Project Design and Management

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PROJECT DESIGN
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EQUIPO EDITORIAL / EDITORIAL TEAM / EQUIPA EDITORIAL

SUMARIO ● SUMMARY ● RESUMO

Editorial

This issue of MLS Project Design and Management reinforces the multidisciplinary scientific participation of our collaborators in the design, development and implementation of tools and instruments applicable to business, educational and environmental development. Innovation in scientific-technological development is a fundamental feature reflected in the main objectives of the journal as part of its lines of research and dissemination. This edition presents 10 articles selected for the technological development and methodological design implemented by the authors for publication. The first investigations correspond to the discipline of business management, implementing methodologies that solve challenges ranging from the integration of criteria for adequate business sustainability to labor motivation as a crucial element for business growth. The second section corresponds to the technical development, exposing methodologies of free use that are reflected in the cost-benefit improvement of the companies. In addition, it presents a methodology that improves operational performance with high efficiency in the manufacturing of automotive parts through the implementation of production systems in the value chain. Finally, the teaching section, based on a hermeneutic literature review, analyzes knowledge management in higher education institutions, allowing the implementation of solutions to address knowledge gaps through projects strategically directed to higher education.

The first article presents the process for the implementation of a model that determines social vulnerability and flood risk in a hydrological unit in order to promote the exchange of environmental responsibility in the face of socioeconomic development in Central America that allows resilience to the effects of climate change. The research conducted for Knowledge Management Systems (KMS) presented in the second article of this edition is implemented in higher education, demonstrating that the prescribed knowledge management models and general methodologies for implementing KMS projects not only optimize the results of higher education, but also allow the design and development of new solutions to challenges that arise at this educational level.

The third article demonstrates how the construction of infrastructure is one of the challenges of Cameroon's development policy, applying a methodology based on a SWOT analysis and reflecting the maturity of the management of public investment projects, reflects the need to implement measures and recommendations to improve and update project management in this country, in order to develop a better leadership in economic exchange with other countries.

The fourth article, based on the Sustainable Development Goals (SDGs), demonstrates with a quantitative, transversal and descriptive methodology that the social dimension criteria are of greater importance than the economic and environmental dimensions, reflecting the main barriers identified for the integration of sustainability criteria in Public Investment Projects in Peru.

The objective of the fifth article was to measure and justify the use of free application software by individuals and companies in Brazil. The main results obtained were: the existence of positive correlations in the use of free applications among legal entities and individuals, highlighting cost-benefit and cost as motivating elements for the use of these applications by the target public.

In relation to technological innovation and level of automation in small businesses in Panama, the sixth article states that the weaknesses in relation to knowledge of digital literacy and digital skills are focused on packaged solutions in the cloud, which provide all the necessary elements to respond to the particular problems of each company, accompanied by a training plan to get the most out of it, and place the small business in a place of greater competitiveness.

The seventh article analyzes the roles of actors within Development Projects and Programs (DPP) highlighting the participatory management of the DPP system by the Technical and Financial Development Partner, the Regulator, the Technical Team Leader and, to some extent, the Steering Committee, demonstrating the need for transparency, power organization and dynamization in Cameroon. The eighth article is a qualitative case study that explores recruitment and selection practices in small businesses (SMEs) in Puerto Rico. The results show that the participating companies lack a formal recruitment and selection strategy and policy, suggesting a modification in their traditional processes, using technological elements.

The ninth research determined the factors that influence the performance improvement of auto parts manufacturers in Nuevo Leon, using a literature review and the implementation of a survey approved and validated by experts in the field, which was applied to a pilot sample to review reliability, resulting in the acceptance of organizational practices variables, as well as process innovation as an improvement in organizational performance.

Finally, the last article starts from the dynamism of the companies before the improvement of their personnel, through motivation, by means of a bibliographic and field research through the observation and application of surveys to the agents of the different directorates, departments and sectors of the Provincial Command of Mozambique showing the existence of intrinsic and extrinsic motivations in the agents, driven by the diffusion of their rights and duties, the existence and diffusion of the promotion and progression plan, concluding that it is necessary to verify the influence of the material resources and physical means for the optimization of the companies and the growth of their personnel.

Before concluding this editorial, it is important for all of us who collaborate in this new project to thank the team of collaborators, IT and technical, as well as the Ibero-American University Foundation (FUNIBER) and the Universities that have provided all the material support so that this issue can be carried out, with the conviction that we are on the right path towards international recognition.

Dr. Luis A. Dzul López
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Editors in chief

MODEL FOR DETERMINING SOCIAL VULNERABILITY AND FLOOD RISK IN THE CHINANDEGA-LEÓN HYDROLOGICAL UNIT (NICARAGUA) AS A STRATEGY FOR ADAPTATION TO CLIMATE CHANGE

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Abstract. The main interest of this research work is to promote scientific exchange on issues of the regional agenda and the socioeconomic development of the Central American region, facilitating a result through a novel model in a practical way, generating new ideas and knowledge that allows the continuous improvement, to face the new challenges and challenges related to climate change and comprehensive disaster risk management. The article shows the conceptual bases, the methodology used, the results and conclusions of a model used to determine social vulnerability and risk of flooding in the Chinandega-León hydrological unit, as a strategy for adaptation to climate change, Nicaragua. As a conclusion in the framework of SDGs 11 and 13, it was evidenced that the proposed model is this research work, it contributes to scientific knowledge for local, regional and national planning that involves mitigation of climate change, adaptation and adaptation. disaster resilience. It is emphasized that the management of social vulnerability was made as a variable of greater importance, since it is where the harmonization of the passive agent (society) with the active agent (natural environment) is based. On the other hand, the quantification of social vulnerability and risk as variables, and that they are directly proportional, is demonstrated. The variables that affect the reduction of vulnerability are those that are related to climate change adaptation variables, resilience (harmonization) and social preparedness.

Keywords: Risk, Climate change, model, social vulnerability, flood, threat.

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MODELO PARA LA DETERMINACIÓN DE LA VULNERABILIDAD SOCIAL Y RIESGO POR INUNDACIONES EN LA UNIDAD HIDROLÓGICA CHINANDEGA-LEÓN (NICARAGUA) COMO ESTRATEGIA DE ADAPTACIÓN AL CAMBIO CLIMÁTICO

Resumen: El principal objetivo del presente trabajo de investigación, es promover el intercambio científico en temas de la agenda regional y el desarrollo socioeconómico de la región centroamericana, facilitando un resultado por medio de un modelo novedoso de manera práctica, generando nuevas ideas y conocimientos que permita la mejora continua, para enfrentar los nuevos retos y desafíos relacionados con el cambio climático y la gestión integral del riesgo de desastre. Como objetivos específicos, el artículo muestra las bases conceptuales, la metodología empleada, los resultados y conclusiones de un modelo empleado para la determinación de la vulnerabilidad social y riesgo por inundaciones en la unidad hidrológica Chinandega-León, como una estrategia de adaptación al cambio climático, Nicaragua. Como conclusión, en el marco de los Objetivos de Desarrollo Sostenibles 11 y 13, se evidencio que el modelo propuesto en este trabajo de investigación, aporta a los conocimientos científicos para la planificación local, regional y nacional que involucran la mitigación ante el cambio climático, la adaptación y la resiliencia ante desastres. Se enfatiza el aporte como el manejo de la vulnerabilidad social como una variable de mayor importancia, ya que es donde se sustenta la armonización del agente pasivo (sociedad) con el agente activo (medio natural). Por otro lado, se obtuvo la cuantificación de la vulnerabilidad social y el riesgo como variables, y que son directamente proporcionales. Las variables que inciden en la disminución de la vulnerabilidad, son las que están relacionadas llamadas variables de adaptación al cambio climático, la resiliencia (armonización) y la preparación social.

Palabras clave: Riesgo, cambio climático, modelo, vulnerabilidad social, inundación, amenaza.

Introduction

According to the National Climatic Data Center of the National Oceanic and Atmospheric Administration (National Climatic Data Center, 1999):

> Hurricane Mitch is among the five strongest hurricanes on record in the Atlantic in terms of sustained winds, barometric pressure and duration. Hurricane Mitch was also one of the worst storms in the Atlantic in terms of loss of human life and property. The estimated death toll throughout the region was more than 9,000; thousands of people were reported missing. Economic losses throughout the region were estimated at more than $7.5 billion (U.S. Agency for International Development, 1999) (Smith, et al., 2002, p. 1).

The National System for the Prevention, Mitigation and Attention to Disasters (SINAPRED), in 2019 developed the project "Analysis and Incorporation of Disaster Risk Management in Municipal Planning in Nicaragua", in addition to which the Guidelines for Municipal Plans for Integrated Risk Management (PMGIR) were developed. "The methodology aims to guide and define the minimum procedures required for Disaster Risk Analysis and Management at the municipal level and for the preparation of Municipal Plans for Integrated Disaster Risk Management (PMGIR), in order to ensure their insertion into the municipal development plan (PDM), incorporating disaster prevention and mitigation measures, Land Use Planning and Zoning proposals" (SINAPRED, 2019, pp. 34-39).

In 2011, the Ministry of Environment and Natural Resources, together with the General Directorate of Climate Change, developed workshops linked to the project in the study area (Leon-Chinandega hydrological unit):

Flood and Drought Risk and Vulnerability Reduction Project in the Estero Real River Basin. The project aimed to reduce the risks of droughts and floods generated by climate change in the Estero Real river basin. Although all of Nicaragua faces the severe impacts of extreme natural phenomena, droughts and floods are combined in the selected region (Marena, 2011, pp. 6-7).

On the other hand, SINAPRED of Nicaragua has a risk management manual, which addresses the subject from the point of view of management, prevention and emergency preparedness. There are publications on the mainstreaming of climate change in Nicaragua (PENUD, 2010), however, the quantification of risk and social vulnerability is not addressed from the point of view of a model for determining social vulnerability and flood risk in the Chinandega-León hydrological unit, as a strategy for adaptation to climate change in Nicaragua.

Within the framework of Sustainable Development Goals 11 and 13, sustainable cities and communities, and climate action, respectively, a model was developed to determine social vulnerability and flood risk in the Chinandega-Leon hydrological unit, as a strategy for adaptation to climate change in Nicaragua. The work was developed in a comprehensive manner, which includes the elements of risk such as hazard and social vulnerability. The model is a tool to strengthen and contribute to plans and programs for flood disaster mitigation; it is based on quantitative mathematical development and qualitative data obtained in situ, using matrices for the collection of information and subsequent processing of data through descriptive statistics.

On the other hand, the results are shown in tables and maps at the basin scale, which show the correlation of risk elements with vulnerability and hazard with risk.

Method

Theoretical Framework

Disaster risk management, and in particular the model proposed in this article, is in line with Sustainable Development Goals 11, 13, since it contributes to increase the scientific knowledge essential for national planning involving climate change mitigation, adaptation and resilience to disasters. The proposed model is a mathematical tool that can be used in territories that lack information from satellites or other sources. By using the model, percentage point values of vulnerability and risk will be obtained from the flood hazard.

As a legal basis, the work is supported by Law 337 of Nicaragua, "Law creating the National System for the prevention, mitigation and attention to disasters. The Law of the National Risk Management System (SINAGER) of Honduras. Law 109-96 "Ley de Coordinadora Nacional para la Reducción de Desastres" in Guatemala. The Civil Protection, Disaster Prevention and Mitigation Law (Decree No. 777) in El Salvador.

According to Tirado, V., & Ugarte, A. (2019). They propose the following risk equation, $R = (\ln(V) + A) * V$ equation 1, where $\ln(V) \geq 1$. On this basis, correlations between elements and vulnerability, hazard and risk, element intervals and qualitative and quantitative scales were constructed, and geographic information systems were incorporated for spatial analysis (vulnerability, hazard and risk mapping) for flooding, resulting in the proposed model.

The threat is considered as an element of the environment dangerous to man, these are originated by magnitudes of external forces, it refers to all phenomena of natural origin, and anthropogenic. A threat can be incident in lesser to greater degree, or from greater to lesser degree, according to the social vulnerability of the territory under study, therefore, vulnerability

according to (Pizarro, 2001), "defined as the insecurity and defenselessness experienced by communities, families and individuals in their living conditions as a result of the impact caused by some type of social economic event of a traumatic nature" (p.15)

On the other hand, vulnerability represents the exposure, susceptibility, resilience and preparedness experienced by communities, families and individuals in a local territory. Exposure is considered as the degree to which tangible assets and/or people in a community may be affected by a natural hazard. Susceptibility, considered as an element of risk, refers to the degree of predisposition to an event. Resilience, considered as an element of risk, refers to the capacity of communities, families and individuals to overcome and adapt to critical moments generated by a natural or anthropogenic event. Finally, preparedness, an element that refers to prevention plans and emergency preparedness.

