$ (nivel de tolerancia), Vergara, (1999). Entonces, se ha tomado los datos a 10 microempresas de poliuretanos (Estado de México, Hidalgo, Toluca y Ciudad de México) proveedoras de espumas flexibles a tapiceros de la región centro del país. En el estudio se consideró una base de cálculo con los promedios de los reactivos usados por estas empresas en función a la capacidad instalada.

Las plantas de espumado cuentan con tanques mezcladores de aditivos, necesarios para dosificar a las máquinas espumadoras, como son procesos semi-continuos regularmente, en los tanques de mezclado se revisa continuamente sus niveles con los componentes que sea el adecuado a la formulación, de lo contario afecta la estequiometría y, consecuentemente, pérdidas económicas. Los tanques mezcladores alimentan a las máquinas espumadoras en función flujos precisos de cantidad de componente i por unidad de tiempo. La preparación de dos productos de poliuretano se requiere de tres dosificadores de componentes para cada máquina de espumado en función del volumen contenido en del tanque y los flujos de entrada y salida (balance de materia), Felder *et. al.* (2004). De modo que el volumen contenido en el tanque está en función a la diferencia de entrada del componente i y salida componente i de los flujos por unidad de tiempo más el volumen inicial:

$$V_i(t) = (A_i - B_i)t + V_{i0} \tag{16}$$

Considerando la velocidad de concentrado de los aditivos en unidad de tiempo, tenemos:

$$\frac{dQ_i}{dt} = A_i C_{Ai} - \frac{B_i Q_i}{V_i(t)} \tag{17}$$

Así que al sustituir los V (t) de la ecuación (16) en la ecuación (17) y reacomodando, tenemos:

$$\frac{dQ_i}{dt} + \frac{B_i Q_i}{(A_i - B_i)t + V_{i0}} = A_i C_{Ai} \tag{18}$$

La ecuación anterior corresponde a una ecuación diferencial lineal ordinaria, la cual se soluciona con el método de factor integrante. Una vez sustituidos los flujos de concentración de entrada y la cantidad de componentes en el tanque y su volumen se puede deducir la ecuación matemática específica para cada tanque dosificador a la máquina espumadora. Lo anterior proporciona la base de datos para aplicar PLD y conocer el intervalo de confianza difuso que permita la flexibilidad utilidad de acuerdo a la capacidad instalada. Es necesario aclarar que se ha tomado los niveles promedios de los tanques para para proyectar la productividad de la industria poliuretánicas con los stakeholders.

Una vez conocida los márgenes de flexibilidad productiva se hace el enfoque holístico, se conforma la generación de la matriz de asignación (por parte de los expertos) de las plantas poliuretánicas con el resto de stakeholders, de acuerdo al modelo mapas cognitivos difusos (MCD). Dividido en dos escenarios posibles: aquel donde se ofrecen garantías para empresarios y los stakeholders; y aquel donde las garantías no son cumplidas o simplemente se toman decisiones arbitrarias contrarias al desarrollo y bienestar social.

4. Resultados

El monómero poliol es elaborado por Polioles S. A. (Lerma, Edo. México) y Poliuretanos Toluca, las cuales abastecen a la mayoría de las microempresas poliuretánicas del centro del país. Los resultados se desarrollan de acuerdo a las capacidades de producción estos pequeños espumeros, para lo cual, se ha tomado los promedios de las cantidades de componentes químicos empleados y de las capacidades instalada en tanques de mezclas de estos químicos. De forma empírica se sugiere un proceso dinámico con ecuaciones diferenciales para conocer los tiempos que involucra cada proceso, así que cada tiempo tendrá su imagen con la cantidad de reactivo presente. Las espumas poliuretánicas según su formulación y monómeros empleados, se clasifican en espumas flexibles y rígidas de acuerdo a la base empleada en la polimerización como puede ser glicerina, o sacarosa respectivamente. La cantidad de reactivo contenido en cada tanque-dosificador va disminuyendo conforme pasa el tiempo. En este sentido, si se asignan las variables para resolver la ecuación diferencial lineal, tendremos que proporcionar el volumen inicial

contenido en el tanque dosificador y con la cantidad de reactivo presente, así como los flujos de entrada y salida; finalmente, la concentración de entrada, aún para este caso será cero, ya que sólo se alimenta solvente (ver tabla 1).

	A $(lts./min)_{Ent.}$	Conc. A (kg/lts.)	Q_0 inicial de componente en tanque (kg.)	V_0 tanque (lts.)	$B(lts./min)_{Salida}$
Tanque 1	10	0	40	400	6
Tanque 2	7	0	25	200	5
Tanque 3	8	0	15	300	5

Tabla 1. Datos flujos, volumen, concentración y cantidad de aditivo en los tanques

Con los datos anteriores, se obtienen las siguientes ecuaciones diferenciales de cada tanque de acuerdo al dominio de las cantidades apropiadas en cantidad de aditivos para que se lleven a cabo las reacciones correspondientes para cada producto de poliuretano. Para el tanque 1, la función de densidad se encuentra con un dominio de $0 \leq t \leq 60$ que corresponde al tiempo consumido por tanque-máquina espumadora:

$$Q(t)_w = \begin{Bmatrix} \dfrac{320000}{(4t+400)^{\frac{3}{2}}}, & 0 \leq t \leq 60 \\ 0, & cualquier\ otro\ valor \end{Bmatrix}$$

Para el tanque 2, la función de densidad y dominios:

$$Q(t)_x = \begin{Bmatrix} \dfrac{14142135.62}{(2t+200)^{\frac{5}{2}}}, & 0 \leq t \leq 30 \\ 0, & cualquier\ otro\ valor \end{Bmatrix}$$

Para el tanque 3, la densidad de la función:

$$Q(t) = \begin{Bmatrix} \dfrac{201663.21}{(3t+300)^{5/3}}, & 0 \leq t \leq 40 \\ 0, & cualquier\ otro\ valor \end{Bmatrix}$$

Los intervalos de tiempo para cada uno de los tanques corresponderán al dominio en la función de densidad, que, a su vez, tienen relación con las cantidades estequiométricas de la reacción que se deben emplear para llevar a cabo los productos de poliuretanos. Las funciones de densidad proporcionan la cantidad de materia por unidad de tiempo que dosifica a cada máquina espumadora, y con ello, puede calcular la maximización de la utilidad a través del método simplex.

Para maximizar los recursos, se toman en cuenta las restricciones en función del tiempo antes de que la materia contenida en el tanque deje de ser significativa para la reacción, es decir, que la concentración del reactivo debe ser importante para que la reacción funcione proporcionalmente a la estequiometria correspondiente, así que los tiempos medios son: 400 minutos para el proceso tanque-máquina 1, 200 minutos para el tanque-máquina 2 y 300 minutos para el tanque-máquina 3 (casualmente corresponde al volumen asignado para cada tanque), lo anterior corresponde al 60% en promedio de la capacidad instalada, ver tabla 2.

	Tanque-máquina 1	Tanque-máquina 2	Tanque-máquina 3	Precio ($) /kgs.
Producto 1	50 min	15 min	18 min	93
Producto 2	30 min	20 min	31 min	107

Tabla 2. Relación de producto-máquina

Se requiere conocer el máximo beneficio de utilidad entre los productos de acuerdo a la información anterior. Presentamos la solución en promedio a las capacidades manejadas por las microempresas:

Método simplex tradicional:

$$\text{Max } z = 93\,x_1 + 107x_2 \quad (24)$$

s. a:

$$50x_1 + 30x_2 \leq 400 \quad (25)$$

$$15x_1 + 20x_2 \leq 200 \quad (26)$$

$$18x_1 + 31x_2 \leq 300 \quad (27)$$

$$\forall\, x_1, x_2 \geq 0$$

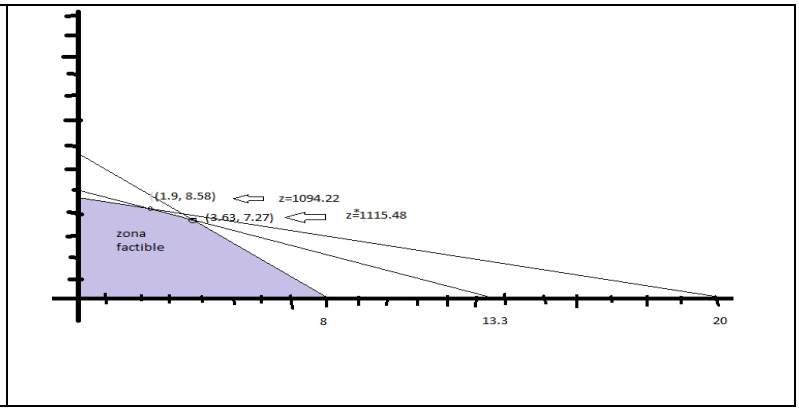


Figura 1. Ecuaciones y gráfica de programación lineal convencional

La ecuación (25) tiene sus puntos de intersección con los ejes en P_1 (0, 13.33) y P_2 (8,0); la ecuación (26) en P_3 (0, 10) y P_4 (13.33, 0) y la ecuación (27) en P_5 (0, 9.7) y P_6 (20, 0). La solución de maximización es el punto en el vértice: **P_8 (3.63, 7.27)** con valor de **z*=1115.48.** A partir de esta z*, si se considera, como objetivo aumentar la utilidad en un intervalo de [$1200.00, $1500.00]. Entonces, se aumenta al 90 % de la capacidad instalada (tiempo) por máquina y, las diferencias de tiempo será la holgura en las restricciones de la PLD. Así pues, los nuevos valores asignados en las restricciones de cada máquina, tabla 3:

	Valores iniciales	Nuevos valores *f* (Cap. Inst.)	Diferencia en minutos
Máquina 1	400	600 min.	200
Máquina 2	200	300 min.	100
Máquina 3	300	450 min.	150

Tabla 3. Relación producto-máquina flexible

Método simplex flexible: las ecuaciones y la zona factible flexible son representados por la figura 2:

Max λ,
s. a:

$$93x_1 + 107x_2 \geq 1500 + (\lambda - 1)300 \quad (28)$$

$$50x_1 + 30x_2 \leq 400 + (1 - \lambda)200 \quad (29)$$

$$15x_1 + 20x_2 \leq 200 + (1 - \lambda)100 \quad (30)$$

$$18x_1 + 31x_2 \leq 300 + (1 - \lambda)150 \quad (31)$$

$$\forall\, x_1, x_2 \geq 0$$

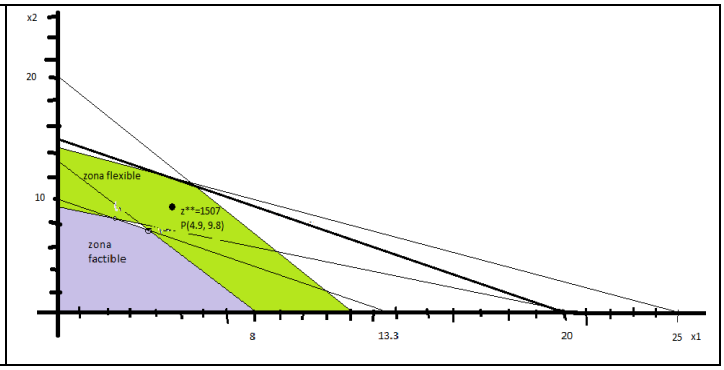


Figura 2. Ecuaciones y gráfica de programación lineal difuso

Los resultados del método flexible en los distintos cortes-λ, para z** en el vértice P_8(4.9, 9.8) para λ=0.3, se podrán obtener 25.98% de aumento a la capacidad moderadamente aceptable. Además, de acuerdo al objetivo planteado en el intervalo de máxima utilidad entre: [$1200, $1500], el valor de λ=0.3 puede ser aceptable, ver la tabla 4.

λ	X_8	Y_8	z**	% de aumento
0	5.45454545	10.9090909	1674.54545	33.3861019
0.1	5.27272727	10.5454545	1618.72727	31.089071
0.2	5.09090909	10.1818182	1562.90909	28.6279665
0.3	4.90909091	9.81818182	1507.09091	25.9845579
0.4	4.72727273	9.45454545	1451.27273	23.1378102
0.5	4.54545455	9.09090909	1395.45455	20.0633227
0.6	4.36363636	8.72727273	1339.63636	16.7326274
0.7	4.18181818	8.36363636	1283.81818	13.1123069
0.8	4	8	1228	9.16286645
0.9	3.81818182	7.63636364	1172.18182	4.83728881
1	3.63636364	7.27272727	1116.36364	0.07915342

Tabla 4. Coordenadas de optimización en función a λ

Con la PLD existe flexibilidad sobre los márgenes de utilidad en valores de λ<1, siempre y cuando la capacidad instalada lo permita. La PL convencional genera un valor utilidad base (z*= $1115.48) para después formular objetivos estratégicos de aumento de ganancias.

λ	Umax (70%)	Umax (80%)	Umax (90%)
0	1002.89	**1219.39***	**1408.99***
0.1	1032.89	**1249.39***	**1438.99***
0.2	1062.89	**1279.39***	**1468.99***
0.3	1092.89	**1309.39***	**1498.99***
0.4	1122.89	**1339.39***	1528.99
0.5	1152.89	**1369.39***	1558.99
0.6	1182.89	**1399.39***	1588.99
0.7	**1212.89***	**1429.39***	1618.99
0.8	**1242.89***	**1459.39***	1648.99
0.9	**1272.89***	**1489.39***	1678.99
1	**1302.89***	**1519.39***	1708.99

Tabla 5. Utilidades en función a capacidad instala vs λ

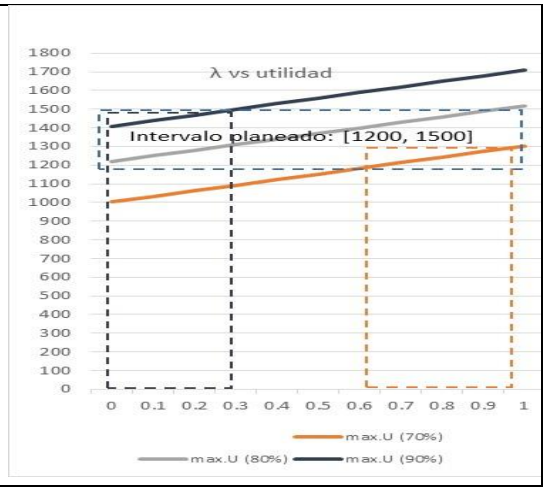


Figura 3. Intervalos óptimos de utilidad (λ)

Los valores óptimos de lambda de acuerdo al objetivo planteado (1200 y 1500 de utilidad), se encuentran por encima de λ*=0. 7 en 70% de la capacidad instalada. Por otra parte, en la capacidad instalada del 80% todas las lambdas son óptimas y, finalmente, para una capacidad del 90% las lambdas óptimas están entre 0* y 0.3*, ver tabla 5 y figura 3 correspondiente.

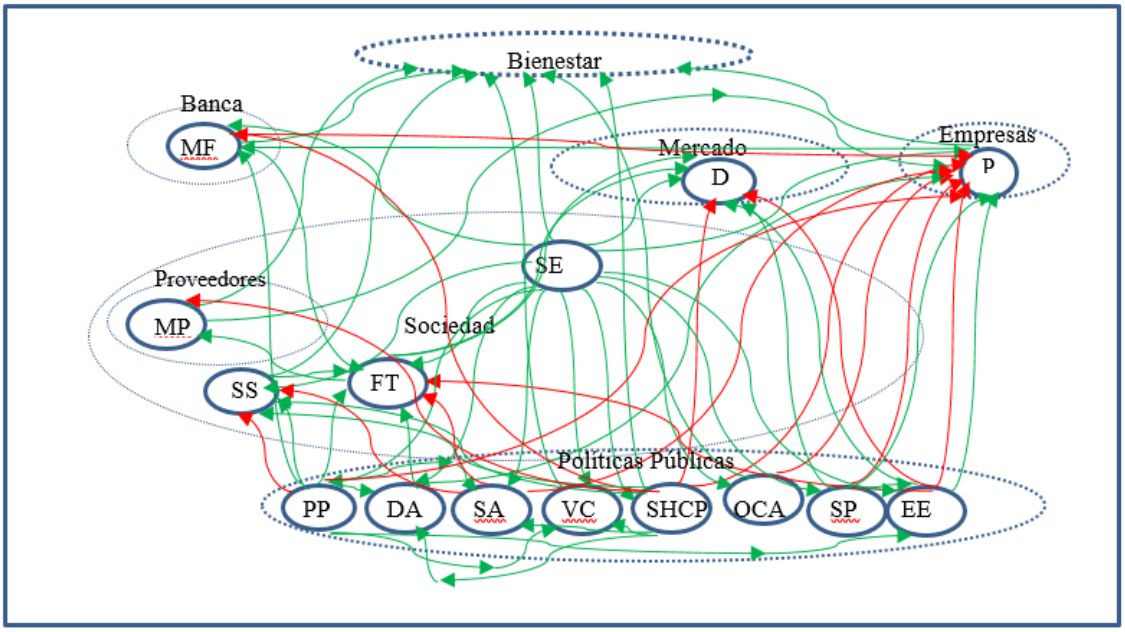
El intervalo de valores óptimos en el intervalo [1200, 1500] permite realizar un contra-expertizaje al interior, y el ambiente socio-económico con su relación a estas empresas con la perspectiva holística. El objetivo es obtener la matriz de asignación que permita el diagnóstico sobre los agentes involucrados que permitan el desarrollo sustentable de la región (Freeman y Mcvea, 2001).

