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Organizational Performance From The Knowledge Management Perspective, An Approach To Its Measurement

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Abstract

This article presents the initial results of the research entitled "Organizational performance measurement and knowledge management in public higher education institutions, based on artificial intelligence techniques", developed by the author. An approximation of the measurement of organizational performance represented through knowledge management variables, specifically, intellectual capital, is shown. A measurement tool is proposed applying the theory of fuzzy logic, where initially the relationship between organizational performance and knowledge management is considered, through the identification and definition of variables that will be part of the proposed tool. Measurement indices are proposed to identify the degree of belonging and the parameters for each variable are defined. As a result, the guidelines for the development of a tool that establishes the measurement of organizational performance based on practices implemented within the organization are proposed.

Keywords: Organizational performance, Knowledge management, Fuzzy logic, Measurement.

1. Introduction

Within organizations, human talent plays an important role, since its performance is framed in the performance of its members. The attempt to generate an approach to an estimate of the performance of organizations, is developed through the use of tools, methodologies and / or techniques that allow determining and assessing at a general or particular level (for each member of the organization), the contribution and/or actions developed within its management to achieve organizational goals. However, many times due to the difficulty of application, complexity or other factors, these tools are perceived as one more compliance requirement, leaving aside their relevance and contribution to performance measurement.(Rodriguez, 2011). This resistance and lack of interest in the use of these tools could generate a mistake in the results obtained, giving rise to vague interpretations that do not represent the real situation in organizations.

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Within the concept of organizational performance, the role of knowledge and information is also recognized, where intangible assets are becoming increasingly important.(Carmeli & Tishler, 2004). However, there is the difficulty of measuring and replicating these intangible assets and, therefore, establishing their impact on the performance of organizations, which limits the simulation of a model that best characterizes the organizational environment and its interrelationships. Given the questions about the difficulty of measuring the qualitative and intangible variables of organizational performance, a tool is proposed that allows establishing this measurement from variables that relate organizational performance and knowledge management.

2. Theoretical framework organizational performance

The performance of the members of the organization is a base that determines the fulfillment of the objectives and the achievement of success. For this reason, the institutions look for the improvement of the processes and the application of actions that guarantee the improvement(Chavez, 2014). These actions must be related to the best practices for the development of each activity within the organization.

Initially, effectiveness and efficiency were considered standards in the measurement of organizational performance. Over time, other variables that impact performance have been established; Some are: job satisfaction, innovation, staff turnover, adaptability, organizational culture, among others.(Lusthaus et al., 2002). As can be seen, there are new variables and very surely even more will be generated, which will be associated with the way in which each organization evaluates and measures performance, with the aim of ensuring the survival of the organization.

Qualitative variables of organizational performance

The qualitative variables of organizational performance are identified from the review of various studies, where different approaches are evident in terms of the quality of performance, according to the vision, strategy and environment of the organization.

Table 1. Identification of organizational performance variables

STUDY	DEVELOPMENT AND IDENTIFIED VARIABLES
Critical variables in the measurement of performance in companies with implementation of total quality management(Fuentes & Hurtado, 2002).	Three categories are identified for measurement: - Financial performance - Operational performance - Worker performance In the category of worker performance, the following variables are defined: • Employee satisfaction level. • Level of work absenteeism.
Design of a comprehensive model for evaluating the performance of human talent based on organizational competencies, for a Financial Institution in the city of Quito(Uria, 2020).	Institutional competencies that are related to the performance of the organization are defined and a transformation of quantitative to qualitative variables is described: • teamwork and cooperation • Customer orientation • Achievement orientation
Incidence of the organizational climate on the work performance of the collaborators of the company Datapro	In his study, he identifies variables that are related to organizational performance: • Satisfaction towards work • Self esteem