Type of Research

The present work is designed under the methodological approach of the qualitative and quantitative (mixed) approach, since this is the one that best adapts to the characteristics and needs of the research.

The quantitative approach:

It uses data collection and analysis to answer research questions and test previously established hypotheses, and relies on numerical measurement, frequent counting, and the use of statistics to accurately establish patterns of behavior in a series of data (Hernández Sampieri & Fernández Collado, 2014, p. 5).

From the mixed approach, the survey format technique will be used to describe the behavior of the communities in the face of a possible flood hazard.

Execution time

The development of the research, in order to meet the proposed objectives, was carried out in 4 months, from January to April 2021. The first two months were dedicated to collecting primary information, applying the survey instrument to 11 identified communities, as well as obtaining information on precipitation. The third month was devoted to the analysis, interpretation and analysis of the results, and the fourth month was devoted to the final report of the research.

Data Collection Techniques and Methods

Primary Sources

In situ observation: field visit to four communities, verification of the water footprint of the rivers.

Application of the instrument: format designed to collect information on the condition of risk, vulnerability and hazards.

Archives: National Water Authority (ANA), Nicaragua, and Nicaraguan Institute of Territorial Studies (INETER), Directorate of Water Resources.

Universe

In general, these are the communities located within the boundaries of the Leon-Chinandega hydrographic unit.

Population

The study population is made up of those belonging to 11 the communities under study.

Sample

It considers as a sample, the families to which the instrument will be applied, the format of the physical conditions (risk, vulnerability and threats). According to (López, 2004) rescued from (CFR.:MATA et al, 1997) the following equation is used to determine the sample:

$$m = \frac{N}{(N-1)*K^2+1} \text{ equation 2}$$

Where:

m = sample

N = population or universe

K= margin of error for the study 5% expressed in decimals was used

Inclusion Criteria

All families belonging to the communities under study.

All families who are at risk.

Exclusion criteria

All families that do not belong to the communities under study.

All families who are not at risk.

Method

In stage 1: The flood hazard was identified based on meteorological phenomena, choosing the years of occurrence of the event by obtaining information from the Chinandega hydrometeorological station code 64018 provided by the Nicaraguan Institute of Territorial Studies (INETER), in this case the factor to be studied is precipitation.

Table 1

Hurricanes that partially and totally affected the León-Chinandega hydrological unit

Year	Hurricanes	Jan	Feb	Sea	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
						Rainfall in millimeters								
1971	Irene	1.9	0.0	0.0	0.0	200.8	175.8	173.7	265.1	627.2	385.6	124.7	1.2	1956.0
1974	Fifi	0.2	0.0	0.0	2.0	163.3	421.7	128.0	213.2	898.6	268.7	5.8	0.0	2101.5
1982	Alleta	6.9	1.8	0.4	0.0	1,685.7	129.2	94.2	15.3	359.2	163.8	9.7	1.6	2467.8
1988	Joan	0.0	0.0	6.1	1.3	216.4	382.3	285.0	734.2	378.0	389.0	49.7	0.9	2442.9
1993	Gert	17.0	0.0	0.0	125.3	458.7	483.0	57.8	226.9	789.7	238.1	9.4	0.3	2406.2
1998	Mitch	0.0	0.0	8.4	24.0	74.2	225.2	393.2	399.8	438.3	1,985.5	229.2	2.9	3780.7
2005	Stan	0.0	0.0	38.7	39.0	187.2	286.6	302.5	272.8	482.4	732.5	34.1	1.9	2377.7
2008	Felix	0.5	6.4	1.8	47.2	440.3	218.2	159.2	470.5	391.9	429.6	9.9	0.1	2175.6
2009	Ida	4.9	0.0	0.0	0.0	180.8	429.3	77.8	105.7	381.7	209.3	135.7	33.4	1558.7
2020	Eta and Iota	0.0	0.0	0.0	0.0	323.4	430.0	165.2	427.2	345.9	300.5	313.5	0.0	2305.7

Note. Summary table based on data from INETER (2021)

For the flood hazard, we work with the average precipitation of the total data for the months of the year for each event (hurricane), then divide by 10 to obtain the magnitude in centimeters and then select the largest of the events to divide by each one and normalize.

In Stage 2: Resilience, preparedness, level of exposure and susceptibility were determined; for this purpose, survey instruments were applied to verify the perception of risk, the instruments or surveys allowed the collection of field information, such as: general data; description of the factor (resilience, preparedness, exposure and susceptibility); exposed population, and vulnerable groups.

With equation 1, social vulnerability and risk were calculated for each event in the established timeline.

In the last stage, correlations and graphs were prepared with Microsoft Excel, and maps of the Chinandega-León hydrological unit were created using QGis software (free software), showing spatially the behavior of the variables under study.

Results

The area under study corresponds to the León-Chinandega hydrological unit. According to data provided by INETER and SINAPRED, this area has been one of those affected by floods with three events per decade.

Map 1 shows the historical floods and flood zones in which the municipalities of Somotillo, Villanueva, Chinandega, Telica and La Reynaga are involved, specifically corresponding to the communities of: Apancuca, Aquespalada, Matapalo, Lourdes, El Bonete, Las Grietes, Ojo de agua, La Sirena, El Piñuelar, Glilao and Mocoren.

Figure 1

Historical and current flood zones in the Leon-Chinandega hydrological unit

Table 2 shows the results of the average of the different hazard events in mm, cm and normalized. Elements such as exposure, susceptibility, resilience (harmonization) and social preparedness are obtained from field data as percentage scores, vulnerability and risk calculations are observed.

Table 2

Calculation of vulnerability and risk in the Leon-Chinandega hydrological unit

Elements	Threat	Event									
		Irene	Fifi	Alleta	Joan	Gert	Mitch	Stan	Felix	Ida	Eta, iota
	mm	163.0	175.13	205.65	203.58	200.52	315.06	198.14	181.30	129.89	192.14
	cm	16.3	17.51	20.57	20.36	20.05	31.51	19.81	18.13	12.99	19.21
	Normalized	0.52	0.56	0.65	0.65	0.64	1.00	0.63	0.58	0.41	0.61
Exhibition		0.80	0.79	0.78	0.72	0.70	0.69	0.65	0.63	0.60	0.55
Susceptibility		0.80	0.79	0.78	0.77	0.76	0.75	0.70	0.65	0.60	0.55
Resilience		0.50	0.51	0.52	0.53	0.54	0.55	0.60	0.65	0.70	0.75
Social Preparation		0.45	0.46	0.47	0.48	0.49	0.50	0.55	0.60	0.65	0.70
Vulnerability		**0.67**	**0.64**	**0.61**	**0.55**	**0.52**	**0.49**	**0.40**	**0.33**	**0.27**	**0.21**
Risk		**10.71**	**10.98**	**12.34**	**10.85**	**10.02**	**15.18**	**7.47**	**5.57**	**3.11**	**3.68**

Table 3

Item ranges and qualitative and quantitative scales

Elements			Factor Description		
			Intervals		
Exhibition	Average	Deviation	**≤0.61**	**0.61> y ≤0.78**	**0.78&gt**
	0.69	0.08	**BAJA**	**MEDIO**	**ALTA**
Susceptibility	Average	Deviation	**≤0.63**	**0.63> y ≤0.80**	**0.80&gt**
	0.72	0.09	**BAJA**	**MEDIO**	**ALTA**
Resilience	Average	Deviation	**≤0.50**	**0.50> y ≤0.62**	**0.62&gt**
	0.59	0.09	**BAJA**	**MEDIO**	**ALTA**
Preparation	Average	Deviation	**≤0.45**	**0.45> y ≤0.62**	**0.62&gt**
	0.54	0.09	**BAJA**	**MEDIO**	**ALTA**
Vulnerability	Average	Deviation	**≤0.31**	**0.31> y ≤0.63**	**0.63&gt**
	0.47	0.16	**BAJA**	**MEDIO**	**ALTA**

For each element, from the statistical descriptors such as the average and standard deviation, the intervals of the factors are deduced, the intervals of B=LOW green color; M=MEDIUM yellow color; and A=HIGH red color, for the elements EXPOSURE, SUSCEPTIBILITY AND VULNERABILITY; in the case of B=LOW red color; M=MEDIUM yellow color; and A=HIGH green color, for the elements of RESILIENCE and SOCIAL PREPAREDNESS.

Table 4
Intervals for hazard, risk and qualitative and quantitative scales

			Factor Description		
			Intervals		
	Average	Deviation	≤ 14.87	14.87> y ≤ 24.41	24.41&gt
Threat			BAJA	MEDIO	ALTA
	19.64	4.77			
	Average	Deviation	≤ 5.08	5.08> y ≤ 12.90	12.90&gt
Risk			BAJA	MEDIO	ALTA
	8.99	3.91			

In relation to the elements THREAT and RISK, with the statistical descriptors, the average and the standard deviation, the intervals of the factors are deduced, the intervals B=LOW green color; M=MEDIUM yellow color; and A=HIGH red color for both elements. There is a directly proportional relationship.

Figure 2
Correlation of elements vs. Vulnerability
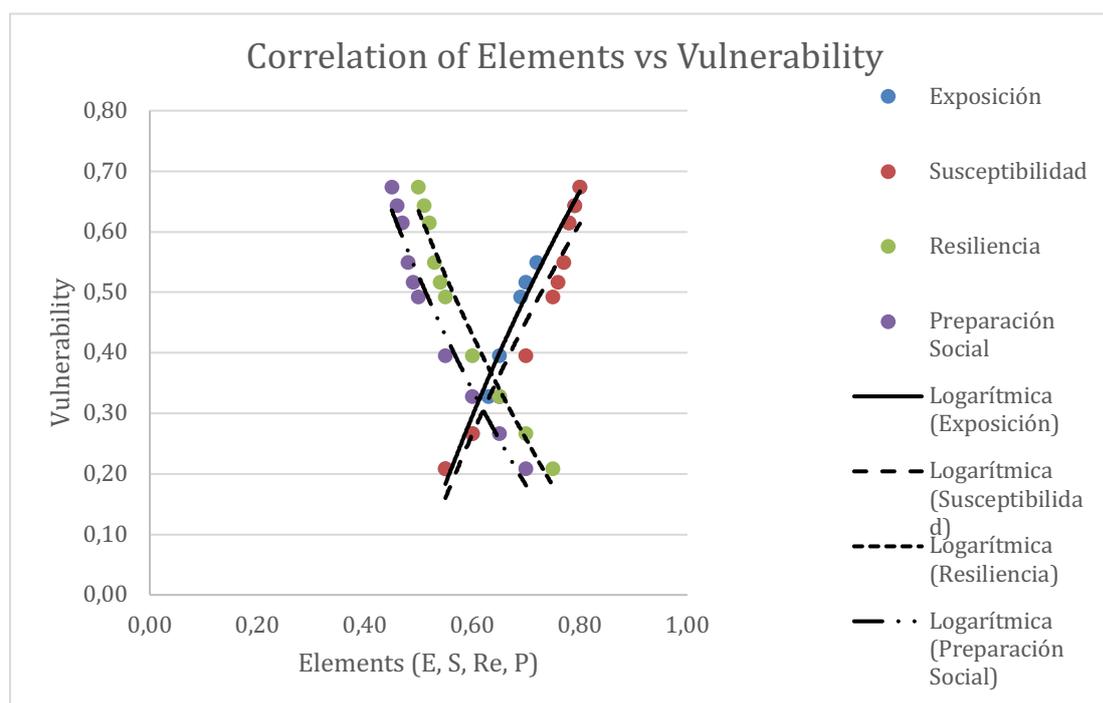
The graph represents the correlation of the elements with vulnerability, i.e., for each element studied from the environmental and socio-environmental analysis as a percentage score, it is placed on the X-axis as an independent variable to find the vulnerability on the Y-axis as a dependent variable, therefore, the following expressions and correlation are written:

Table 5

Results show the correlation between the different elements and vulnerability

Elements	Equation	Correlation
Exhibition	y = 1.2906ln(x) + 0.9548	$R^2 = 0.983$
Susceptibility	y = 1.2103ln(x) + 0.8836	$R^2 = 0.9293$
Resilience	y = -1.121ln(x) - 0.1427	$R^2 = 0.9664$
Preparation	y = -1.029ln(x) - 0.1863	$R^2 = 0.9678$

The following graph represents the correlation between THREAT and RISK, achieving an equation that best fits the model. For the flood event located on the X-axis as an independent variable, the curve is intercepted and projected to the left, determining the risk on the Y-axis as a dependent variable.