La encuesta a 20 expertos (5 empresarios, 7 servidores públicos, 4 académicos, 2 directores de salud, 2 gerentes bancarios) está enfoca en la incidencia con los diferentes stakeholders involucrados desde la perspectiva económica y solución de problemas que permita sinergias para el bienestar social. Los agentes-factores involucrados en el fenómeno que accionan sobre los costos generados, los cuales pueden ser favorables económicamente (positivos: aumento) o desfavorables económicamente (negativos: disminución). El conjunto de agentes participantes de forma directa a la empresa {materias primas (MP), demanda (D), capacidad instalada (CI), fuerza de trabajo (FT)} el entorno se relaciona con la banca: {mecanismos de financiamiento (MF)}; aportaciones fiscales y administración pública:{energía eléctrica (EE), seguridad pública (SP); políticas públicas (PP), drenaje y alcantarillad (DA), vías de comunicación (VC), servicio de agua (SA),

organismo de control ambiental (OCA), Secretaria de Hacienda y Crédito Público (SHCP)}; {sistemas de salud (SS)}, {sistema educativos (SE)} están asociados a sociedad y {bienestar (B)}.

La aplicación de la encuesta es formula por dos escenarios fundamentales, el escenario optimista: con políticas públicas que fomenten sinergias entre los diferentes stakeholders en los que se permita un puente de comunicación y acuerdos que favorezca todas las partes involucradas y el escenario pesimista: como aquel donde el gobierno impone condiciones y no permite la retroalimentación (autoritarismo: estado actual del país). De modo, que se generan dos matrices posibles, el mapa de causalidades se puede ver en la Figura 3 y las matrices del primero y segundo escenario en la Figura 4 y 5.

Figura 3. Mapa cognitivo difuso de los stakeholders



Los arcos rojos que unen los nodos del MCD cambian de positivo a negativos según los escenarios optimista y pesimista respectivamente. Y a través de la encuesta realizada a 20 expertos se consolida dos matrices de asignación (mediante la función de frecuencias acumuladas o expertones, Kaufmann, Gil, Terceño, 1999, p.299), la matriz de asignación optimista (Figura 4) y la matriz asignación pesimista (Figura 5).

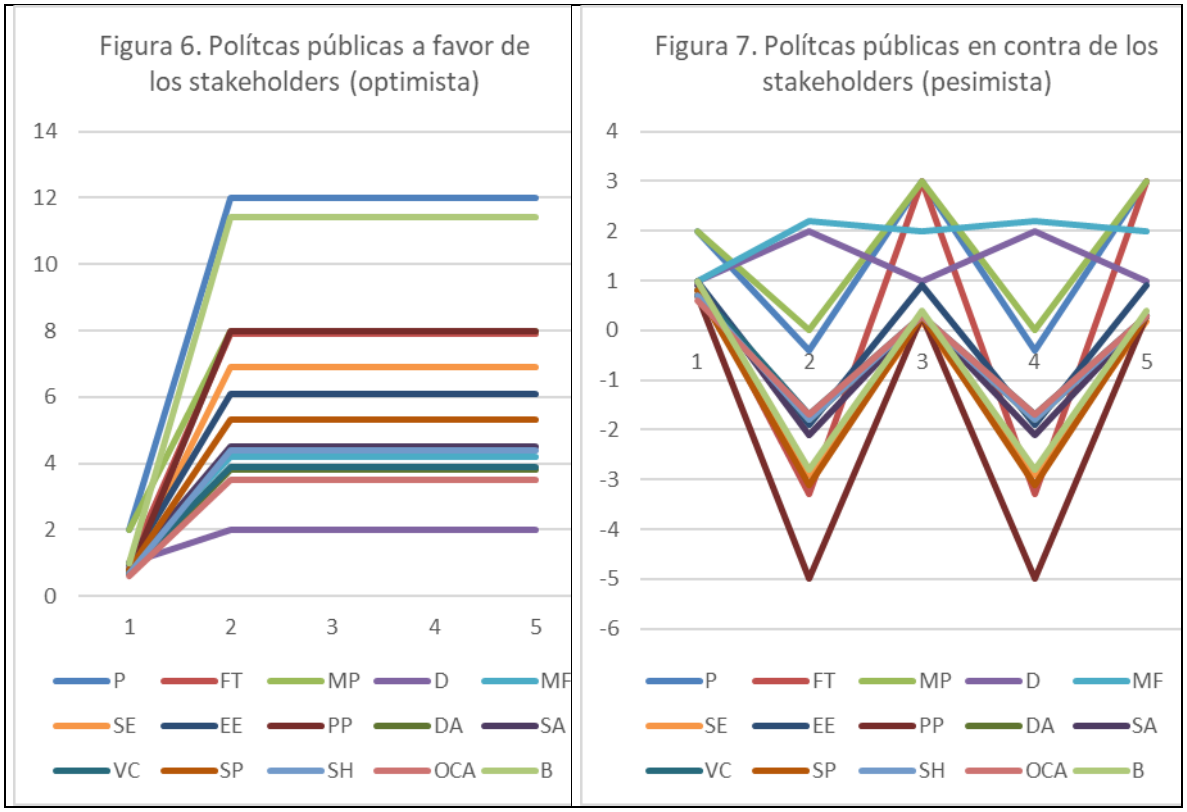
Figura 4. Matriz de asignación con el primer escenario

	P	FT	MP	D	MF	SE	EE	PP	DA	SA	VC	SP	SHCP	OCA	B
P	1	1	1	1	1	0.8	1	0.7	0.7	0.9	0.8	0.8	0.7	0.6	1
FT	1	0	0	0	0	0	0	0.3	0	0	0	0	0.3	0	1
MP	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
D	1	0	1	1	1	0	0.3	0	0	0	0	0	0	0	0
MF	1	0.3	1	0	1	0.2	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
SE	0.8	1	0	0	0.2	1	0.2	0.2	0	0	0	0	0	0	0.9
EE	1	1	0	0	0.3	1	1	1	0.2	0.2	0.2	0.4	0.5	0.2	1
PP	*0.7*	*0.7*	*0.6*	*0*	*0.7*	*0.7*	*0.7*	1	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*	*1*
DA	*0.8*	*0.8*	*0.5*	*0*	*0*	*0.8*	*0*	*0.8*	1	*0*	*0*	*0*	*0*	*0*	*0.7*
SA	*0.8*	*0.8*	*0.5*	*0*	*0*	*0.8*	*0*	*0.8*	*0*	1	*0*	*0*	*0*	*0*	*0.9*
VC	*0.8*	*0.8*	*0.7*	*0*	*0*	*0.8*	*0.8*	*0.8*	*0*	*0.5*	1	*0.7*	*0*	*0*	*0.8*
SP	*0.8*	*0.7*	*0.9*	*0*	*0*	*0.8*	*0.7*	*0.7*	*0*	*0*	*0*	1	*0.9*	*0.4*	*0.9*
SHCP	*0.8*	*0.8*	*0.8*	*0*	*0*	*0*	*0.8*	*0.6*	*0.3*	*0.3*	*0.3*	*0.8*	1	*0.3*	1
OCA	*0.5*	*0*	*0*	*0*	*0*	*0*	*0*	*0.8*	*0.6*	*0.6*	*0.6*	*0.6*	*0*	1	0.8
B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Figura 5. Matriz de asignación con el segundo escenario

	P	FT	MP	D	MF	SE	EE	PP	DA	SA	VC	SP	SHCP	OCA	B
P	1	1	1	1	1	0.8	1	0.7	0.7	0.9	0.8	0.8	0.7	0.6	1
FT	1	0	0	0	0	0	0	0.3	0	0	0	0	0.3	0	1
MP	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
D	1	0	1	1	1	0	0.3	0	0	0	0	0	0	0	0
MF	1	0.3	1	0	1	0.2	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
SE	0.8	1	0	0	0.2	1	0.2	0.2	0	0	0	0	0	0	0.9
EE	-1	-1	0	0	-0.3	-1	-1	-1	-0.2	-0.2	-0.2	-0.4	-0.5	-0.2	-1
PP	*-0.7*	*-0.7*	*-0.6*	*0*	*-0.7*	*-0.7*	*-0.7*	-1	*-0.7*	*-0.7*	*-0.7*	*-0.7*	*-0.7*	*-0.7*	*-1*
DA	*-0.8*	*-0.8*	*-0.5*	*0*	*0*	*-0.8*	*0*	*-0.8*	-1	*0*	*0*	*0*	*0*	*0*	*-0.7*
SA	*-0.8*	*-0.8*	*-0.5*	*0*	*0*	*-0.8*	*0*	*-0.8*	*0*	-1	*0*	*0*	*0*	*0*	*-0.9*
VC	*-0.8*	*-0.8*	*-0.7*	*0*	*0*	*-0.8*	*-0.8*	*-0.8*	*0*	*-0.5*	-1	*-0.7*	*0*	*0*	*-0.8*
SP	*-0.8*	*-0.7*	*-0.9*	*0*	*0*	*-0.8*	*-0.7*	*-0.7*	*0*	*0*	*0*	-1	*-0.9*	*-0.4*	*-0.9*
SHCP	*-0.8*	*-0.8*	*-0.8*	*0*	*0*	*0*	*-0.8*	*-0.6*	*-0.3*	*-0.3*	*-0.3*	*-0.8*	-1	*-0.3*	-1
OCA	*-0.5*	*0*	*0*	*0*	*0*	*0*	*0*	*-0.8*	*-0.6*	*-0.6*	*-0.6*	*-0.6*	*0*	-1	-0.8
B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

El comportamiento de oscilación de ambos escenarios aplicando el proceso iterativo de MCD se tiene



Las condiciones de ofrecer políticas congruentes sin sobre saltos a los diferentes stakeholders es manifestado por la Figura 6. Sin embargo, aquellas decisiones políticas que se están tomando a últimas fechas hacen sentir una desconfianza total sobre los stakeholders: empresarios, académicos, gerentes de la banca, directivos de sector salud e incluso a servidores públicos. Como se puede apreciar las políticas públicas (PP) y seguridad pública (SP) son las peor valuadas, seguida por los servicios que ofrece el propio gobierno; resultando que el bienestar social (B) resulte negativo, (ver Figura 7).