SA(Santamaria, 2020).	• Teamwork • Motivation
Model for the improvement of organizational performance through practices of quality management, knowledge management and transformational leadership(Coaquira, 2017).	Development areas are defined that are related to organizational performance • Quality Management • Knowledge Management • transformational leadership
Performance evaluation as a tool for the analysis of human capital(Alveiro, 2009).	Variables that define a performance measurement system are identified: • Knowledge to exercise the position • Quality and presentation of work • Amount of work • Relationships • Sense of belonging • Responsibility • initiative and creativity • Adaptation • Communication • Leadership • Personal presentation and vital tone

Based on the variables identified in the qualitative analysis of organizational performance, it is evident that there are many factors focused on human capital in organizations and that they are essential for measuring and characterizing performance, where human resources and their intangible assets are focused. generated, which add value to the organization.

Main tools for measuring organizational performance

Some tools applied in the measurement of organizational performance in the public and private sectors are briefly identified and described.

- **Job Performance Evaluation - EDL:**It is a management tool that allows measuring institutional performance and assesses individual contributions and employee behavior, where the positive and negative impact of achieving goals is measured.(National Civil Service Commission, 2018).
- **Unique Management Progress Report Form – FURAG:**It is an online application that captures, monitors and evaluates progress in the implementation of management and performance policies. Measures institutional management and performance in entities that are within the scope of application of the Integrated Planning and Management Model - MIPG, and the Standard Internal Control Model - MECI(Public Function, 2021).
- **Survey on environment and national institutional performance - EDI:**It is a survey aimed at public servants, in which the perception of the environment and the performance of the entities are analyzed as an approximation for the measurement of institutional development in the country.(DANE, 2021).
- **Balanced Socrecard – BSC:**It is a management methodology that is used to identify and follow the strategy of an organization, allows structuring strategic objectives and defining indicators

that evaluate the performance of the actions carried out for their fulfillment.(Kaplan & Norton, 2000).

- **Key performance indicators – KPIs:**They are metrics that allow identifying and monitoring the performance of an action or strategy, these metrics indicate the level of performance in accordance with the objectives and goals that have been set.(Parmer, 2015).
- **360 evaluation:**It is a human talent management tool that performs a comprehensive evaluation to measure competencies, it is based on the relationships that the employee has, where feedback becomes a key factor in evaluating the performance of workers, teams, and organizations. in which they are(Jimenez et al., 2010).

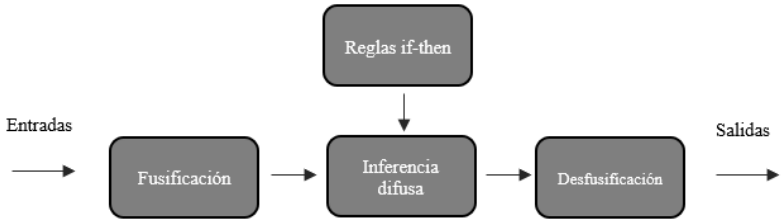
The above are some of the most used tools regarding the measurement of organizational performance, however, applications of other tools such as scales, binary comparisons, forced selection, critical incidents, among others, have been made. The proposal presented in this article focuses on proposing a tool for measuring organizational performance from knowledge management variables based on a fuzzy logic system.

Diffuse logic

Fuzzy logic could be considered as an extension of infinite value logic in which it applies fuzzy sets and fuzzy relations on the infinite value logic system.(Bojadziev & Bojadziev, 2007).

- **fuzzy sets:**A fuzzy set is a set in which an element may have a degree of membership between 1 and 0. To define a fuzzy set, its membership function must be defined. This process is known as fuzzy set; once the fuzzy values are obtained, linguistic rules are used to obtain a result(Gonzales, 2011).
- **Linguistic variables:**They are representations of any complex element in a natural or artificial language.
- **Fuzzy inference system:**Its structure has three components:
  - fuzzy rule base
  - Database (membership functions)
  - Reasoning mechanism (fuzzy inference)

Fuzzy inference systems can be based on Boolean relations, Mamdani system, Sugeno system, among others. The diffuse interference system that will be applied in the development of the tool will be of the Mamdani type. The structure of this system is as follows.(Espitia & Soriano, 2010):



Graph 1. Mamdani fuzzy inference system
Font:(Espitia & Soriano, 2010)

fussification: The input and output variables of the system, their linguistic values and membership functions are defined.(Medina et al., 2010).