Figure 3

Correlation of threat vs. risk
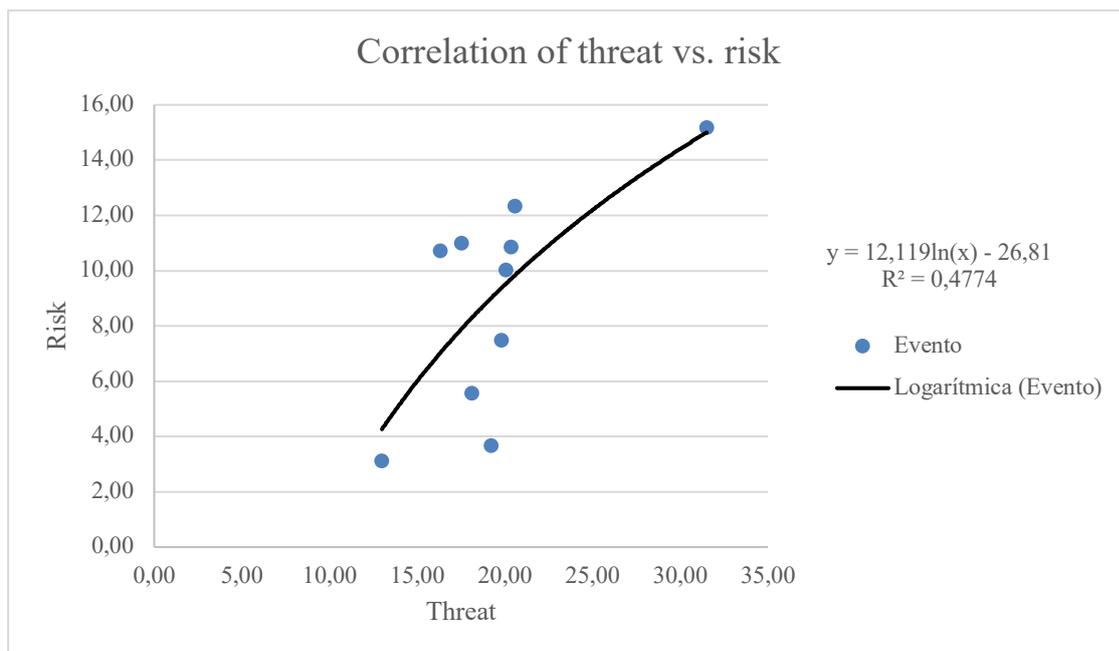
From the correlation graph, the deduced trend equation is obtained, having a relationship with equation 1, being as follows:

Adapted equation	Deduced equation
$R = (\ln(V) + A) * V$	$y = a * ln(x) - b$

Where:
y = risk, dimensionless
x = threat, dimensionless
a, b = multipliers 12.119, and 26.81 respectively

Application of the magnitudes of risk elements to spatial maps:

Figure 4
*Spatial results in the hydrological unit of the degree of exposure and susceptibility to four
events: Mitch, IDA, Iota and Eta*
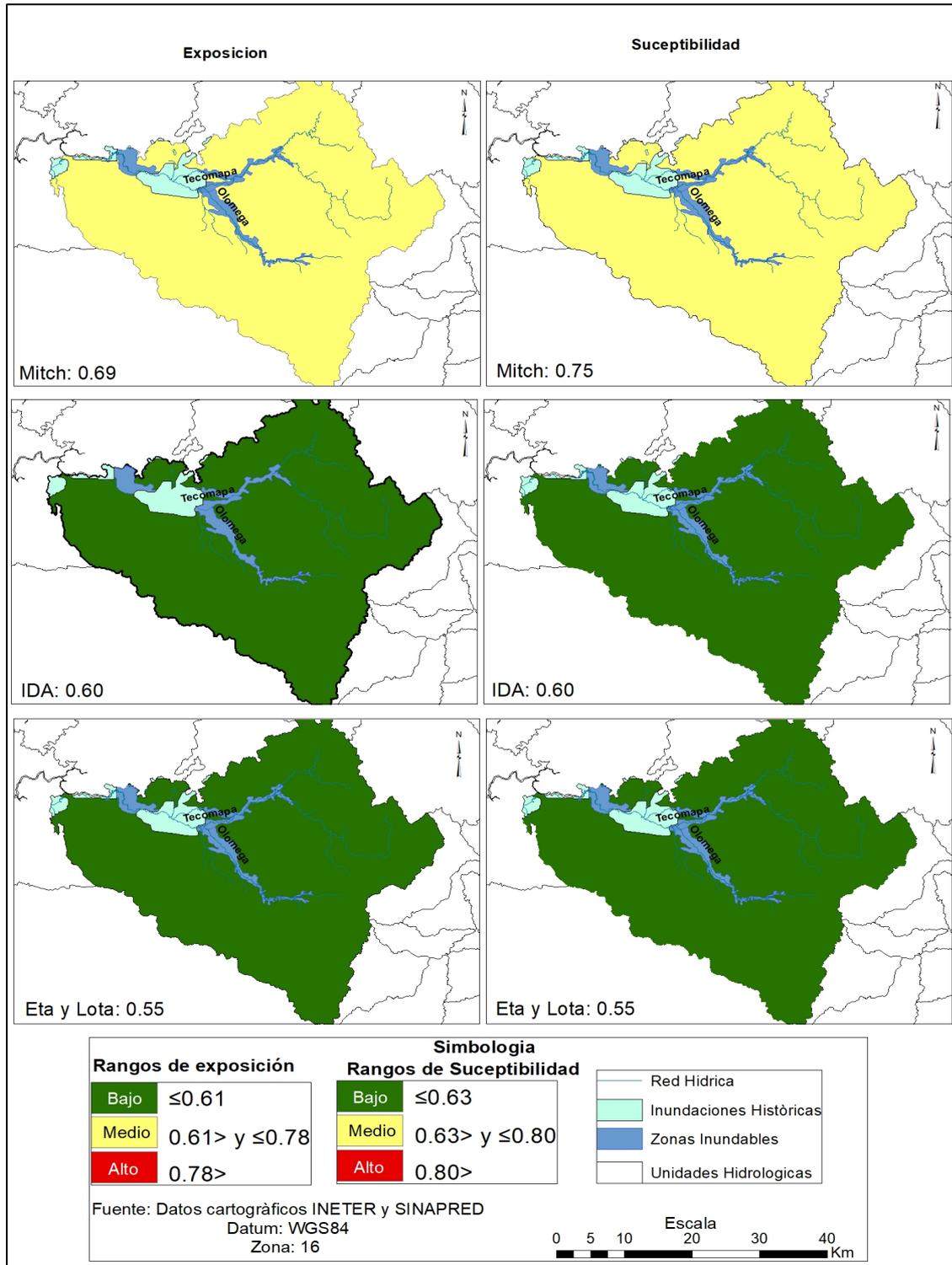
Figure 5
Spatial results in the hydrological unit of the degree of resilience and social preparedness to four events: Mitch, IDA, Iota and Eta
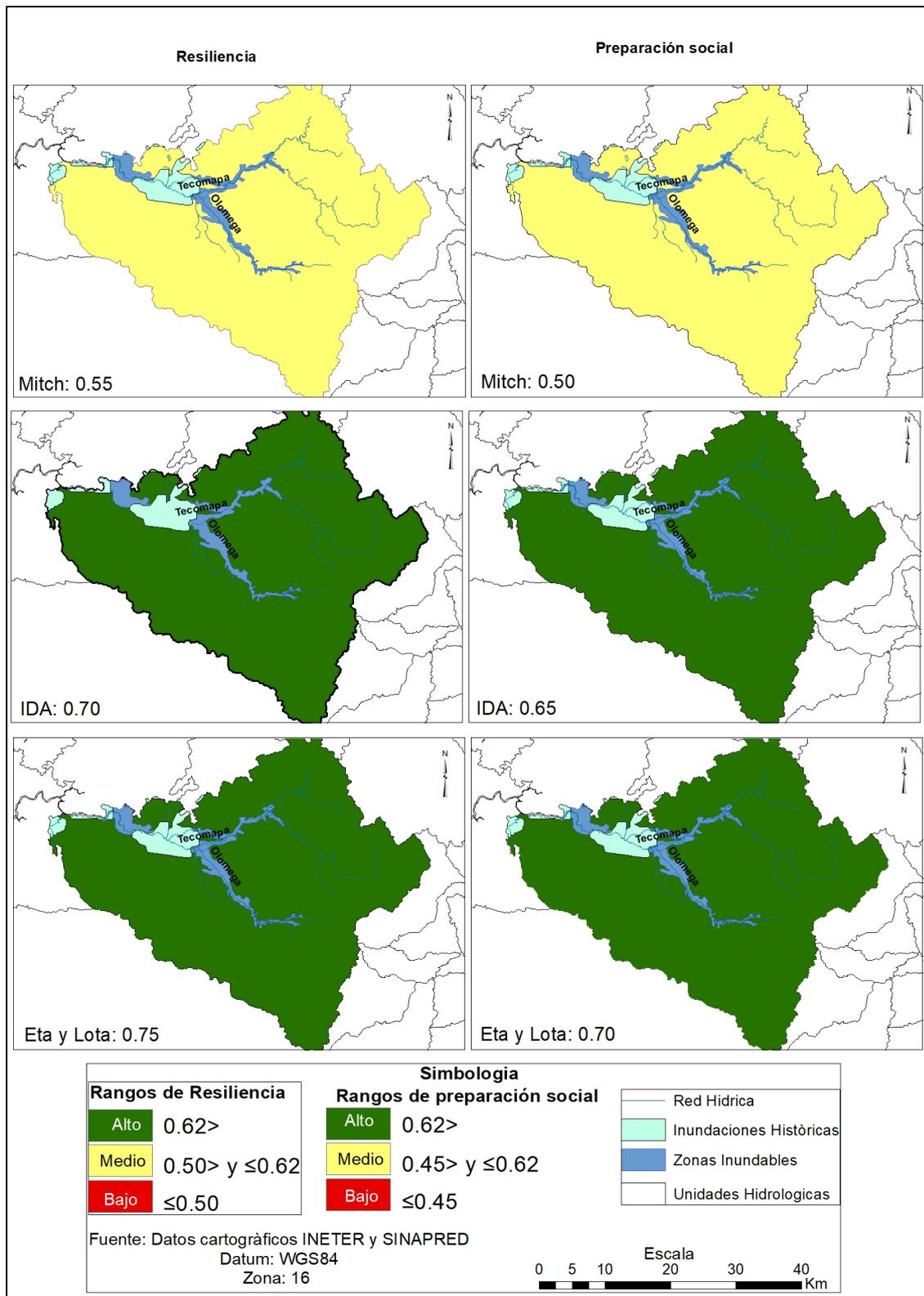
Figure 6
Spatial results in the hydrological unit of the degree of vulnerability and risk to four events: Mitch, IDA, Iota and Eta
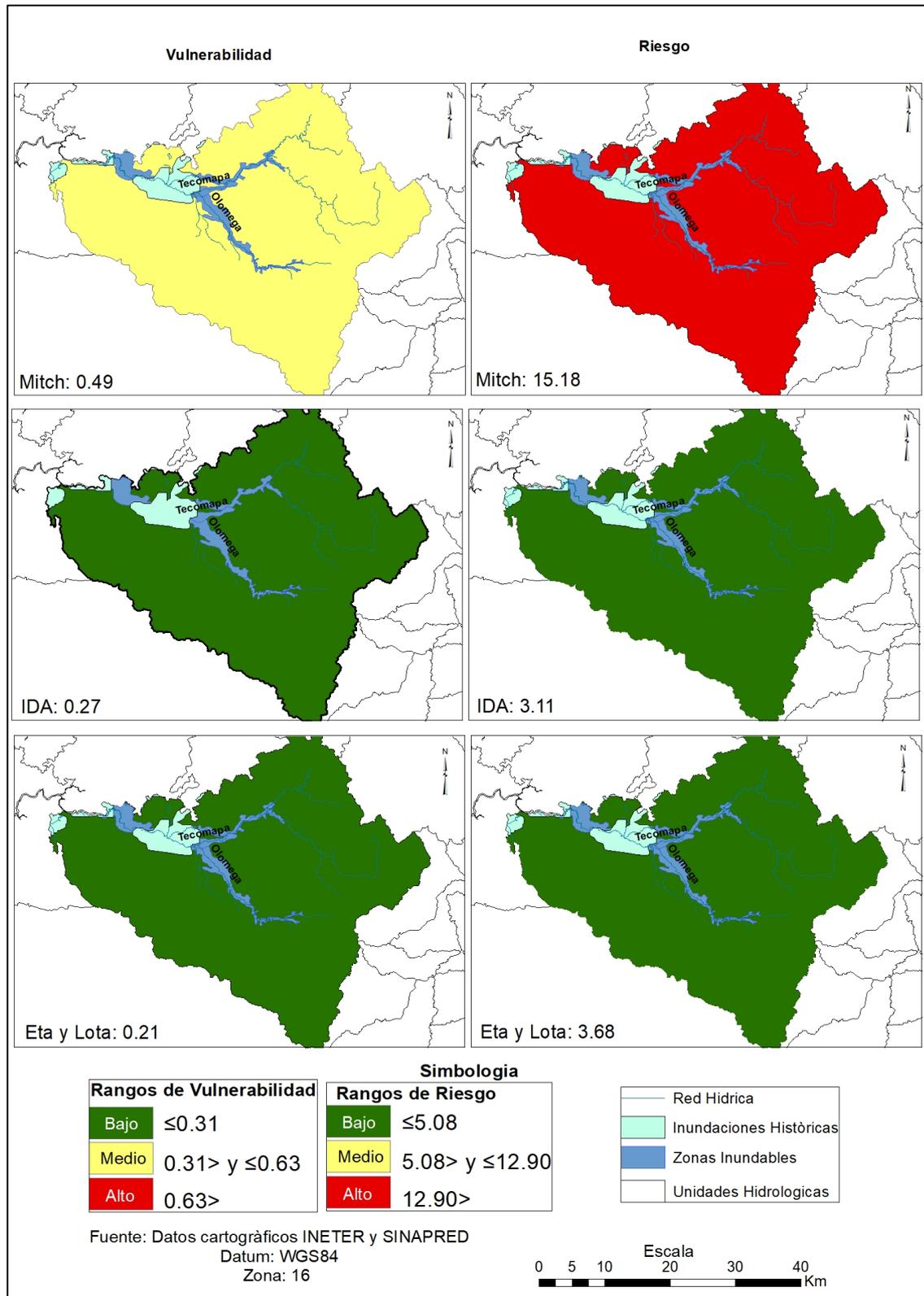
With the development of the model, it is possible to map the results obtained from the application of the instrument (survey). Based on the quantified magnitudes of the risk elements such as vulnerability, preparedness, exposure and susceptibility, spatial maps are generated for four maximum events, modeling the extent that a flood could generate in the communities studied.