5. Conclusiones

Con la PLD se encuentran λ^* (lambdas óptimas), ampliando la posibilidad de ganancias con respecto al método PL. Además de disponer de un espectro de alternativas para la toma de decisión en función a las demandas del mercado que a su vez dependen de la capacidad instalada. La flexibilidad de la PLD permite cumplir entonces, con los objetivos planeados, además, de tener un margen de maniobra por eventos imprevistos como contratiempos en el proceso de espumado por fallas en el equipo o por la sensibilidad estequiométrica, debido al entrecruzamiento en la formación de la estructura molecular del poliuretano. Los estados financieros en estas empresas son limitados, por lo que es recomendable que estructuren y fundamenten las acciones antes llevarlas a cabo. Las

operaciones se centran en la carga de reactivo conforme al protocolo establecido. Sin embargo, cuando existe una eventualidad, el nivel de estrés es tan alto (por la pérdida económica), que ocasiona errores de manera consecutiva; dicho por los propios espumeros. El intervalo de confianza (ver la Figura 2) generado por el PLD y sus correspondientes valores (tabla 4 y 5) permite ajustar las restricciones en las variables tecnológicas y las variables de los recursos disponibles para los próximos lotes de producto.

El escenario optimista desde la perspectiva de las políticas públicas como organismo estabilidad económico-social permite que los stakeholders de la región puedan trabajar armónicamente, ver Figura 6. Sin embargo, si las políticas públicas actúan de manera autoritaria o desorden, se crea un ambiente de incertidumbre económico-social donde el bienestar tiene un comportamiento medio ocre en forma de "zic-zag" a veces arriba y a veces abajo y con valores negativos, ver Figura 7.

Referencias bibliográficas

Amin, (2016). Tesis doctoral: Procesos para la síntesis de poliuretanos con base acuosa: modelado, validación y simulación. Universidad Nacional del Sur, Argentina.

Bellman, & Zadeh, (1970*)*. *Decision-making in a fuzzy environment*, Management Science 17.

Buckley, & Esfandiar, (2002). An introduction to fuzzy logic and fuzzy sets., Heidelberg: Physica-Verlag.

Boisier, S. (1999). ¨Desarrollo (local) ¿de qué estamos hablando?, Artículo en Estudios Sociales, N°103, C.P.U., Santiago de Chile.

Boltvinik, J. (2005). ¨Ampliar la mirada. Un nuevo enfoque de la pobreza y el florecimiento humano¨. México, Papeles de población. UAEM.

Butelmann, A, y Gallego, F (2001) ¨Ahorro de los hogares en Chile: evidencia macroeconómica¨. Banco central de Chile, Vol. 3 No. 1.

Cárdenas, & Verdegay (1999). Modelos de optimización con datos imprecisos Servicio de Publicaciones, Universidad de Murcia.

Chasco, C. (2003). ¨Medición del bienestar social provincial a través de indicadores objetivos¨ España, Instituto Lawrence R. Klein- Departamento de economía aplicada, Universidad Autónoma de Madrid.

Dantzig, (1957). Discrete variable extremum problems, Operations Research 5(2) p. 266-277.

Engels et. al (2013). Polyurethanes: Versatile Materials and Sustainable Problem Solvers for Todays Challenges. Angewandte Reviews, Angew chem. int. Ed. 2013, 52-2-22

Felder *et. al.* (2004). Principios básicos de los procesos químicos. Editorial El Manual Moderno. S. A. México p. 87

Jaroslav (2001). Soft Computing: Overview and Recent Developments in Fuzzy Optimization., Ostravská univerzita. Listopad.

Freeman y McVea, (2001). A Stakeholders Approach to Strategic Management. Social Science Research Network Electronic. Oxford No. 01-02 University of Virginia
Gallopín, G, C. (2006). ¨Los Indicadores de desarrollo sostenible: aspectos conceptuales y metodológicos¨, Chile, Fodepal.
Gallopin, G. (1980). ¨El medio ambiente humano¨, México. Estilos de desarrollo y medio ambiente en la América Latina, F.C.E.
Kaufmann, Gil, Terceño, (1994), Matemática para la economía y la gestión de empresas. Ediciones Foro Científico. p.299. Barcelona
Kim et al, (2010). *Waterborne polyurethanes and their properties*, Journal of Polymer Science, Part A: Polymer Chemistry: 34, 1095–1104.
Lai, & Hwang, (1992). Interactive fuzzy linear programming, Fuzzy Sets and Systems 45, p. 169-183.
López & Restrepo (2008) *Programación lineal flexible con restricciones difusas*. Ingeniería e Investigación. vol. 28 no.1 Bogotá Jan./Apr.
Negoita, & Sularia, (1976). On fuzzy mathematical programming and tolerances in planning, Economic Computer and Economic Cybernetic Studies and Researches 1, p. 3-15.
Oriol, J. (2006). ¨Teoría y práctica del desarrollo. Cambios en las variables de la ¨ecuación del desarrollo¨ en los últimos 50 años¨, Caracas, Revista del CLAD Reforma y Democracia.
Pena, J, B. (1977). ¨Problemas de medición del bienestar y conceptos afines¨ España, INE, Madrid.
Sydsaeter et al, (2012). Matemáticas para el análisis económico, 2ª. edición Pearson Educación, S.A., Madrid, España, p.603-611.
Tanaka, Okuda & Asai, (1974). *On fuzzy mathematical programming*, Journal of Cybernetics 3, p. 37-46.
Subramani, et al. (2003); *New development of polyurethane dispersión from blocked aromatic diisocyanate*. journal Progress in Organic Coatings, Elsevier, volume 40, issue 1. page 71-79.
Sen, A. (1996). ¨Capacidad y bienestar¨. México, Fondo de la cultura económica.
Solimano, G. y Chapin, G. (1981). ¨Efecto del desarrollo socioeconómico y el cambio ecológico sobre la salud y la nutrición en la América Latina¨, México, Estilos de desarrollo y medio ambiente en la América Latina, F.C.E.
Solis, D. (2010). ¨Análisis térmico de una vivienda económica en clima cálido-seco bajo diferentes orientaciones y medidas de sombreado¨, México, Estudios sobre arquitectura y urbanismo del desierto
Sunkel, O. (1991). ¨Desarrollo desde adentro, un enfoque neo estructuralista para la América Latina¨, México, F.C.E.
Verdegay, (1995). Fuzzy optimization: Models, methods and Perspectives; 6thIFSA-95 World Congress. Sou Paulo - Brazil, 1995, pp. 39-71.
Vázquez, A. (1999). ¨Desarrollo, redes e innovación¨, Santa Cruz de Tenerife, Editorial Pirámide.

Vergara, (1999). Nuevos criterios de parada en algoritmos de optimización. Tesis doctoral, Universidad de Granada, España. p. 5-30.
Zimmermann, (1976). *Description and optimization of fuzzy system*. International journal general system 2, p. 209-21.

LOS NEGOCIOS ELECTRÓNICOS Y EL CONSUMISMO DE CONTENIDOS: PROPUESTA PARA MITIGAR EL CONTROL DE LA INFORMACIÓN

Rueda Chávez Rubén Fernando, Salgado Ortiz Francisco Javier, Montalvo Luna Ana Rosa
Instituto Tecnológico Superior de Salvatierra. México.
rurueda@itess.edu.mx, fasalgado@itess.edu.mx, anmontalvo@itess.edu.mx

RESUMEN

El objetivo de la investigación fue generar un modelo tecnológico que mitigue en menor manera el control de la información. La investigación se realizó mediante un enfoque cualitativo, se analizó detalladamente cada uno de los siguientes puntos; Entetanimiento, Youtube, y Bitube identificando los factores preponderantes lo que permitió el hallazgo de los elementos para la construcción del Modelo tecnológico.
Se obtuvo como principales resultados los diagramas, estructuras de TI y cadena de valor acorde al modelo propuestos, a lo largo de este análisis se encontraron diferentes puntos de vista por los autores en cuanto a los modelos de negocios de estas dos plataformas y sus características. Sin embargo, dada las características de la actual realidad es necesario plantearse un nuevo modelo de negocios que no limite al internauta el poder expresarse de forma libre y a su vez garantice la libertad de la información.