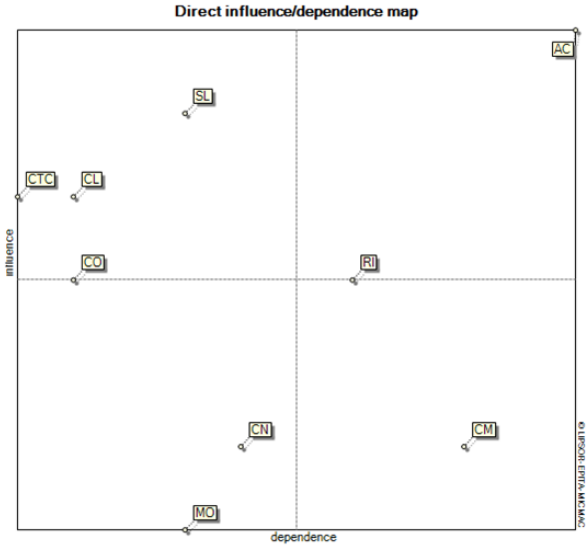
if-then rules: Rules that define the relationship between the input and output variables of the system. They are usually obtained from the knowledge of system experts; if they cannot be accessed, they are obtained from historical data of the input and output variables.

fuzzy inference: It consists of the operations between fuzzy sets, the application of the THEN logical connector and the combination of the outputs to obtain a single fuzzy set.
Defuzzification:A value is obtained from the output fuzzy set, providing the solution to the defined system. There are several solution methods: maximum method, centroid method, and height method.

3. Organizational performance measurement

The proposal for the measurement tool arises in an environment of technology dependencies at the Francisco José de Caldas District University. Initially, the approach for the definition of variables that must be prioritized for the construction and validation of the tool is established. The identification of these variables that relate organizational performance to knowledge management was carried out under the concept of intellectual capital approached from the intellectus model, which is made up of the following elements: human capital, structural capital and relational capital.(Bueno et al., 2011).

A list of variables for each element of intellectual capital was identified, performing a literature review and applying the cause-effect diagram tool. From this list, an initial prioritization was carried out in which the experts of the system participated, determining nine main variables. To establish the definitive variables for the tool, a structural analysis was carried out among the 9 initially prioritized variables. In this way, influential and non-dependent variables were identified and selected. To visually identify the results obtained, a map of influences was made, which is presented below:



Graph 2. Map of influences

Source: Graph taken from the ongoing degree project "Measurement of organizational performance and knowledge management in public higher education institutions, based on artificial intelligence techniques". Developed by the author

The selected variables were the following:

Table 2. Variables Identification of organizational performance variables

Name	Description
Capture and transmission of knowledge	Procedures through which the organization generates and transmits knowledge among its members
skills	Knowledge that the person has about the things that help their work development achieving a good performance
Workload	Set of psychophysical requirements to which the worker is subjected throughout his working day.

Work satisfaction	Degree of involvement and participation in tasks, based on a good balance between contributions and personal compensation.

input variables

These variables will be the input variables of the system. For each of these, the associated parameters are proposed:

- linguistic value
- Associated membership function: with the help of experts, the membership values are established for each linguistic value
- Underlying domain: its value is established based on proposed measurement indices and weightings were defined for each index by system experts.