Discussion and conclusions

Within the framework of Sustainable Development Goals 11 and 13, it became evident that the model proposed in this article contributes to scientific knowledge for local, regional and national planning involving climate change mitigation, adaptation and disaster resilience. It is important to emphasize that the management of social vulnerability was made as a variable of major importance, since it is where the harmonization of the passive agent (society) with the active agent (natural environment) is sustained.

By means of the mathematical model, it was possible to demonstrate the quantification of social vulnerability and risk as variables, and that they are directly proportional variables. The variables that influence the reduction of vulnerability are those related to climate change adaptation variables, resilience (harmonization) and social preparedness.

Specifically, according to the results, very important findings are evidenced, such as: the generation of vector maps from the application of the survey instruments, and the quantification of the indicators to obtain a deduced equation of risk as a trend related to the different elements of risk.

Recommendations

The proposed model can be applied at different spatial scales, from regional, basin, municipal and local, incorporating it as a strategy for determining social vulnerability and disaster risk in any part of the Central American region.

The mathematical model developed in this work can be adapted to other natural and anthropic events such as: hurricanes, earthquakes, tsunamis, volcanic eruptions, landslides, tornadoes, tidal waves, forest fires, environmental pollution, armed conflict, terrorism, overpopulation, social problems, drugs, insecurity, marginalization and poverty.

The spatial representation of the results through maps can be used in community workshops related to Climate Change and Integrated Disaster Risk Management in the study area developed by decision makers.

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IMPLEMENTATION METHODOLOGY OF KNOWLEDGE MANAGEMENT SYSTEM PROJECTS

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Abstract. Knowledge management in higher education institutions is a research topic that has increased over the last ten years. Knowledge Management Systems (KMS) are solutions to attend to the knowledge gaps through projects. This research, with a hermeneutic literature review method, analyses prescriptive and hybrid knowledge management models for higher education institutions and general methodologies for implementing KMS. Based on the results of this analysis, a methodology for the implementation of knowledge management system projects is proposed with an agile and incremental approach and considering the recommendations of the ISO 30401 standard on Knowledge Management System Requirements. The proposed methodology includes other methodologies for knowledge management such as knowledge auditing and maturity assessment, and other methodologies for analysis, design, and development solutions.

Keywords: Knowledge management, Knowledge Management Systems Methodology, Higher Education Institutions.

METODOLOGÍA DE IMPLEMENTACIÓN DE PROYECTOS DE SISTEMAS DE GESTIÓN DE CONOCIMIENTO

Resumen. La gestión del conocimiento en las instituciones de educación superior es un área de investigación cuyo desarrollo se ha incrementado en los últimos diez años. Los Sistemas de Gestión de Conocimiento (SGC) permiten implementar las soluciones para atender las brechas de conocimiento mediante proyectos. Con esta investigación fundamentada en una de revisión de literatura hermenéutica, se analizan modelos de gestión de conocimiento prescriptivos o híbridos para instituciones de educación superior y metodologías generales de implementación de sistemas de gestión de conocimiento. Con base en los resultados de este análisis se propone una metodología de implementación de proyectos de sistemas de gestión de conocimiento con un enfoque ágil e incremental y considerando las recomendaciones del estándar ISO 30401 sobre requerimientos de SGC. Se integran en la metodología propuesta otras metodologías, propias de la disciplina de gestión de conocimiento como la auditoría de conocimiento y la

evaluación de madurez de gestión del conocimiento, así como otras metodologías de análisis, diseño y desarrollo de soluciones.

Palabras clave: Gestión de conocimiento, Metodologías de Sistemas de Gestión de Conocimiento, Instituciones de Educación Superior.

Introduction

In an organization, knowledge management has the purpose of improving performance through the creation, exchange and application of organizational knowledge. Its effectiveness depends directly on the people, processes, technology and organizational structure (Dalkir, 2005, p. 3; Girard & Girard, 2015).

Knowledge Management (KM) is a discipline that can be defined from different perspectives; thus, in the process approach, emphasis is placed on the processing of information to convert it into usable knowledge (Dalkir, 2005; Serenko, 2021). Therefore, the implementation of knowledge management initiatives depends on the perspective of the discipline considered; thus, from the computer science approach, the emphasis is more technical and is oriented to the implementation of Knowledge Management Systems (KMS).

A QMS is the knowledge part of the management system. The elements of the system include the organization's knowledge management culture, structure, governance and leadership; roles and responsibilities; planning, technology, processes and operation (International Organization for Standardization, 2018, p. 5). The integration of the components of a knowledge management system: people, processes and technology are generally represented by a model or framework, understood as a set of systematic approaches to analyze, organize and develop better ways to manage knowledge" (Wiig, 1993).

In the literature, three types of knowledge management models are distinguished in terms of their comprehensiveness: descriptive, prescriptive or hybrid (Fteimi, 2015; Heisig, 2009; Rubenstein-Montano et al., 2001, p. 7). Prescriptive models are task-oriented, dealing with knowledge management procedures; while descriptive models characterize the aspects of knowledge management that influence the success or failure of initiatives; hybrids are descriptive-prescriptive.

The implementation of knowledge management initiatives is based on the prescriptive perspective of the models. There are a significant number of knowledge management system models in the literature, but many are presented in a conceptual or descriptive manner and do not provide an action plan for implementation, resulting in a gap between theory and practice; therefore, models should incorporate guidelines for implementation and should be simple but complete so that they can be understood by non-expert knowledge management professionals (Arisha & Ragab, 2013, p. 895).

In the particular case of this study, we are interested in the implementation of knowledge management initiatives in higher education institutions. Although the origins of knowledge management in business organizations date back to the 90s of the 20th century, interest in universities has increased in the last 10 years. The literature review shows a fragmentation of

knowledge management models applied to the context of higher education, as well as of strategies or guidelines to guide the implementation of initiatives.

Therefore, the objective of this article is to present a proposed methodology for the implementation of knowledge management initiatives in higher education institutions, based on the analysis of other methodologies and the requirements established by the literature.

Method

In order to define a methodology for implementing knowledge management initiatives, a literature review of knowledge management models for higher education institutions was conducted. Ten models were identified, analyzed and classified according to the categories of knowledge management models of Rubenstein-Montano et al. (2001, p. 7). Of these models, the five that included prescriptive characteristics were selected in order to analyze the methodologies applied to implement knowledge management solutions in higher education institutions.

Four methodologies for implementing knowledge management initiatives were also identified, but they are not directed at the higher education institution environment. The results summarize the characteristics of each and provide a comparative analysis.

Based on the results of the previous analysis, a methodology with an agile approach is proposed that can be applied to any type of knowledge management system project in a higher education institution. Projects may be solutions with a human, organizational or technological perspective.

The hermeneutic framework for literature review of Boell & Cecez-Kecmanovic (2014), which consists of iterations of the hermeneutic circles of search and acquisition, and analysis and interpretation, has been applied in the development of this study. Keyword search, forward and backward search techniques have been applied, which has allowed the identification of knowledge management models of interest for this research (vom Brocke et al., 2015, p. 214).

Databases were consulted during the source search process: Google Scholar, EBSCO Host, Emerald eJournal, ResearchGate, AIS eLibrary, IGI Global. The selected sources, written in English and Spanish, include: books, scientific journal articles, conference papers, conference proceedings, theses, standards, Web pages. Zotero software was used for source management.

Consultations were conducted on knowledge management models in higher education institutions in the period 2016 to 2021. Once the models were selected, an analysis was carried out to identify the purpose of the model, the research methodology used for its conception and validation, the origin and source of the study, and the model category (descriptive, prescriptive, hybrid). Given that the models analyzed reflected very specific characteristics for very particular solutions, we proceeded to consult other general methodologies for implementing knowledge management projects, in this case we identified four contributions of great value in the literature (American Productivity & Quality Center, s.f.; Milton & Lambe, 2020; Smuts et al., 2009; Tiwana, 2000).

Using an inductive categorization approach (Pantoja Vallejo, 2015, p. 306) , the analysis of the information sources was carried out in order to answer the research questions:

- What is the methodological approach applied to implement knowledge management solutions in higher education institutions?
- How are the models studied classified?

Results

This section is presented in three parts: A first analysis of ten knowledge management models aimed at higher education institutions, a second analysis of methodologies for the implementation of KM initiatives, and in a third section, the proposed Methodology for the implementation of knowledge management projects.

Analysis of knowledge management models for higher education institutions

Ten knowledge management models aimed at higher education institutions were analyzed (Baptista Nunes et al., 2017; Fernandes et al., 2019; Guevara B. et al., 2016; Meghji et al., 2020; Miake et al., 2018; Moscoso-Zea et al., 2016; Ojo, 2016; Pierre et al., 2017; Straujuma & Gaile-Sarkane, 2018; Zabaleta de Armas et al., 2016). It has been found that there is no single or standard approach to define a knowledge management model; therefore, each institution defines the purpose of its proposal in terms of its context. The models studied have varied purposes, some are conceptual, others have been defined seeking to improve a service and the effectiveness of the institution from an administrative perspective, others seek to support a process or institutional function such as research, teaching, extension; the orientation is also diverse; some support the management of tacit knowledge, others lean towards the management of explicit knowledge. Not all models are prescriptive or hybrid, the implementation methodology of those models that include it is presented at Table 1 .

In general, the application of the systems approach is observed, with diagnostic, design, implementation and evaluation phases. In the diagnostic stages, studies of the organizational context, process mapping, knowledge prioritization, needs identification, stakeholder analysis, evaluation and tool selection are carried out. In the design stages, tools and techniques are proposed to support the knowledge management processes according to the organization's knowledge management activities. The implementation stage is the implementation of solutions through knowledge management practices and Information and Communication Technology (ICT) tools that support knowledge management processes and activities. The evaluation stage includes mechanisms to validate results and provide feedback to the system so that learning is achieved and allows the organization to increase its knowledge spiral. Depending on the focus of the model, there are implementation methodologies that involve organizational processes and the structure of the organization (Fernandes et al., 2019; Guevara B. et al., 2016), others are more oriented to the implementation of IT solutions to generate or process knowledge (Meghji et al., 2020; Moscoso-Zea et al., 2016), and others integrate organizational and technological elements (Miake et al., 2018; Ojo, 2016).