Palabras Claves: Negocios electrónicos, Entetanimeinto, plataformas digitales.

ABSTRACT

The objective of the research was to generate a technological model that mitigates information control in a lesser way. The research was carried out through a qualitative approach, each of the following points was analyzed in detail; Tittytainment, Youtube, and Bitube identifying the preponderant factors which allowed the discovery of the elements for the construction of the Technological Model.
The main results were the diagrams, IT structures and value chain according to the proposed model, throughout this analysis, different points of view were found by the authors regarding the business models of these two platforms and their characteristics. However, given the characteristics of the current reality, it is necessary to consider a new business model that does not limit the Internet user to be able to express himself freely and at the same time guarantees freedom of information.

KEYWORDS: Electronic Business, Tittytainment, Digital Platforms.

1. INTRODUCCIÓN

A través del tiempo el ser humano ha evolucionado y creado nuevas alternativas para llevar una vida mejor, un aspecto que ha ayudado a que este proceso de evolución avance rápidamente es algo con lo que convivimos a diario y se llama tecnología, que no es más que una herramienta que ha generado una brecha en este desarrollo del ser humano.

Algunas empresas de tecnología han evolucionado a través de los años y es que todo evoluciona, si en el mundo de los negocios te quedas estancado estás condenado al fracaso, por lo que todas las empresas tienen que ser innovadoras y evolucionar a la par de la tecnología y de lo que el mundo en el que se vive solicita.

Términos un poco extraños y relativamente nuevos, que tienen su raíz hace miles de años atrás en el tiempo de grandes pensadores de la historia, hoy vienen a retumbar en nuestros tiempos bajo un nuevo concepto, pero conservando la misma idea que personas destacadas y relevantes en la historia del mundo han utilizado de la mejor forma posible para cada uno de sus intereses.

Lo interesante de todo esto es como unir ideas tan antiguas con conceptos modernos, y como ejemplificar como todo tiene sus raíces atrás y como estamos inmersos en una realidad que ni siquiera creíamos posible, como el mundo y la mercadotecnia ha abrumado a la sociedad y ha hecho que esta misma Sociedad prefiera tener nuevos "trabajos" desde la comodidad de su casa, tan solo viendo un monitor.

2. ENTETANIMIENTO

En el presente capitulo comenzaremos con el siguiente fragmento de texto sobre una definición del término "entetanimiento":

"[...] una mezcla de entretenimiento mediocre y vulgar, bazofia intelectual, propaganda y elementos psicológica y físicamente nutritivos que satisfarán al ser humano, lo mantendrían convenientemente sedado, perpetuamente ansioso, sumiso y servil ante los dictados de la minoría que decidiría su destino". (Sala, 2007)

Una vez mencionado lo anterior, podemos encaminarnos a la siguiente cuestión: *"¿la mayoría del contenido, que solemos denominar como información a través de medios electrónicos (redes sociales, vídeos, juegos, etc…), que consumimos diariamente es plenamente parte del entetanimiento?"*, y dicha cuestión se genera debido a que si hacemos una breve búsqueda en internet sobre dicho término nos encontraremos, principalmente, que se utiliza como herramienta de control en la población, esto como una forma de mantenernos "cegados" de lo que realmente está ocurriendo en la realidad, de la verdad, donde se nos

convierte a plenos consumistas del contenido que genera un pequeño fragmento de la demás población, sin contar con la posibilidad de cambiar la situación, es más, algunas veces ni siquiera pasa por nuestros pensamientos, simplemente nos conformamos con ello, y aunque no lo hagamos al principio, se acepta en algún momento sin mayor inconveniente.

En la actualidad existen novedosas plataformas las cuales tratan de mitigar lo recién mencionado sobre el entetanimiento, una de ellas es YouTube, que, aunque se trata de una plataforma que surgió en el año 2007 en México, es punta de lanza para el cambio de esa idea, como lo menciona Ignacio Santiago: "YouTube es un sitio web para compartir vídeos subidos por los usuarios a través de Internet, por tanto, es un servicio de alojamiento de vídeos por excelencia. El término proviene del Inglés «you«, que significa tú y «tube«, que significa tubo, canal, pero se utiliza en argot como «televisión». Por lo tanto, el significado del término YouTube podría ser «tú transmites» o «canal hecho por ti»." (Santiago, 2020). De acuerdo con dicho autor y contrastando la idea anterior, ahora no solo estamos obligados a consumir lo que hay, no solo contamos con reducidas opciones, sino que gracias a esta plataforma podemos generar el contenido que deseemos y compartirlo con los demás, así como buscar temas de interés y banales, pero con la principal diferencia que es lo que cada usuario escoge. Sin embargo, aunque dicha plataforma, al inicio contaba con buenas intenciones, poco a poco se ha ido transformando, con el pretexto de proteger derechos de autor y mantener su modelo de monetización, ha hecho cada vez más estrictas sus políticas de censura, siendo así partícipes de violar el derecho al libre discurso, participando una vez más en el acto de entetanimiento.

BitTube, es una plataforma de transmisión de video revolucionaria y descentralizada que devuelve el poder a los creadores y espectadores. Es una plataforma donde las soluciones de criptomonedas como BitTube (TUBE) ya están integradas a través de las cuales los creadores de videos pueden ganar dinero con su contenido, sin anuncios.

Y no solo los pagos se descentralizan a través de la criptomoneda, sino que la base de datos subyacente también es IPFS (InterPlanetary File System), que es una tecnología de contabilidad descentralizada y distribuida, por lo que no hay servidores centralizados que alojen sus datos de videos, lo que resulta en contenido bastante resistente a la censura para cualquier persona en cualquier parte del mundo. Ningún país, ningún protector de datos y ninguna compañía tiene control sobre estos datos. Una vez cargados, los datos no se pueden eliminar ni cambiar y están disponibles para todos los usuarios de Internet a través de cualquier puerta de enlace IPFS con una dirección única (hash) en todo el mundo.

BitTube se encuentra completamente basado en el navegador, cabe destacar que consta de 2 partes, las cuales son:

- No es necesaria la instalación de software: Para visualizar los datos solamente se requiere del navegador de un dispositivo, es suficiente para acceder a todos los datos en la red IPFS a través de BitTube, independientemente de quién los cargó o cuándo y dónde.
- Cada vez que un espectador visualiza cualquier contenido de video con un hashrate de hasta 30 hash / seg, se toma como la potencia de cómputo de su dispositivo (móvil / pc) para extraer BitTube, que luego se distribuye al creador del contenido y al espectador.

De acorde a estas características de libre discurso y no centralización, BitTube es la mejor herramienta actualmente donde se pueden conocer lo que está pasando alrededor del mundo, sin manipulación mediática o corporativa, proporcionando una plataforma libre.

5.1. Modelo Conceptual

En el presente apartado se mostrará y describirá a la brevedad el modelo conceptual correspondiente a nuestras ideas y argumentos sobre las plataformas mencionadas anteriormente, el cual se muestra a continuación:

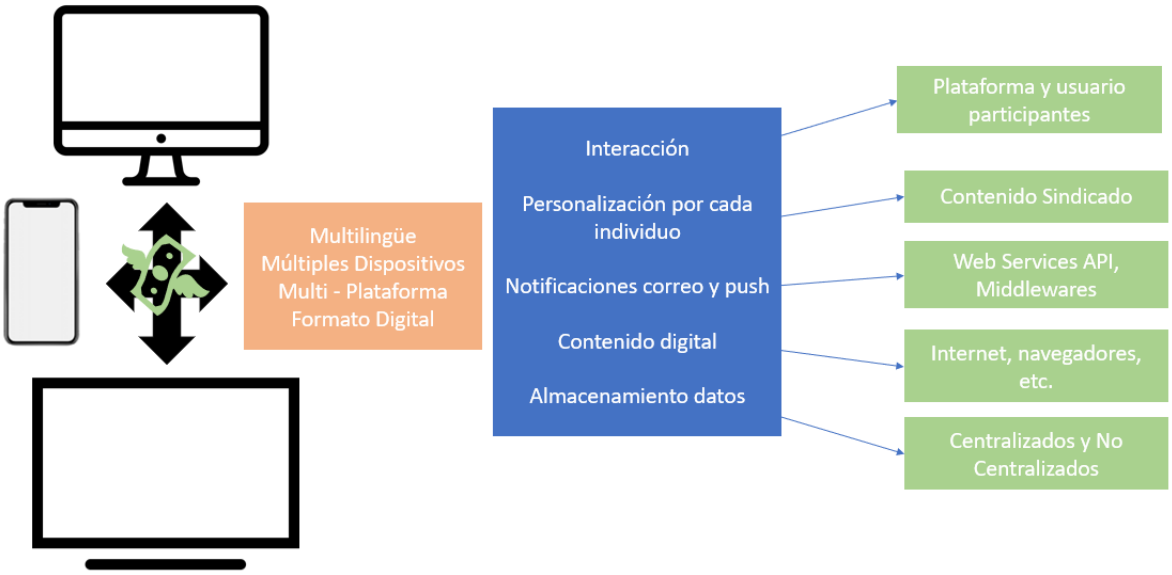


Figura 1. Modelo Conceptual (Elaboración Propia)