Table 2. Input variable membership function

Variable	**linguistic values**		
	Non-existent	**standardized**	**implemented**
Capture and transmission of knowledge	$f(x) = \begin{cases} 1, & x < 0{,}05 \\ \frac{0{,}45 - x}{0{,}4}, & 0{,}04 \le x \le \\ 0, & x > 0{,}45 \end{cases}$	$f(x) = \begin{cases} 0, & x < 0{,}05 \\ \frac{x - 0{,}05}{0{,}4}, & 0{,}05 \le x \le \\ 1, & 0{,}45 \le x \le 0 \\ \frac{0{,}95 - x}{0{,}4}, & 0{,}55 \le x \le \\ 0, & x > 0{,}95 \end{cases}$	$f(x) = \begin{cases} 0, & x < 0{,}5 \\ \frac{x - 0{,}55}{0{,}4}, & 0{,}55 \le x \\ 1, & x > 0{,}9 \end{cases}$
skills	**Value added**	**Necessary**	**basic**
	$f(x) = \begin{cases} \frac{0{,}3 - x}{0{,}3}, & 0 \le x \le 0{,}3 \\ 0, & x > 0{,}3 \end{cases}$	$f(x) = \begin{cases} 0, & x < 0 \\ \frac{x - 0}{0{,}3}, & 0 \le x \le 0{,}3 \\ 1, & 0{,}3 \le x \le 0{,}7 \\ \frac{1 - x}{0{,}3}, & 0{,}7 \le x \le 1 \\ 0, & x > 1 \end{cases}$	$f(x) = \begin{cases} \frac{x - 0{,}7}{0{,}3}, & 0{,}7 \le x \le \\ 0, & x < 0{,}7 \end{cases}$
Workload	**adequate**	**inadequate**	
	$f(x) = \begin{cases} 1, & 0 \le x \le 0{,}2 \\ \frac{0{,}6 - x}{0{,}4}, & 0{,}2 \le x \le 0 \\ 0, & x > 0{,}6 \end{cases}$	$f(x) = \begin{cases} 0, & x < 0{,}2 \\ \frac{x - 0{,}2}{0{,}4}, & 0{,}2 \le x \le 0{,}6 \\ 1, & 0{,}6 \le x \le 1 \end{cases}$	
	high	**Half**	**Short**

Work satisfaction	$f(x) = \begin{cases} 1, & 0 \le x \le 0{,}2 \\ \frac{0{,}5 - x}{0{,}3}, & 0{,}2 \le x \le 0 \\ 0, & x > 0{,}5 \end{cases}$	$f(x) = \begin{cases} 0, & x < 0{,}2 \\ \frac{x - 0{,}2}{0{,}3}, & 0{,}2 \le x \le 0{,}5 \\ 1, & 0{,}5 \le x \le 0{,}7 \\ \frac{1 - x}{0{,}3}, & 0{,}7 \le x \le 1 \\ 0, & x > 1 \end{cases}$	$f(x) = \begin{cases} \frac{x - 0{,}7}{0{,}3}, & 0{,}7 \le x \le \\ 0, & x < 0{,}7 \end{cases}$

The table above shows the proposal established for the input variables with their respective linguistic values and associated membership functions. These were determined in a review carried out by system experts and the proposed measurement indices are presented below:

Table 3. Input variable measurement indices

Variable	**Index**	**Weighing**
Capture and transmission of knowledge	$\frac{N° \text{ de procedimientos de captación y transmisión de conocimiento con}}{N° \text{ de procedimientos de captación y transmisión de conocimiento to}}$	0.48
	$\frac{N° \text{ de procedimientos de captación y transmisión de conocimiento apli}}{N° \text{ de procedimientos de captación y transmisión de conocimiento tot}}$	0.52
skills	$\frac{N° \text{ de personas con certificaciones y/o estudios relacionados con su c}}{N° \text{ de personas contratadas}}$	0.35
	$\frac{N° \text{ de personas con certificados y/o estudios adicionales no relaciona}}{N° \text{ de personas contratadas}}$	0.21
	$\frac{N° \text{ de personas con experiencia en otros sectores relacionada con su c}}{N° \text{ de personas contratadas}}$	0.26
	$\frac{N° \text{ de personas con experiencia en otros sectores no relacionada con s}}{N° \text{ de personas contratadas}}$	0.18
Workload	$\frac{N° \text{ de personas que han expresado inconformidad por el volumen de t}}{N° \text{ de personas contratadas}}$	0.23
	$\frac{N° \text{ de personas con retrasos frecuentes en la entrega de sus tareas o}}{N° \text{ de personas contratadas}}$	0.25
	$\frac{N° \text{ de personas que han denotado fatiga de manera recurrente en la j}}{N° \text{ de personas contratadas}}$	0.23
	$\frac{N° \text{ de personas que han empleado tiempo de esparcimiento en el desar}}{N° \text{ de personas contratadas}}$	0.29
Work satisfaction	$\frac{N° \text{ de personas que se sienten a gusto con las actividades realizadas en el trabajo}}{N° \text{ de personas contratadas}}$	0.21
	$\frac{N° \text{ de personas con sentimiento de estabilidad y crecimiento en la org}}{N° \text{ de personas contratadas}}$	0.18
	$\frac{N° \text{ de personas que a mediano plazo se ven continuando en la organiz}}{N° \text{ de personas contratadas}}$	0.17
	$\frac{N° \text{ de personas se sienten a gusto con su equipo de trabajo}}{N° \text{ de personas contratadas}}$	0.25

	$\frac{N°\ de\ personas\ se\ sienten\ a\ gusto\ con\ las\ condiciones\ laborales\ del\ tr}{N°\ de\ personas\ contratadas}$	0.19

The indices presented in Table 4 are proposed to measure the input variables and from this result of each index, multiplied by its associated weighting, the value of that variable is identified and associated with the corresponding membership function. .

output variable

The output variable of the system is organizational performance.The parameters identified for this variable were:

Table 4. Output variable membership function

Variable	linguistic values		
	not satisfactory	**satisfactory**	**Outstanding**
organizational performance	$f(x) = \begin{cases} 1, & x < 0{,}3 \\ \frac{0{,}55 - x}{0{,}25}, & 0{,}3 \le x \le \\ 0, & x > 0{,}55 \end{cases}$	$f(x) = \begin{cases} 0, & x < 0{,}3 \\ \frac{x - 0{,}3}{0{,}25}, & 0{,}3 \le x \le 0 \\ 1, & 0{,}55 \le x \le 0 \\ \frac{0{,}95 - x}{0{,}2}, & 0{,}75 \le x \le \\ 0, & x > 0{,}95 \end{cases}$	$f(x) = \begin{cases} 0, & x < 0{,}7 \\ \frac{x - 0{,}75}{0{,}2}, & 0{,}75 \le x \\ 1, & x > 0{,}9 \end{cases}$

The parameters established for the output variable are determined in a review carried out by system experts, and the parameters identified for the input variables.

knowledge base

Once the parameters for the output variable have been defined, the fuzzy rules of the system are proposed, identified from the knowledge and expertise of the group of system experts:

Table 5. Fuzzy system rules – Organizational Performance

Capture and transmission of knowledge	skills	Workload	Work satisfaction	ORGANIZATIONAL PERFORMANCE
Non-existent	basic	inadequate	Short	not satisfactory
Non-existent	basic	inadequate	Half	not satisfactory
Non-existent	basic	inadequate	high	not satisfactory
Non-existent	basic	adequate	Short	not satisfactory
Non-existent	basic	adequate	Half	not satisfactory
Non-existent	basic	adequate	high	Satisfying
Non-existent	Necessary	inadequate	Short	not satisfactory
Non-existent	Necessary	inadequate	Half	not satisfactory
Non-existent	Necessary	inadequate	high	not satisfactory
Non-existent	Necessary	adequate	Short	not satisfactory
Non-existent	Necessary	adequate	Half	Satisfying
Non-existent	Necessary	adequate	high	Satisfying
Non-existent	Value added	inadequate	Short	not satisfactory
Non-existent	Value added	inadequate	Half	not satisfactory