Table 1

Methodology for the implementation of knowledge management models for higher education institutions

Author	Model implementation method

(Fernandes et al., 2019)	Phase 1. Diagnosis:
	    Organizational context
	    Process mapping
	    Knowledge prioritization
	    Identification of the degree of qualification of employees
	    Identification of action points.
	Phase 2. Implementation:
	    Link between QA practices and critical knowledge
	    Proposal for QA practices
	    Implementation of QA practices.
	Phase 3. Control:
	    Proposal of QA indicators

(Guevara B. et al., 2016)	Layer 1. Organization (institutional philosophy and business processes) Layer 2. Knowledge (life cycle, processes and knowledge management activities) Layer 3. Integration (modify, store, consult and delete knowledge) Layer 4. Physical (databases, archives and repositories)
(Meghji et al., 2020)	Execution of QA processes on the data to be analyzed, using data mining techniques, by the identified experts.
(Miake et al., 2018)	Data acquisition and integration Data processing and analysis Interactions with customers Feedback
(Moscoso-Zea et al., 2016)	Stakeholder analysis Tool evaluation and selection Infrastructure, enterprise architecture and data warehouse implementation Knowledge creation

(Ojo, 2016)	5-phase cycle:
	    Identify needs
	    Store in repositories
	    Share
	    Apply to improve efficiency and innovation
	    Evaluate the results.

QA implementation methodologies

In the previous section, methodologies with very specific characteristics are observed, to meet very particular needs. In general, it is desirable that the models incorporate detailed and easy-to-understand guidelines for the implementation of the solutions (American Productivity & Quality Center, 2019), preferably with an incremental and iterative approach (Milton & Lambe, 2020), until the expected results are achieved. The QA implementation roadmap is a "detailed plan of the steps an organization will take to implement a QA strategy and/or program, as well as the estimated time frame for each step" (American Productivity & Quality Center, 2019).

Based on these general precepts and the results of the literature review, general methodologies for implementing knowledge management projects have been found and are

analyzed in this article (American Productivity & Quality Center, s.f.; Milton & Lambe, 2020; Smuts et al., 2009; Tiwana, 2000). The phases and steps of these general methodologies are summarized on Table 2 .

Tiwana (2000), proposes a ten-step roadmap in four phases, based on the general systems approach, with phases of infrastructure assessment to align QA with the organization's business strategy; another phase of analysis, design and development of the QMS architecture in which knowledge assets are audited, the QA team is designed and the QMS is developed; in the implementation phase an incremental methodology is applied; and finally, an evaluation phase is identified to measure the return on investment and incrementally refine the system.

Smuts et al. (2009) suggests five stages and defines the steps for each one: in the first stage, the KM strategy is developed by performing a requirements analysis and considering the organizational structure, as well as knowledge management principles; in the next, evaluation stage, the current state of knowledge management is determined through a knowledge audit and initiatives are prioritized; the next stage is the development stage, where solution blocks are built for the prioritized initiatives; in the next, validation stage, pilot tests are dealt with; and in the last, implementation stage, results are published, maintenance, support and measurement of results are performed.

Milton and Lambe (2020), identify five stages: In the first stage, the need to implement KM to support a business case is identified; in the second stage, a plan is designed based on a knowledge audit and context assessment; in the third stage, cycles of testing, improvement and incorporation of KM components in the organization are successively repeated; in the fourth stage, the solution is implemented and delivered, it becomes operational and policies and governance are defined; in the last stage, operation and improvement, knowledge management becomes an integral part of the organization.

At American Productivity & Quality Center (Guevara B. et al., 2016; Meghji et al., 2020; Moscoso-Zea et al., 2016) they conceive of a first stage of solicitation to explore the value of the QA program to the organization, identify critical knowledge and obtain the organization's consent; in the second stage the QA strategy is developed by determining the current state and designing the implementation plan based on the prioritization of opportunities; in the third stage the QA initiatives defined through a plan, project and budget are designed and implemented; in the fourth stage of evolution and maintenance the QA program is valued and embedded within the organization.

Table 2

Methodology for the implementation of knowledge management initiatives

Tiwana (2000)	Smuts et al. (2009)	Milton and Lambe (2020)	APQC (s.f.)

Phase 1: Evaluation of infrastructure
Step 1: Analyze existing infrastructure
Step 2: Align QA with business strategy.
	Strategy: Develop the entire QA strategy for the organization including desired outcomes.
	Steps:
	QA and governance principles
	Organizational structure and sponsorship
	Requirements analysis
	Measurement.
		Stage 1: Strategy
		Identify the need for QA implementation to support a business case.
			Stage 1: Call for action
			Shares:
			Explore the organizational value of the QA program.
			Identify critical knowledge.
			Align QA with business priorities and functions
			Obtaining consent
			Results:
			    Consent of the organization
			    Value proposition
			    QA Management

Phase 2: QMS Analysis, Design and Development
Step 3: Design the QA architecture and its integration with the existing structure.
Step 4: Audit existing knowledge assets and systems.
Step 5: Design QA equipment
Step 6: Create the QA project
Step 7: Develop the QMS
	Evaluation: It focuses on the assessment of the current state of knowledge and KM in the organization, as well as the scope and prioritization of initiatives.
	Steps:
	Knowledge audit
	Scope of the initiative
	Prioritization
	Evaluation of the technological solution.
		Stage 2: Planning
		Knowledge audit, assessment of framework elements, assessment of stakeholders, assessment of culture and preparation of a communication strategy and plan.
			Stage 2: QA strategy development
			Shares:
			Determine the current status
			Create a governance framework
			Design the phased implementation plan
			Scope and prioritization of opportunities
			Create business cases and budgets
			Results:
			    QA Strategy
			    QA Roadmap

Phase 3: Implement the system
Step 8: Implement the system using a results-oriented incremental methodology.
Step 9: Managing change, culture and reward structure
	Development: It deals with the building blocks required for the implementation of the prioritized initiatives.
	Steps:
	Planning
	Obtaining knowledge
	Construction.
		Stage 3: Testing and piloting
		Successively, the QA components are tested, improved and incorporated effectively within the organization.
			Stage 3: Design and Implementation of QA Capabilities
			Shares:
			Form operational design teams
			Design the knowledge flow process
			Designing QA approaches
			Design the resources and capabilities model
			Leveraging and improving information technologies
			Develop measurements
			Ratify plans and budgets
			Results:
			    Dynamic plans for projects and infrastructure
			    Detailed budget
			    QA implementation

Tiwana (2000)	Smuts et al. (2009)	Milton and Lambe (2020)	APQC (s.f.)
Phase 4: Evaluation Step 10: Evaluate QA results, measure ROI and incrementally refine the QMS.	*Validation*: It deals with the components required to launch the pilot program of knowledge management practices, as well as the testing and updating of the pilot initiative. *Steps*: Definition of the pilot initiative Review and update Knowledge maintenance processes.	*Stage 4: Implement and deliver* Application of the QA framework to the rest of the organization that was not included in the pilot test. Preparation for the operational stage: documenting the framework, training people in their new roles, the new processes and the use of new technologies. It ends with the governance system and CG policies.	*Stage 4: Evolution and Maintenance* Shares: Developing QA capabilities Ensuring alignment between QA and organizational priorities Maintain awareness and commitment. Expand QA infrastructure to meet demand. Results Dynamic QA program: valued and embedded.
	Implementation: Focuses on publishing QA results and everything related to communication and change management. *Steps*: Publishing, communication and change management Maintenance and support Measurement and reporting.	*Stage 5: Operation and improvement* At this stage, QA is integrated into the organization's way of working. The QA team adopts a role of supporting and monitoring knowledge management activity in the organization with the aim of continuous improvement.	

The authors agree on the need to align QA with the organization's processes, to base the proposal on the audit of knowledge assets (Milton & Lambe, 2020; Smuts et al., 2009; Tiwana, 2000) and requirements analysis, considering the organization's structure and governance (American Productivity & Quality Center, s.f.; Smuts et al., 2009). Before undertaking the QA initiative, it is necessary to obtain the consent of the organization(American Productivity & Quality Center, s.f.). Technology solution assessment and prioritization of initiatives, needs and opportunities is necessary, as well as pilot testing to test QA initiatives (American Productivity & Quality Center, s.f.; Milton & Lambe, 2020; Smuts et al., 2009). There are also common ground among the authors regarding the implementation strategy, Milton and Lambe and Tiwana (2020; 2000) suggest the use of incremental and iterative methodologies to implement the solutions, others such as Smuts et al. (2009) refer to building blocks that include planning, knowledge gathering and construction, also considered a cyclical and iterative approach; these design and implementation stages are expected to have dynamic project and infrastructure plans (American Productivity & Quality Center, s.f.) that also include budgets. During the process it is necessary to manage cultural and organizational changes to incrementally refine the QMS through evaluation processes (Tiwana, 2000), leading to the maintenance of knowledge and measurement of the QMS (Smuts et al., 2009). Milton and Lambe(2020) identify the need to document the model and train people in new roles, new processes and the use of new technologies. It is necessary to have a team of people (Tiwana, 2000) to lead the implementation of QA initiatives and, once QA is integrated into the way the organization works, this team will take on a support and monitoring role (Milton & Lambe, 2020).

Finally, it is expected to have QA programs embedded in the organization's ways of working with ongoing evaluation and measurement activities (American Productivity & Quality Center, s.f.; Milton & Lambe, 2020; Smuts et al., 2009; Tiwana, 2000). In this sense, QA maturity models have been defined with which the organization can measure the maturity level of its QA program, which applied in a cyclical manner contribute to the continuous improvement and evolution of the program (American Productivity & Quality Center, s.f.; Collins, 2017)

Each organization must define its own knowledge management strategy and its own QMS, because as Tiwana (2000) points out "knowledge is the only resource that cannot be easily copied..., it is protected by the context".

Methodology for the implementation of knowledge management projects

Based on the results of the above analysis, a methodology is proposed for implementing knowledge management projects to put into practice the QMS Model defined for a higher education institution. A draft is a "first outline or plan of any work that is sometimes done as a test before it is given final form" (Real Academia Española, 2020ª, p. definición 5). Knowledge management projects must start with a recognized organizational problem related to knowledge. Based on the needs analysis, the solution is designed and developed, which may be aimed at improving organizational processes, implementing information and communication technologies, or defining improvements in human resources.

Unlike the prescriptive models analyzed in the Table 1 the proposed stages include specific methodologies for the stages proposed by the ISO 30401 standard on requirements for Knowledge Management Systems (International Organization for Standardization, 2018): planning, organizational support, operation, performance evaluation, improvement. Specific methodologies include the knowledge audit as one of the first stages in order to determine the knowledge gaps, as well as the knowledge map and flow. Another specific methodology included is the maturity assessment of knowledge management in an organization. Methodologies for solution design can be dynamically incorporated, depending on the type of solution identified, which gives freedom to knowledge managers to make adjustments to their needs and experiences.

Table 3 summarizes the steps of the proposed methodology and identifies commonalities with the methodologies discussed, which also use a systems project approach (American Productivity & Quality Center, s.f.; Milton & Lambe, 2020; Smuts et al., 2009; Tiwana, 2000).

Table 3
QMS implementation methodology

Stage	Activities	Tiwana (2000)	Smuts et al. (2009)	Milton and Lambe (2020)	APQC (s.f.)
Strategy	Identification of problem areas oriented to knowledge management and of interest to users and authorities.	x	x	x	x
	Obtaining the consent of the authorities.		x		x
	Designation of the work team.	x			x
	Project feasibility assessment.		x		x
Knowledge audit	Definition of the methodology for data collection and analysis.	x		x	

Stage	Activities	Tiwana (2000)	Smuts et al. (2009)	Milton and Lambe (2020)	APQC (s.f.)
	Obtaining the knowledge map and knowledge flow of the study area.				x
	Identify knowledge gaps and recommendations for addressing them.		x	x	
	Prioritize the knowledge gaps to be addressed with the design of the solution.	x	x		x
Solution Analysis, Design and Development	Analysis of solution requirements not covered in the knowledge audit.		x		
	Solution design.	x	x		x
	Solution development.	x	x		
	Pilot testing of the solution with potential users.	x	x	x	
	Presentation of the proposed solution to the authorities.				
Solution implementation	Design of the implementation strategy.			x	x
	Implementation of the solution.	x		x	x
Evaluation and improvements	Definition of the methodology for the evaluation of results and maturity of knowledge management.	x			
	Application of data collection instruments.				
	Analysis of results.				
	Formulation of an improvement plan.		x	x	
	Presentation of the results to the authorities.		x		

The following is a description of the stages, the main activities to be carried out in each stage and the expected results. Figure 1 shows the diagram of the relationship between the stages of the methodology, an initial strategy stage is conceived to identify needs and obtain an initial assessment of the context, then a knowledge audit is included as a second stage, with the purpose of detecting knowledge gaps and prioritizing needs; in the third stage, repeated cycles are carried out with an agile approach of analysis, design and development of the solution; in the fourth stage of implementation, the developed solution is inserted in the institution and in the last stage of evaluation and improvement, an assessment of the level of maturity of knowledge management in the institution is obtained, the results are measured and improvement plans are proposed.