La idea principal de este tipo de plataformas, y más en la época que nos encontramos donde casi desde cualquier lugar podemos acceder a internet a través de nuestros dispositivos (computadora, smartphone, Tablet, televisor), es el llegar a la mayor parte de la población a través de contenido digital, sirviendo no sólo como medios de entretenimiento, sino también como estrategias de marketing para muchas empresas que

deseen dar a conocer sus productos y/o servicios que ofrezcan. El usuario cuenta con la posibilidad de personalizar el contenido que desea consumir, solamente ves lo que ocupas o quieres ver, así mismo, la plataforma se convierte en un ente participante al ofrecer contenido similar al que el usuario ha estado visualizando. Lamentablemente la popularidad que con el paso de los años fue tomando YouTube hizo que perdiera el buscar la libre expresión por parte de sus usuarios creadores y empezar a convertirse de una plataforma de entretenimiento a una de entetanimiento, mostrando como tendencias solamente lo que le conviene a esta plataforma o a determinadas personas, lo que a su vez podríamos decir que crea monopolio de ciertos canales; sin embargo, en el caso de la plataforma BitTube, el usuario vuelve a ser tomado en cuenta, fomentando, como se dijo anteriormente, la creación de contenido de distintos temas, buscando descentralizar los ideales que YouTube últimamente ha ido manejando.

Además de este modelo, también se realizó un Modelo E-R (Modelo Entidad Relación), el cual suele ser representado de manera formal mediante un Diagrama, donde se muestran entidades, los atributos de estas y las relaciones existentes entre ellas, dicho diagrama se muestra a continuación:

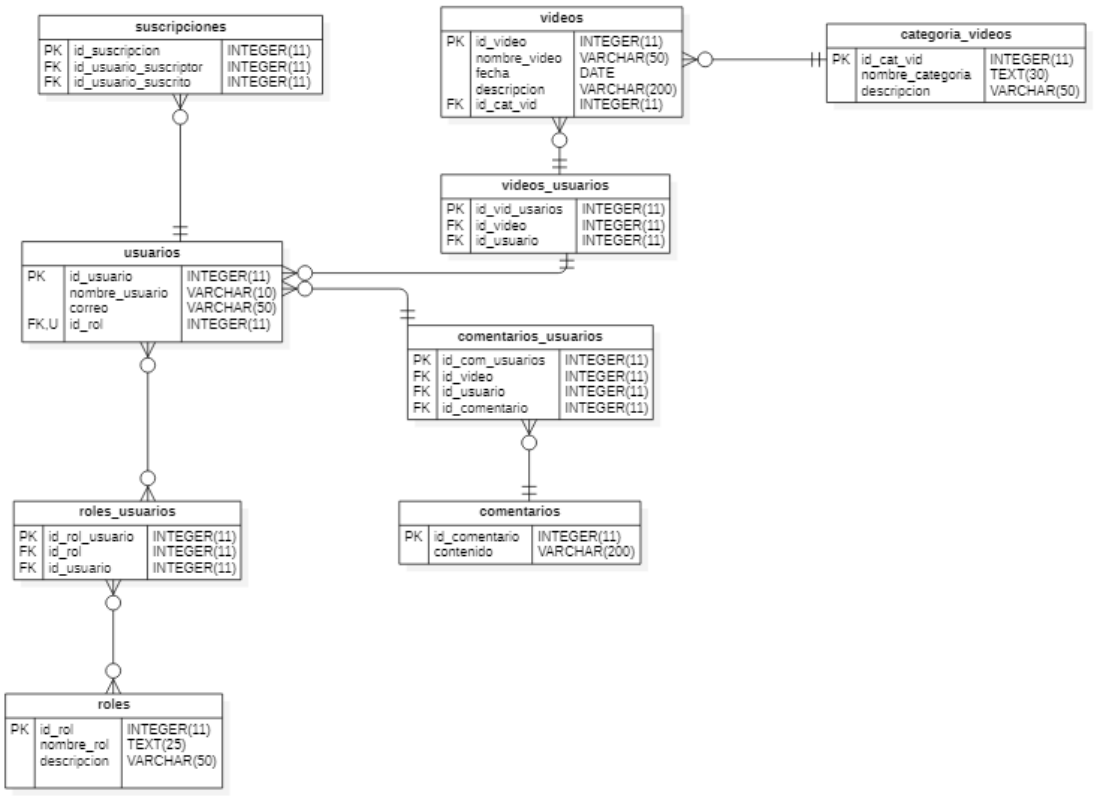


Figura 2. Diagrama Entidad - Relación (Elaboración Propia)

Tal como se muestra en la imagen anterior, podemos encontrar diversas entidades que creemos son básicas en dichas plataformas, que hacen referencia al entetanimiento que existe en la actualidad, que básicamente podemos resumir en dos, las cuales serían los usuarios y los vídeos, dentro de los usuarios se pueden identificar a los que consumen contenido de otros y los que crean dicho contenido de determinados temas, dicho contenido son los videos que existen en dichas plataformas, estos videos se encuentran categorizados de acorde a elección libre del usuario al momento de subirlo a la plataforma. Los usuarios al suscribirse a otro canal, lo que realmente sucede es que se suscriben al contenido de otro usuario, como mencionamos anteriormente el contenido principal son los videos, los cuales son propiedad del usuario creador de estos. Cabe mencionar que los usuarios pueden tomar distintos roles, puesto que además de contar con su canal, también pueden ser administradores de otros canales a los cuales se les haya otorgado dicho acceso. Por último, todos los usuarios cuentan con la posibilidad de realizar comentarios en prácticamente cualquier vídeo, a menos que el creador de dicho vídeo haya prohibido esta opción.

5.2. Arquitectura de TI

A continuación, se describe la arquitectura correspondiente a las tecnologías de la información de las plataformas mencionadas anteriormente, por lo que se muestra un sencillo diagrama sobre el funcionamiento de las estas:

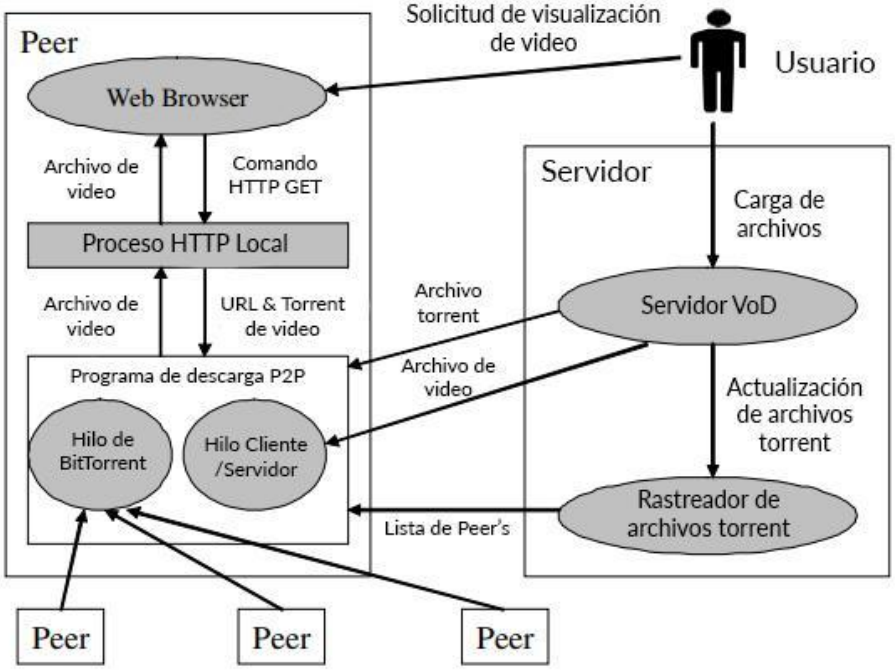


Figura 3. Diagrama de Arquitectura TI (Elaboración Propia)

En dicha arquitectura de TI, podemos observar que todo el sistema depende del mismo usuario como tal, el cual puede actuar de dos maneras diferentes, ya sea como servidor y como peer.

Del lado del servidor, notamos que existen dos entidades: servidor VoD (Video on Demand) y rastreador de archivos Torrent. El servidor VoD es un servidor web, que actúa como el portal de información, en el cual los usuarios pueden navegar, enviar y buscar archivos de video.