Non-existent	Value added	inadequate	high	Satisfying
Non-existent	Value added	adequate	Short	not satisfactory
Non-existent	Value added	adequate	Half	Satisfying
Non-existent	Value added	adequate	high	Satisfying
standardized	basic	inadequate	Short	not satisfactory
standardized	basic	inadequate	Half	Satisfying
standardized	basic	inadequate	high	Satisfying
standardized	basic	adequate	Short	not satisfactory
standardized	basic	adequate	Half	Satisfying
standardized	basic	adequate	high	Satisfying
standardized	Necessary	inadequate	Short	not satisfactory
standardized	Necessary	inadequate	Half	Satisfying
standardized	Necessary	inadequate	high	Satisfying
standardized	Necessary	adequate	Short	not satisfactory
standardized	Necessary	adequate	Half	Outstanding
standardized	Necessary	adequate	high	Outstanding
standardized	Value added	inadequate	Short	not satisfactory
standardized	Value added	inadequate	Half	Satisfying
standardized	Value added	inadequate	high	Satisfying
standardized	Value added	adequate	Short	not satisfactory
standardized	Value added	adequate	Half	Outstanding
standardized	Value added	adequate	high	Outstanding
implemented	basic	inadequate	Short	not satisfactory
implemented	basic	inadequate	Half	Satisfying
implemented	basic	inadequate	high	Satisfying
implemented	basic	adequate	Short	not satisfactory
implemented	basic	adequate	Half	Satisfying
implemented	basic	adequate	high	Outstanding
implemented	Necessary	inadequate	Short	not satisfactory
implemented	Necessary	inadequate	Half	Satisfying
implemented	Necessary	inadequate	high	Satisfying
implemented	Necessary	adequate	Short	not satisfactory
implemented	Necessary	adequate	Half	Satisfying
implemented	Necessary	adequate	high	Outstanding
implemented	Value added	inadequate	Short	not satisfactory
implemented	Value added	inadequate	Half	Satisfying
implemented	Value added	inadequate	high	Satisfying
implemented	Value added	adequate	Short	not satisfactory
implemented	Value added	adequate	Half	Outstanding
implemented	Value added	adequate	high	Outstanding

Based on the established rules, the organizational performance scenarios are identified. These are described below:

- **Unsatisfactory organizational performance:**An unsatisfactory organizational performance is one where the satisfaction of people in the organization is low; there are no clear knowledge transfer

processes, there is no adequate load balance and there are no training actions.

- **Satisfactory organizational performance:**Satisfactory organizational performance is one where the job satisfaction of the people in the organization ranges from medium to high, there may or may not be clear knowledge transfer processes, however work is being done on the consolidation of the processes; there is an initial or strengthened balance of charges and work is being done to a basic degree on strengthening internal competencies.

- **Outstanding Organizational Performance:**An outstanding organizational performance is one where the job satisfaction of the people in the organization is high, there are established procedures on the transfer of knowledge, there is a balance of charges according to the positions, and there is a trained staff that is constantly strengthening their skills. .

4. conclusions

- According to the study context, different types of qualitative variables are identified in which factors of human capital are developed and their application will depend on the environment and the characteristics and typology of the organization's personnel.
- The guidelines established for the development of the organizational performance measurement tool are established for a specific environment of technology dependencies in a higher education institution, so they must be validated in different environments to verify their operation in various sectors.
- The proposed membership functions are established under the assumption that they are trapezoidal functions, this assumption must be verified once the tool is validated by performing the corresponding simulation.
- The proposed measurement indices may be adjusted according to the environment of the organization and its application relevance.

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