Figure 1
Methodology for the implementation of the knowledge management system model

Stage 1. Strategy

Objective: Identify the need to develop a knowledge management initiative to improve a process of the institution, based on a preliminary assessment of the context.

Description: At this stage, it is recommended to identify knowledge-oriented problem areas that can be viably addressed with the resources available in the institution. It is necessary to have the support of the authorities, organize the work teams, define the scope of the project, and have an assessment of the project's feasibility.

Activities:

1. Identification of problem areas oriented to knowledge management and of interest to users and authorities.
2. Obtaining the consent of the authorities.
3. Designation of the work team.
4. Project feasibility assessment.

Results:

1. Priority area of attention and its viability.
2. Consent of the authorities.
3. Work team.

Stage 2. Knowledge audit

Objective: Determine existing knowledge gaps through an assessment of the technological infrastructure, organizational processes and knowledge management practices.

Description: At this stage, it is recommended to apply a knowledge audit methodology to analyze organizational processes, knowledge management practices and the available technological infrastructure.

Activities:

1. Definition of the methodology for data collection and analysis.
2. Obtaining the knowledge map and knowledge flow of the study area.
3. Identify knowledge gaps and recommendations for addressing them.
4. Prioritize the knowledge gaps to be addressed with the solution design.

Results:

1. Knowledge map.
2. Prioritization of knowledge gaps.

Stage 3. Solution Analysis, Design and Development

Objective: Apply an agile systems development methodology to analyze, design and develop the proposed solution, considering the components of the proposed knowledge management model.

Description: At this stage, it is recommended to apply a methodology of analysis, design and development of systems to build the solution that satisfies the detected knowledge need. This solution may be related to the human, organizational or technological factor, or involve a combination. It is recommended at this stage to consider all the elements of the proposed knowledge management model, and to use an agile approach that allows implementing partial solutions in an iterative way.

Activities:

1. Analysis of solution requirements not covered in the knowledge audit.
2. Solution design.
3. Solution development.
4. Pilot testing of the solution with potential users.
5. Presentation of the proposed solution to the authorities.

Results:

1. Solution developed.
2. Approval for implementation.

Stage 4. Solution implementation

Objective: Incorporate the solution effectively into the institution's processes.

Description: With the consent of the authorities and the positive results of the pilot test, the solution is incorporated into the institution's processes.

Activities:

1. Design of the implementation strategy.
2. Implementation of the solution.

Results:

1. Solution implemented.
2. Documented knowledge management initiative.

Stage 5. Evaluation and improvements

Objective: Evaluation of the results of the implementation of the solution, with a view to defining improvement plans.

Description: At this stage, it is recommended to apply knowledge management maturity assessment models to identify the level of maturity of the institution's capabilities in the various human, organizational and technological factors. With the results, a continuous improvement plan can be defined to guarantee the growth of the institution in its knowledge spiral.

Activities:

1. Definition of the methodology for the evaluation of results and maturity of knowledge management.
2. Application of data collection instruments.
3. Analysis of results.
4. Formulation of an improvement plan.
5. Presentation of the results to the authorities.

Results:

1. Evaluation results.
2. Improvement plan.
3. Knowledge management program.

Discussion and conclusions

A knowledge management model must be consistent with systems thinking, i.e., consider the knowledge management process as a whole, analyze the interrelationship between all parts and evaluate the results to solve the problems (Rubenstein-Montano et al., 2001). In the models analyzed, Table 1, the importance of the relationship between the knowledge management initiative and the organization's strategic objectives and/or goals is emphasized, as well as the need for a needs assessment. The sequence of steps to design, develop, implement and evaluate the results of the solutions is varied, depending on the purpose of the model and the type of solution to be implemented. The evaluation of results, as an adaptive mechanism of the system, is not always explicit, nor is the response capacity. In the general methodologies for the design and implementation of knowledge management systems shown in Table 2, improvement phases such as system responsiveness and results evaluation phases are observed. The proposed methodology, in contrast to those analyzed in Table 1, uses an agile approach, with analysis, design and development cycles that adapt to the type of solution required to meet the detected knowledge management need. Unlike other authors, (Guevara B. et al., 2016; Meghji et al., 2020; Moscoso-Zea et al., 2016) applies evaluation and improvement stages in order to guarantee the increase of the organizational knowledge spiral.

All models show that one of the initial activities is the identification of the need, by means of a diagnosis or knowledge audit; other authors agree with this criterion (Cheung et al., 2007; Daghfous et al., 2013; Lambe & Tan, 2013; Liebowitz et al., 2000; Perez-Soltero et al., 2007; Taheri et al., 2017). The proposed methodology includes a knowledge audit stage.

The knowledge audit, over other forms of needs detection, has the advantage that it allows to obtain the knowledge map, the organization's knowledge flow and an analysis of the knowledge gaps; in this way it is possible to detect organizational, technological and human needs related to knowledge. With these results it is possible to design a solution, considering a methodology that fits the type of need detected. This is the principle on which the proposed methodology is based. The evaluation of results and continuous improvement can be done by applying a knowledge management maturity model with which the institution can obtain a parameter on the growth of the knowledge spiral until it becomes a learning organization (American Productivity & Quality Center, 2021; Cuadrado-Barreto, 2020; de Freitas, 2017; Demchig, 2015; Kulkarni & Freeze, 2004; Secundo et al., 2015).

The agile approach of the methodology allows, in an incremental and continuous way, to design, develop, implement and evaluate solutions, in this way there is a greater probability of achieving the acceptance of changes by users and quickly assess the benefits that will bring to the institution the modification of ways of working, the incorporation of new technologies, or make the necessary adjustments in order to achieve the improvement of the institution's performance.

The analyzed knowledge management models for higher education institutions correspond to the period 2016-2021, have been taken from bibliographic databases such as Google Scholar, EBSCO Host, Emerald eJournal, ResearchGate, AIS eLibrary, IGI Global. General methodologies for implementing knowledge management initiatives come mainly from books and organizations such as APQC. The proposed methodology considers aspects of the different methodologies analyzed (see Table 3), unlike the methodologies for implementing knowledge management models for higher education institutions (see Table 1), the proposal uses a project approach and is based on the ISO 30401 standard on knowledge management system requirements (International Organization for Standardization, 2018).

As future work, it is recommended that the proposed methodology be implemented to design organizational, human and technological solutions applicable to higher education institutions, and based on the results, make the necessary adaptations. Although the model has been designed for higher education institutions, as a future line of research it could be applied to other types of organizations and the results evaluated. In this way, it would be possible to move towards the achievement of a standardized methodology for the implementation of knowledge management system projects.

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THE SCOPE OF PROJECT MATURITY ISSUES IN CAMEROON

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Abstract. Cameroon, located in Central Africa, plays a leading role in terms of trade, with about half of the GDP of the Central African Economic and Monetary Commission area. Yet, the quality of public expenditure in Cameroon is said to be one of the grievances plaguing its economic growth. This underperformance is generally linked to project management, an essential lever for the country's development. The construction of infrastructure is one of the challenges of Cameroon's development policy. This lack of stakeholders in the knowledge and practice of maturation has an enormous impact in the votes consumption and the execution of projects that inevitably leads to the abandonment of projects, the multiplication of amendments, poor workmanship and the lack of satisfaction on the part of the beneficiaries. Hence, this study, after performing a SWOT analysis on project management maturity in Cameroon public projects, explores 17 projects undertaken over the past decade, in order to probe the impact of problems caused by the immaturity of projects on schedule and costs. The results revealed that the general maturity level for this study was 68%. Out of the ten hypotheses stated, seven were accepted. It was also found that the level of maturity of a public investment project in Cameroon positively affects its delivery whereas, some of the maturity variables do not significantly explain the costs with its parameters but impact others. Recommendations for a better project management in the country are thrown.

Keywords: maturation, project duration, public investment projects, vote consumption, Project costs.

EL ALCANCE DE LOS PROBLEMAS DE MADUREZ DEL PROYECTO EN CAMERUN

Resumen. Camerún, ubicado en África Central, juega un papel de liderazgo en términos de comercio, representando alrededor de la mitad del PIB del área de la Comisión Económica y Monetaria de África Central. Sin embargo, la calidad del gasto público en Camerún sería uno de los agravios que diluye su crecimiento económico. Este bajo desempeño generalmente está relacionado con la gestión de proyectos, una palanca esencial para el desarrollo del país. La construcción de infraestructura es uno de los desafíos de la política de desarrollo de Camerún. Esta falta de conocimiento y práctica de maduración por parte de los actores involucrados tiene enormes consecuencias en el consumo de créditos y la ejecución de proyectos lo que conduce inevitablemente al abandono de proyectos, la multiplicación de enmiendas, mala ejecución e insatisfacción por parte de los beneficiarios. Así, el presente estudio, después de haber realizado un análisis FODA sobre la madurez de la gestión de los proyectos de inversión pública cameruneses, explora 17 proyectos realizados durante los últimos diez años, con el fin de

sondear el impacto de los problemas causados por la inmadurez de los proyectos en tiempo y costo. Los resultados revelaron que el nivel general de madurez para este estudio fue del 68%. De las diez (10) hipótesis planteadas, siete (07) fueron aceptadas. También se encontró que el nivel de madurez de un proyecto de inversión pública en Camerún afecta positivamente su entrega mientras que algunas variables de madurez no explican significativamente los costos con sus parámetros pero afectan a otras. Se proponen recomendaciones para una mejor gestión de los proyectos en el país.
Palabras clave: Maduración, plazo del proyecto, proyecto de inversión pública, consumo de crédito, costo del proyecto.

Introduction

Following the cancellation in April 2006 of a large part of its bilateral and multilateral debt, Cameroon has set its sights on becoming an emerging country by 2035. This perspective places the country in front of the challenges of developing its infrastructure, diversifying its economy, consolidating its growth, reducing poverty and ensuring sustainable development. Public investment projects are essential to economic activity, as they help maintain or increase productive capacities and enhance the well-being of the population (MINEPAT, 2018). Development projects also appear to be the instrument for transforming a country's financial potential into infrastructure and social facilities (Messengue, 2013).

Infrastructure is an engine that facilitates trade and promotes strong and sustainable growth (DSCE, 2009), especially for developing countries. This is why the Cameroon government has invested heavily in infrastructure projects over the past decade through the Public Investment Budget (PIB). Thus, several projects have been launched in various sectors (road infrastructure with highways, engineering structures and bridges, port platforms, hydroelectric dams, water, agriculture and livestock) and since 2015, the three-year Emergency Plan that brings together several sectors of activity has been put in place to accelerate growth in Cameroon and improve the living conditions of the population (SPM, 2014).

According to PMI (2017), "a project is an effort made over a period of time with the goal of creating a unique product, service, or outcome". Furthermore, it describes it as "a set of coordinated activities, with start and end dates, undertaken by individuals or organizations to achieve specific objectives, within a defined time, cost and performance parameters." According to Aurégan and Joffre (2004), the project is present at all levels of the organization. Thus, it has particular characteristics, its uniqueness, its time horizon and its novelty. Indeed, its purpose is variable. It is also limited in time since the project has a start and end date. Finally, it is a break with the permanent management of the company.

The project planning phase is the process by which project tasks must be executed on time and within the cost. Project maturity has a positive effect on project performance, and continuous improvement in project management performance. Performance can be achieved through improving project maturity (Ko & Kim, 2019). Maturity models seek to improve the organization's ability to manage projects successfully (Kostalova & Tetrevova, 2014).

In Cameroon, multiple efforts have been made to improve project maturity and accelerate economic growth. The Finance and Budget Committee of Cameroon's National Assembly still points to the immaturity of a large proportion of projects in the PIB[1]. Despite these efforts, bad practices resulting from underspending of the Public Investment Budget (PIB) and poor management or maturity compromise the expected development process. The perfect example is the launch of several infrastructure projects for the African Cup of Nations (AfCON)

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[1] The EcoMatin newspaper of October 18, 2019. Website: https://ecomatin.net/

recently organized in Cameroon and the Three-Year Emergency Plan. The management of these infrastructure related to the construction of stadiums, hotels and access roads has always been a concern for public services, as contracts were signed in haste without the projects being mature. Thus, the Public Investment Budget continues to be poorly executed, despite the existence of a mechanism that sets out the procedures for developing and validating the maturity of projects.