El servidor VoD administra todos los archivos Torrent. Cada vez que un nuevo video es subido al servidor VoD un archivo Torrent correspondiente. En el lado del peer, cada máquina que sirve de peer ejecuta un programa de descarga de P2P, que es un módulo compatible con BitTorrent responsable de coordinar con el rastreador de BitTorrent y organizar la descarga de contenido de vídeo de otros pares. Además, admite la descarga tradicional de cliente-servidor del servidor VoD a través del protocolo HTTP, que se activa automáticamente cuando no hay suficientes pares para admitir la transmisión de video.

En el servicio tradicional UGC (User Generated Content) basado en la web, como YouTube, la solicitud de visualización del usuario se inicia como un comando HTTP GET desde el navegador web al servidor VoD. Para redirigir esta solicitud al código auxiliar de descarga P2P, presentamos un proceso HTTP local en cada máquina peer. Se escucha en un puerto local, después se intercepta el comando HTTP GET, descarga el archivo Torrent del video solicitado, luego lo entrega al código auxiliar de descarga, que contiene un hilo BitTorrent y un hilo cliente/servidor. En consecuencia, el hilo de BitTorrent contacta con el rastreador de BitTorrent y comienza a descargar, mientras que el hilo cliente/servidor se descarga desde el servidor VoD. Finalmente, el código auxiliar de descarga devuelve el contenido descargado al proceso HTTP local, que lo entrega aún más al navegador web respondiendo al comando HTTP GET que intercepta previamente.

5.3. Estrategia de Valor (Cadenas de Valor)

A continuación, se generaron dos cadenas de valor, con el objetivo de poder tener una comparativa clara entre el término Entetanimiento y las dos plataformas de vídeos.

Primeramente, se muestra la cadena de valor referente a Entetanimiento, la cual se basa en el contenido controlado en sentido estricto.

Figura 4. Cadena de Valor de Entetanimiento (Elaboración Propia)

Así mismo, se muestra la cadena de valor referente a las nuevas plataformas para la distribución y creación de contenido, en donde se puede elegir que se ve, sin que sea impuesto.

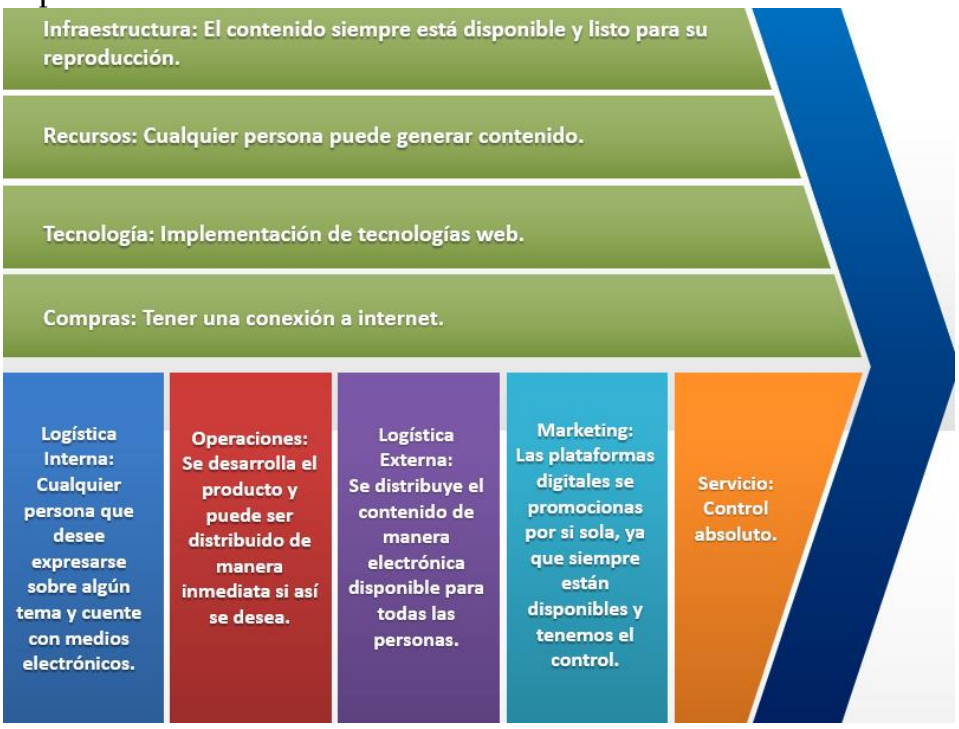


Figura 5. Cadena de Valor de YouTube y BitTube (Elaboración Propia)

5.4. Modelo Integrador de la Información

En esta sección veremos y describiremos el modelo integrador de la información, cómo se maneja en cada capa y cómo interactúa entre los diferentes usuarios. De acuerdo con la arquitectura de TI que se propuso en apartados anteriores.

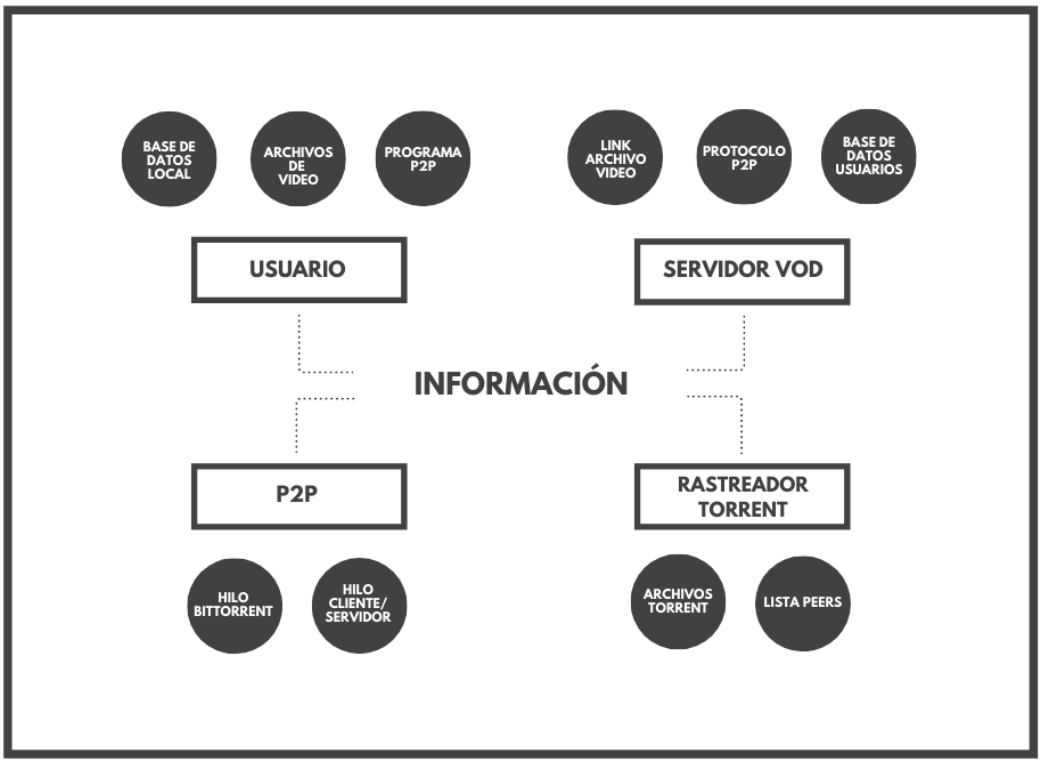


Figura 6. Modelo Integrador de la Información propuesta (Elaboración Propia)

En el presente modelo de la información notamos que, aunque son entes aislados para mantener la descentralización que se busca con el modelo propuesto en la arquitectura de TI, lo que une estos entes es la información. Peticiones a listas de direcciones que se tienen, por medio de protocolos. El usuario es el encargado de almacenar el archivo de video como tal, esto garantiza que ningún ente externo pueda modificarlo, borrarlo o tenga algún tipo de control sobre el contenido ofrecido en la plataforma. Así mismo cuenta con una base de datos local, que es la encargada de guardar la dirección de cada uno de estos archivos de video para que puedan acceder desde la petición web que realiza el programa P2P.

El programa P2P es el vínculo entre el usuario "cliente" y el usuario "servidor", manejando las direcciones de cada uno, sus peticiones, así como el archivo BitTorrent que se está compartiendo entre estos, su manejo de información está cifrado por medio de

blockchain lo que garantiza el anonimato entre el cliente consumiendo el archivo de video y el servidor que está ofreciendo.

El servidor VoD (video on demand) es la interfaz web que muestra los videos disponibles para consumo, cabe mencionar que solamente muestra el contenido que está libre porque por medio de esta plataforma también se puede compartir contenido de manera privada. El servidor es el encargado de tener los links a los archivos de video libres lo que hace que se pueda acceder a ellos de manera más sencilla, este servidor es el que por medio de un navegador realiza el llamado a los usuarios que tienen los archivos de video por medio de un protocolo P2P. Por último, este servidor VoD también tiene una base de datos de los usuarios registrados mas no del contenido que cada uno comparte, esto es trabajo del siguiente componente.

El rastreador Torrent es el encargado de tener una base de datos de los archivos Torrent en existencia, así como la lista de todos los peers que contienen el archivo de video (pueden ser más de uno) esto para ofrecer una lista de descargas más grande, dándole estabilidad a cada descarga o cada petición.

5.5. Modelo de la Estrategia de TI

A lo largo de esta investigación se describió la estrategia de TI (Tecnologías de la Información) comenzando con una breve reflexión sobre las dos plataformas Youtube y Bittube. Partimos de que, así como llega a surgir la idea sobre la creación de algún nuevo proyecto siempre se es necesario conocer el mercado, el público hacia el cual se trata de dirigir, principalmente la cultura tecnológica y sus necesidades de comunicación, para así poder contar con un enfoque más preciso hacia el cómo se debe de dirigir, diseñar y poder lograr su principal objetivo, que de acorde a nuestro punto de vista es el de promover información de diversos contenidos y no limitar el acceso a la información. A pesar de que las dos plataformas, YouTube y BitTube, sean similares en cuanto a que las dos ofrecen contenido a sus usuarios de parte otros usuarios creadores y de ser plataformas casi solamente de vídeos como medio de transmisión de la información buscando centrarse en los gustos y temas de interés que están ocurriendo en la sociedad, a pesar de ello, como se mencionó anteriormente en el desarrollo del presente documento, YouTube ha pasado a censurar gran parte del contenido que se crea en la actualidad, 2020, esto de acuerdo a determinadas reglas de creación de contenido que manejan; sin embargo, en vez de traer consigo un mayor beneficio, tanto para la plataforma como para los usuarios, esto ha conllevado a generar cierto repudio por parte de los usuarios y a buscar en otras plataformas lo que no hay o ha dejado de existir en YouTube, lo que nos lleva a la plataforma BitTube, en la cual se olvidan de la centralización y buscan no solamente entender al usuario sobre la libertad de contenido, sino también compensarlo por crearlo y, se podría decir, por haber elegido su plataforma.

Figura 6. Modelo de la Estrategia de TI (Elaboración Propia).

Con lo presentado anteriormente lo que se busca en este tipo de plataformas es fomentar la creación de contenido a través del mismo contenido ya cargado en la plataforma, lo que conlleva a la obtención de conocimiento, así como a la globalización de contenido.

3. CONCLUSION

Internet se ha convertido en un nuevo medio de comunicación y que día con día ha tomado una fuerza e importancia en todas las áreas de nuestras vidas. En un mundo invadido por la información, Internet ha venido a darle mayor proyección y facilidad para que un gran número de gente esté informada, y pueda tener la oportunidad de desarrollarse y comunicarse de una mejor manera y en gran medida ha evolucionado el entretenimiento.

Este nuevo medio de comunicación no puede ser visto de otra manera ya que lo que conforma precisamente a la red de redes es precisamente la gran cantidad de información que circula alrededor del mundo, llevando y trayendo datos de un lado al otro del planeta y por lo mismo convirtiéndose en medios de entretenimiento muy importantes.

Por otro lado, la búsqueda del entretenimiento siempre ha sido de interés humano, sin embargo, cuando los grandes líderes encontraron la forma de controlar a la población mediante este método, se volvió una de las formas más comunes de mantener a las personas bajo control, consumiendo solamente lo que se les impone, lo cual le conviene a

las personas que se encuentren detrás esto, generando pasividad, conformismo e ignorancia.

Es importante destacar que, de algunos años a la fecha, las tecnologías de la información han propiciado un enorme cambio, debido a que revolucionaron los medios para consumo y generación de contenido, en el que cualquier persona puede hacer uso de su opinión mediante, un video, audio, escrito, documento o fotografía, entre otros, otorgando mayor control a los usuarios para seleccionar los temas sobre los cuales se quiere estar enterado. Es por esto que toma relevancia esta investigación dado el aumento del consumismo de contenidos y la falta de estrategias de Tecnologías de Información (TI) que no censuren la información, es por esto que a través de esta investigación se propone un estrategia de TI que permita la libre información.

4. REFERENCIAS

Harsh A. (2018). *What Is BitTube & Why It Is Better Than YouTube – Videos on Blockchain*. Recuperado el 28 de abril de 2020, Sitio Web: https://coinsutra.com/

Laetoli. Winkler, R. (2015). YouTube: 1.000 millones de usuarios, cero ganancias. Retrieved May 1, 2020, from LA NACION website: https://www.lanacion.com.ar/tecnologia/youtube-1000-millones-de-usuarios-cero-ganancias-nid1771893

Liu, B., Cui, Y., Chang, B., Gotow, B., & Xue, Y. (2008). BitTube: Case study of a web-based peer-assisted video-on-demand system. Proceedings - 10th IEEE International Symposium on Multimedia, ISM 2008, 242–249. https://doi.org/10.1109/ISM.2008.88

Sala, G. (2007). PANFLETO CONTRA LA ESTUPIDEZ CONTEMPORÁNEA. LAETOLI. Recuperado el 28 de abril de 2020

Santiago, I. (s.f.). *¿Qué es YouTube?: Ignacio Santiago*. Recuperado el 29 de abril de 2020, de Ignacio Santiago Sitio Web: https://ignaciosantiago.com

8bitmen.com. (n.d.). YouTube Database – How Does It Store So Many Videos Without Running Out Of Storage Space? Retrieved May 1, 2020, from 8bitmen.com website: https://www.8bitmen.com/youtube-database-how-does-it-

Yesid, H. (2019). BitTube, una plataforma para ganar criptomonedas Coin Gratis. Retrieved May 1, 2020, from https://medium.com/@HaroldYesidYT/bittube-una-plataforma-para-ganar-criptomonedas-coin-gratis-f7a2e8544626

YouTube. (n.d.). Prensa - YouTube. Retrieved May 1, 2020, from https://www.youtube.com/intl/es/about/press/

INSTRUCCIONES A LOS AUTORES

Requisitos para la representación de trabajos de investigación como posibles publicaciones en la revista.

- ***Revista Científica del Instituto Iberoamericano de Desarrollo Empresarial*** recibe trabajos de investigación en cualquiera de las áreas o especialidades de las ciencias sociales (educación, económico- administrativas, financieras y derecho).
- Los trabajos de investigación que se sometan a ***Revista Científica del Instituto Iberoamericano de Desarrollo Empresarial*** deben ser inéditos.
- Los artículos pueden ser escritos en español o inglés y deben incluir un resumen en ambos idiomas.
- Los trabajos de investigación que se sometan a ***Revista Científica del Instituto Iberoamericano de Desarrollo Empresarial*** no pueden ser enviados simultáneamente a otras revistas.
- Los trabajos de investigación se reciben en el editor de texto (Word) en no más de 15 cuartillas a espacio y medio, incluyendo cuadros y gráficas. Los trabajos pueden ser enviados al correo electrónico: fegosa@gmail.com. El tipo de letra debe ser Calibri, tamaño 12 puntos, márgenes: superior 3 cm, izquierdo 3 cm, inferior 3 cm, derecho 3 cm, en hoja tamaño carta.
- La primera página debe contener: a) título del trabajo; b) nombre(s) del (de los) autor(es); c) institución de adscripción; d) resumen de no más de 200 palabras; e) pie de página con correo electrónico del autor que recibirá correspondencia.
- Gráficas, cuadros y fórmulas se numerarán consecutivamente.
- La bibliografía debe presentarse al final, de acuerdo con los siguientes ejemplos:

Fuller, W. A. (1996). *Introduction to Statistical Time Seriaes*. 2nd ed., John Wiley, New York.

Granger, C. W. (1980). *Long Memory Relationships and the Aggregation of Dynamics Models*. Journal of Econom trics, 14, pp. 227-238.

Duffy, J. (2001). *Learning to Speculate: Experiments with Artificial and Real Agents*. Journal of Economic Dynamics and Control, 25 (3), pp. 295-319.

Arifovic, J., J. Bullard, and J. Duffy (1997). *The Transition from Stagnation to Growth: An Adaptive Learning Approach*. Journal of Economic Growth, 2, pp. 185-209.

Duffy, J., and J. Ochs (1999*)*. *Fiat Money as a Medium of Exchange: Experimental Evidence*. Working paper, University of Pittsburgh.

- Todo trabajo de investigación que reciba **Revista Científica del Instituto Iberoamericano de Desarrollo Empresarial** estará sujeto a la revisión de dos dictaminadores anónimos. Un dictamen en contra resultará en el rechazo de publicación. Los resultados de los dictámenes se entregarán a los autores en un lapso de dos meses, como máximo, después de la recepción del trabajo.
- Recomendable que los trabajos tengan los siguientes apartados: título del trabajo, resumen (abstract) palabras clave, introducción, definición de problema, objetivos, hipótesis, desarrollo teórico, análisis de caso si lo incluye, resultados, conclusiones, recomendaciones y bibliografía.