This situation of failed public investment projects due to maturity in underdeveloped countries has attracted the interest of many researchers. Muriithi and Crawford (2003) drew conclusions regarding existing project management standards and guides to increase their relevance and applicability for projects in Africa. Christoph Albrecht and Spang (2014) identified potential influences on an organization-specific "ideal" level of project management maturity by taking a qualitative and exploratory approach. While Seelhofer and Graf (2018) developed a systematic national project management maturity framework and the national project management maturity model, defining maturity levels, identifying key perspectives and drivers of maturity, and discussing key performance indicators that can be used to assess and compare national project management maturity. In assessing the drivers of project delays in Algeria, Salhi and al. (2018) found that insufficient pre-project studies are the most important but also the most common factor for project failure.

The interest of the study is to allow the smooth running of infrastructure projects financed or co-financed by the state budget to demonstrate the extent of the problems of project maturity during their execution. As stated by Nguyen (2011) the occurrence of a hazard during project execution necessarily influences the time, cost and quality of the project. Thus, the objective of this research is to evaluate the principles of project management, from the design phase to the various potential hazards that may occur during their implementation. To do so, the study addresses the question of the cross influence of project maturation with the process of managing delay and within the limits of expected costs. To achieve this objective, a few research questions were raised: 1). What are the weaknesses of project maturity in Cameroon? 2) To what extent do maturity weaknesses affect project execution delays? 3) To what extent do maturity weaknesses affect projected project costs? Using statistical and qualitative data, a SWOT analysis was conducted and hypotheses were developed and tested to answer the questions posed. This study was conducted in Cameroon in January 2022.

Review of the literature and hypotheses

Project Management Maturity Measures

One of the key success factors of a project is project maturity. Good program and project portfolio management within the organization improves the likelihood of prioritizing projects and meeting quality expectations and project goals (V. S. Anantatmula & Rad, 2018). Organizations with a portfolio management emphasis on maturity are likely to complete projects within the planned budget (V. Anantatmula & Rad, 2013). Descriptive statistics of project maturity levels by assessment area can be identified as methods and tools (M), human resources (H), project environment (E), and knowledge management (K) (Spalek, 2015). Tiwari and al. (2020) developed a mixed maturity model framework that combines sequential and tiered models depending on the scope of the evaluation.

In Cameroon, the management of public investment project maturation occurs at three different levels. In the regions, public investment projects are initiated either by the Decentralized Local Authorities (DLAs) or by the devolved services of the State and coordinated by the Governor of the region concerned. For state corporate entities, the maturation of projects is coordinated by the general management concerned. Finally, for public administrations, the portfolio of public investment projects is made up of projects initiated

either by central services, devolved services, or projects initiated by the Decentralized Local Authorities or public institutions (PMI, 2017).

Taking into account all the previous research raised, in this study, we will consider the following elements as measures of project management maturity: 1-Scope formulation: project whose description has not clearly specified all that is necessary for its success. 2- Availability of funding: projects whose projected budget does not take into account available resources. 3- Release of rights-of-way: projects for which the project execution sites are not available. 4- Execution schedule: projects whose execution schedule is not realistic. 5- Technical studies: projects whose technical studies are insufficient and for which the tender documents are poorly prepared. The tender documents are in fact an output of the technical studies.

A concept for measuring project maturity was created by Mormul (2021) in the form of a weighted average of values (i.e., an average probability of the planned factors: 0.00-0.20, 0.21-0.40, 0.41-0.60, 0.61-0.80, and 0.81-1.00) scaled according to their importance (number of respondents choosing the correct answer). In addition, the indicator value of 1.0 implies that the surveyed companies rate their project maturity as perfect (fully mature organization), while 0.0 means that an organization is not project mature at all. In addition, there are three ranges of the indicator that classify three levels of project maturity: 0.00-0.33 is low project maturity; 0.33-0.66 medium project maturity; and 0.66-1.00 high project maturity. In addition, according to the survey, an overall project maturity score among infrastructure construction firms was calculated at 0.55 (medium). This concept will be used in the present work.

Project Maturity and Project Delay

Several studies have explored the closeness between project maturity and project schedule. Bento and al. (2019) stated that the adoption of organizational project management maturity brought about process improvements, resulting in more appropriate scoping, scheduling, and stakeholder communications. A study by Ibbs and Kwak (2000) involving 38 international companies also concluded that companies with good project management capabilities and skills achieve better project outcomes. Public sector firms in Ghana recorded low levels of maturity in most phases of the project management life cycle. This can be attributed to the low level of project management expertise in the sector, with possible disastrous consequences on project delivery time and the country's development since public sector projects account for a large percentage of projects (Ofori & Deffor, 2013).

Empirical research conducted at Addis Ababa University Institute of Technology revealed that the implementation of road construction projects suffers from poor organizational performance due to project immaturity. Poor scope management, recorded delays, higher than expected costs, and serious quality defects are among the critical effects of these underperforming organizations (Ambaw, 2017). In Nigeria, Koko and al. (2013) found that design flaws, poor contract management, and poor financing, were the most important nodes for improvement in project management. In Egypt, Abu El-Maaty and al. (2017) showed that the contractor's technical staff is insufficient and ineligible to accomplish the project, which should be considered in project maturity models, is one of the important causes of time overrun.

In Cameroon, Kala Kamdjoug and Motcheka (2015) used a mixed-method approach to show that both determinants (maturity and planning) have a positive relationship with delays in the implementation of Information Systems projects. However, none have ever worked on finding the relationship between maturity and delays in public investment projects, so the following hypothesis can be made. Ha: The level of maturity of a public investment project in Cameroon positively affects its delivery delay.

Project Maturity and Project Cost

Research on the benefits of project management maturity has so far focused on studying the relationship between maturity and the certain beneficial effect (Christoph & Konrad, 2014). Later, thousands of articles in the literature proved the proximity of project management maturity and are cost. The research results of Ambaw (2017) indicate that project cost management is considered the most important aspect compared to the management of other knowledge areas. Spalek (2013) proved that an increasing level of maturity in project management can have an influence on reducing the costs of projects managed by the organization. On the other hand, Heravi and Gholami (2018) proved using the project success criteria (cost and quality) that the influence of organizational learning on improving project performance is greater than the influence of the project risk management maturity level.

An Ethiopian study conducted on project management maturity in the construction industry by Yimam (2011) found that 22% of the maturity of the contractors cost management process is incomplete, resulting in projected cost overruns. Tebeje (2015) using interviews with contractors, pointed out that the main factor causing cost overruns in construction projects is poor planning. In Nigeria, Abdulrahman and al. (2019) used a five-scale maturity level in their study, to define the level of maturity achieved by organizations and showed that it is simply the average maturity level, which is not satisfactory, leading to cost overruns. On the other hand, Olanisimi and Amusan (2011) studies found that the main factors observed through factor analyses causing cost overruns were, contractor inexperience, inadequate planning, inflation, continuous variations and changes in project design. In addition, project complexity, shortening or increasing project duration, and fraudulent practices were also responsible.

In Cameroon, Nyuonguo and Sundjo (2018) found that improved planning and risk mitigation at the construction site increased the likelihood that the project would not meet its projected costs. This probability was not significant, however, for failure to meet the planned schedule. However, the current literature lacks models that allow experts to correlate measured maturity with the expected probability of success related to cost overruns (Sanchez et al., 2020). The following hypothesis can be initiated. Hb: The level of maturity of a public investment project in Cameroon positively affects its costs.

The project management maturity baseline provides the information needed to determine the levels of project management maturity in Cameroon's public sectors at a given time. This baseline provides the basis for developing a project management maturity improvement plan. Using the five maturity measures described earlier, the two hypotheses can be divided into five NULL hypotheses, to test the dependence of cost and delivery on each of the maturity variables. The overall structure of the research hypotheses is shown in Figure 1. The "a" hypothesis are cost-related, while all hypotheses noted as "b" are time-related. The appropriate methods for collecting data and testing the hypotheses are presented in the following sections.

Table 1
Hypothesis of the study

No	Hypothesis and null hypothesis
H1	H1a : An appropriate opportunity study influences reducing the costs of a project;

No	Hypothesis and null hypothesis
	H1a0 : The absence of an appropriate opportunity study influences increasing the costs of a project ;
	H1b : An appropriate opportunity study influences the reduction of project lead times of a project ;
	H1b0 : The absence of an appropriate opportunity study influences the overrun of the deadlines of a project.
H2	H2a : An appropriate feasibility study influences reducing the costs of a project;
	H2a0 : The absence of a feasibility study influences increasing the costs of a project;
	H2b : An appropriate feasibility study influences the reduction of project lead times;
	H2b0 : The absence of a feasibility study influences the overrun of the deadlines of a project;
H3	H3a : An adequate method and financing influences reducing the costs of a project ;
	H3a0 : The absence of an adequate method and financing plan influences increasing the costs of a project ;
	H3b : An adequate method and financing plan influences the reduction of project lead times ;
	H2c0 : The absence of an inadequate method and financing plan influences the overrun of the deadlines of a project.
H4	H4a : An adequate project implementation schedule influences reducing the costs of a project ;
	H4a0 : The absence of a project implementation schedule increasing the costs of a project ;
	H4b : An adequate project implementation schedule influences the reduction of project lead times;
	H4b0 : The absence of a project implementation schedule influences the overrun of the deadlines of a project.
H5	H5a : An complete technical study influences reducing the costs of a project ;
	H5a0 : The absence of a technical study influences increasing the costs of a project ;
	H5b : An complete technical study influences the reduction of project lead times;
	H5b : The absence of a technical study influences the overrun of the deadlines of a project.

Figure 1
Theoretical Modeling of the Research
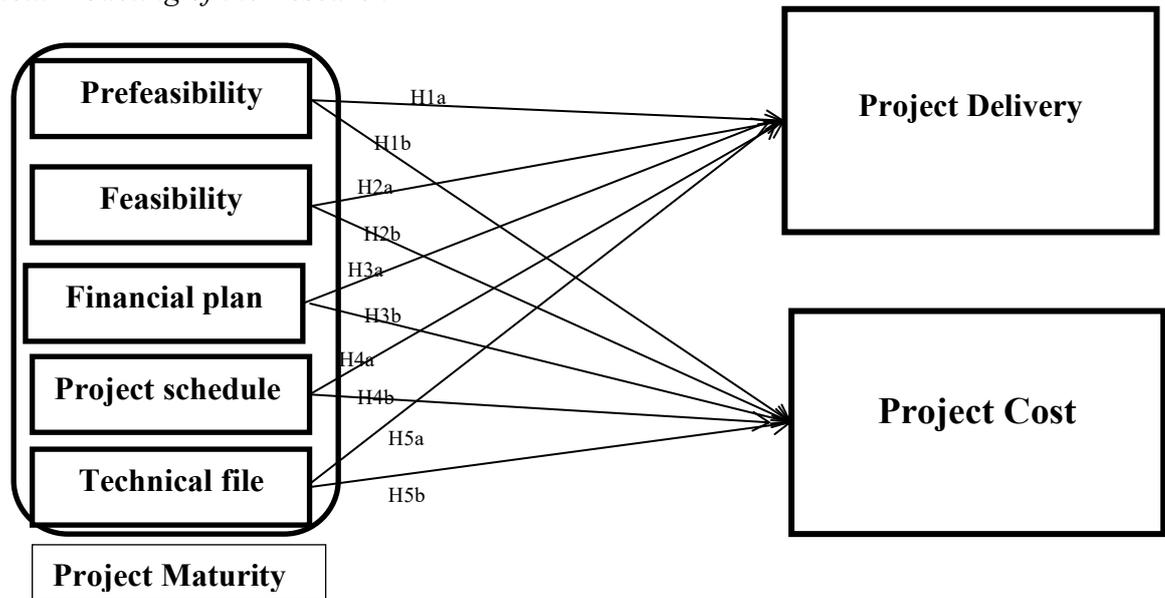
Note. Source : Author, based on data from the preliminary research and the literature review.

Methodology

The overall research methodology used is presented in Figure 2 below

Figure 2

Overall Research Methodology
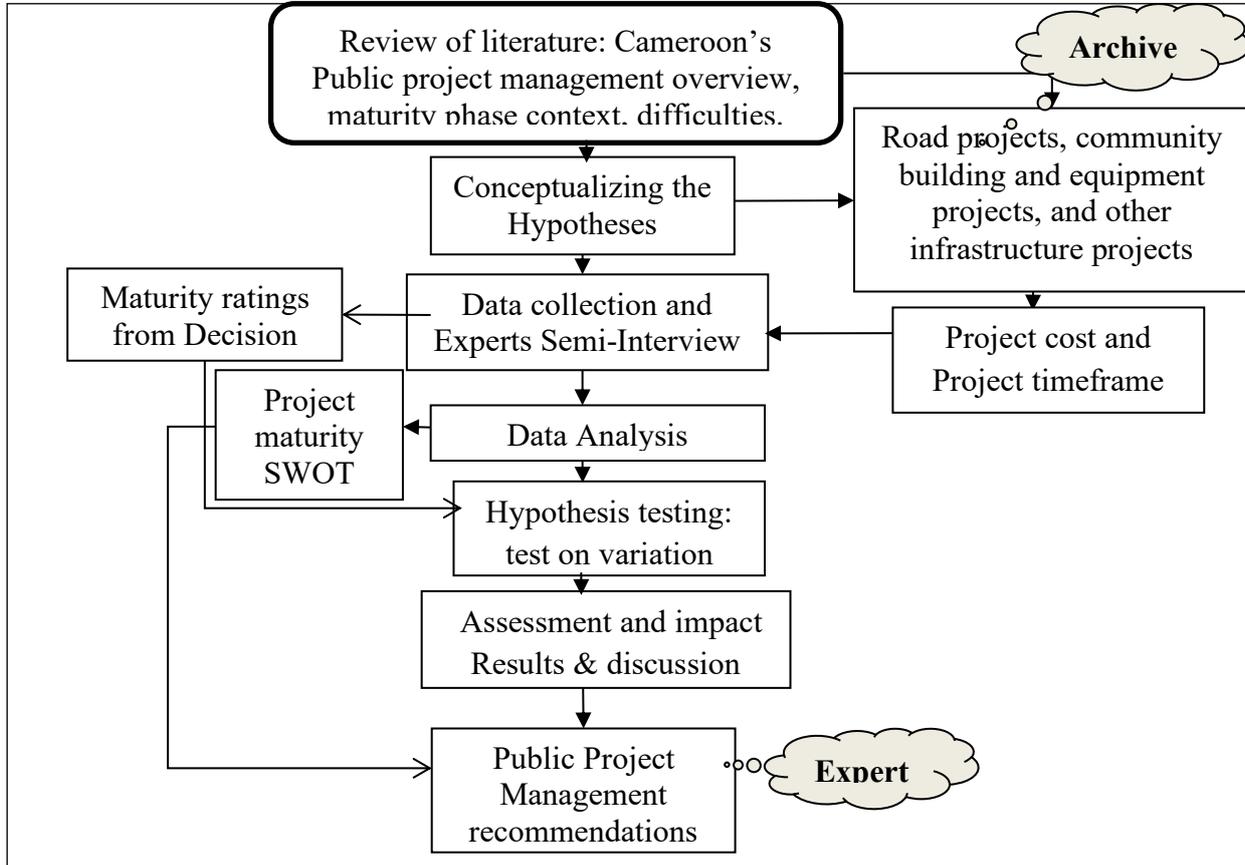
Note. Source : Author, based on data from the preliminary research and the literature review.

A literature review was conducted using open data and data from the Ministries in charge of the Economy, Public Works and Public Contracts. This review led to an inventory of project management in Cameroon and the identification of issues in the maturity phase. The literature review led to the formulation of different hypotheses that will answer the different research questions. A mixed method approach was used in this research. The maturity variables were qualitative, while the success variables were purely quantitative. After a workshop and a semi-interview with seven (7) skilled actors (Decision Makers), the success factors of the project maturity variables were defined and estimated. After collecting archival data, a SWOT analysis of the maturity phase was performed and using IBM SPSS, the hypotheses were tested using correlation analysis. The cost variances (difference between the estimated cost at planning and the cost after execution) were calculated and tested. This led to a first conclusion on maturity weaknesses and opportunities and the involvement of Covid19 was also assessed. Finally, the results were presented, a discussion compared the current work to previous studies, and recommendations were made with the help of experts. The variation that highlights the rate of cost and schedule execution versus the physical execution rate of the services is presented by the following equation:

$$Variation = \left(\frac{Actual\ Consumption\%}{Physiscal\ Execution\%} \times 100\right) - 100\% \qquad (Eq1)$$

Variation=((Actual Consumption%)/(Physical Execution%)×100)-100% (Eq1)

Variables: the independent variables are maturity measures (M1=pre-feasibility/opportunity study; M2=feasibility study; M3=financial plan; M4=project schedule; M5=technical file) that will be evaluated after the Experts have given their maturity scores for each of the selected projects while the dependent variables are the percentage of cost and time overruns in relation to the provisional values, calculated from the data in the archives of MINEPAT and MINMAP.

Sampling and Data Collection: The population was organized at the structural level by project type. The study population is covered by road construction projects, building and public facilities projects, and other infrastructure projects. A simple random sampling (SRS) of seventeen (17) projects was used by selecting the projects and programs directly related to the sample, launched in the last ten years. In the selected sample, road projects were explored. Delays in project execution and financial overruns in the construction of some public buildings and facilities that have been under construction for several years were investigated. The work on other infrastructures was not omitted. Data were collected using two different techniques. Maturity data were collected through interviews with the heads of the government teams responsible for the projects, while cost and schedule data were collected through the archives of the selected project files.

Data Analysis: An average probability of the planned factors: 0.00-0.20, 0.21-0.40, 0.41-0.60, 0.61-0.80, and 0.81-1.00 was used for each of the measures, as mentioned previously, to acquire maturity weights. Project duration and cost overrun was calculated using the equation (1). Spearman's rho correlation analysis in IBM-SPSS statistical tools was used as it helps better to obtain information regarding certain variables that are the main determinants of both noncompliance of delays and forecasted cost. With the SPSS correlation model, we were interested in the impact of certain variables on the non-compliance of both the forecasted cost and the project execution delay.

The projects selected for the study with schedule (over several months) and estimated costs (in billions of CFAF) as of December 31, 2021 are presented in Table 2. These projects have a major development action or a set of integrated major actions of national economic and/or social interest, the result of which is a large-scale physical object or complex infrastructure.

Table 2

Projects selected for the study

No	Projects
1	Yaoundé-Douala Highway Construction Project (Phase I)
2	Complementary rehabilitation works on the eastern entrance road section of the city of Douala, from PK10+400 to PK19+300 (bridge over the Dibamba).
3	Construction of the Sangmelima – Ouesso road, lot 1 (Sangmelima – Djoum), Section 1 (Sangmelima – Mekok – Bikoula: 65 km
4	Construction of the Sangmelima – Ouesso road, lot 1 (Sangmelima – Djoum) Section 2 (Bikoula – Djoum : 38 km
5	Construction of the Kribi-Lolabe highway
6	RN17A construction works: lot 1 Mengong-Sangmélima
7	Olama-Kribi road construction works, Lot 1: Olama-Bingambo
8	Construction works of the MBAMA-MESSAMENA road section
9	Construction of the Yaoundé-Nsimalen highway, open countryside section
10	Drinking Water Supply Project for the City of Yaoundé and its Surroundings from the Sanaga River (PAEPYS).
11	Project for the Upgrading of Electricity Transmission Networks and Reform of the Sector (PRRTERS)
12	Energy evacuation line from the MEMVE'ELE hydroelectric dam
13	BINI WARAK hydroelectric development (75 MW)
14	Lom Pangar hydroelectric development (foot plant with a capacity of 30 MW and energy evacuation lines)
15	Construction of the second phase of the Kribi Deep Water Port
16	Construction of the drinking water supply system for the Port of Kribi and its outbuildings
17	Construction of 1,675 social housing units in Yaoundé/Olembé and Douala/Mbanga-Bakoko

These major projects (roads, highways, ports, hydroelectric dams, drinking water supply, social housing, etc.) are those whose implementation cost represents at least 1% of the State's budgetary expenditure according to MINEPAT Document of Projects in Need of Funding IN 2021. In Cameroon, (MINEPAT, Public Financial Management Assessment Framework (PEFA), February 2016) specifies nine (09) main characteristics that distinguish a major project from a conventional project. These are: cost of preparation and implementation, the multiplier effect and structuring function, the function of training and strengthening the operationality of other projects, the great potential for job creation (direct and induced), the strength and sustainability of the economic and / or social impact, the specific institutional and partnership set-up, technological innovation and connectedness.

Results

Table 3 shows the project management maturity factors found in the successful implementation of public investment projects in the form of a SWOT matrix. This table was developed using related literature, project reports, and with the contribution of experts. This

has helped to identify difficulties encountered by project stakeholders in terms of maturity, and provides a basis for recommendations to be made.

Table 3
SWOT analysis matrix for projects in Cameroon

Criteria	Project management maturity factors
Strengths	1 Donors are still open to investing in Cameroon. 3 Flexibility in project cost estimates. 4 The use of specialists for project implementation. 5 Local project managers (professional and skilled) work in the central administration, devolved services, and Local Decentralized Authorities.
Weaknesses	1-Project management units usually stick to estimates until project completion, with no further effort to refine the costs determined by the studies. Whereas projects should continue to mature during physical and financial execution. 2-The absence of a Technical Consulting Firm in some cases to accompany the project manager in the control and monitoring of the execution of the works. 3-The detailed fore-project studies and technical choices are made during the execution of the project and there is no optimization. 4-The profile of some projects changes after the contract is signed. 5-Some projects start without any study. 6-many contracts are signed on the basis of preliminary designs (APS) contrary to the provision of the Cameroon Public Contract Code which requires that the technical studies be at least at the phase of detailed draft (APD). 7-after signing contracts for major projects, project teams often take one to two years to complete the execution studies. 8-the technical risks of the project are not calculated and measured in the estimates. 9-Lack of qualification criteria to identify the best contractors.
Opportunities	1-the country has qualified engineers in various fields, trained locally or outside the country. 2-the strong production of construction materials at the local level. 3-Information and Communication Technologies offer Cameroonians the possibility of self-training to international standards. 4- Access to contracts deserved for local Small and Medium Enterprises (SMEs) allowing them to participate in the country's economic activities, create jobs, realize their turnover and increase their profits.
Threats	1- Lack of information on facilities and equipment, especially on the plans of projects. 2- Many social and cultural factors surrounding the projects need to be taken into account before their execution. 3- Lack of variety in the projects which is materialized by the standard plans. 4- Corruption in the award and execution of public contracts. 5- Centralization of decision-making, including for smaller projects 6- Insecurity in certain localities. 7- Pandemic and epidemic diseases in some regions of the country. 8- Recurrent difficulties in obtaining compensation and freeing up the right of way for certain projects.

Seven experts were interviewed to collect project maturity measures, and their profiles are recorded in Table 4. This table shows a cumulative experience of over 100 years, with Experts coming from different parts of the country and having at least a university degree. It is reported that all Experts have a Master's degree or higher and 100% have at least 10 years of experience.

Table 4
Profile of Experts

Gender	Frequency	Percentage (%)
Male	5	71
Female	2	29
Skilled		
Less than 10 years	0	0
Between 10 and 15 years	3	43
More than 15 years	4	57
Level of education		
Bachelor's degree	0	0
Master's degree	6	86
PhD	1	17
PostDoc	0	0
Field		
Administration	0	0
Engineering	3	43
Management	3	43
Finance	1	16

Each of the project maturity level weights given by the Experts for each project was recorded and averaged in Table 5. This matrix was used to assess the correlation between maturity and project success factors. Analyzing the comparison of time and cost overruns recorded in Figure 3, it is particularly noticeable for projects N9, N11, and N13 that both delays and cost overrun percentages were positive, suggesting a greater influence on project performance. In particular, project 13 (BINI WARAK hydroelectric scheme, 75 MW) shows the largest cost and schedule overrun, which means that the project has the largest problems among the set studied.

Table 5
Project maturity levels according to the experts

Measure	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
M1	90 %	60 %	50 %	70 %	50 %	50 %	70 %	65 %	70 %	60 %
M2	80 %	70 %	70 %	70 %	60 %	70 %	70 %	70 %	60 %	50 %
M3	40 %	50 %	60 %	50 %	50 %	50 %	55 %	85 %	45 %	70 %
M4	60 %	80 %	85 %	80 %	80 %	85 %	60 %	80 %	85 %	80 %
M5	90 %	80 %	95 %	85 %	90 %	85 %	80 %	90 %	80 %	60 %

Table 5

Project maturity level according to experts (continued)

Measure	P11	P12	P13	P14	P15	P16	P17
M1	55 %	45 %	55 %	60 %	75 %	80 %	60 %
M2	60 %	50 %	50 %	70 %	80 %	85 %	60 %
M3	60 %	45 %	40 %	60 %	40 %	85 %	50 %
M4	85 %	75 %	60 %	80 %	80 %	80 %	70 %
M5	85 %	80 %	80 %	80 %	70 %	85 %	75 %

Table 6

Variation in project implementation costs

Measure	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Consumption %	117	13.42	87	93	96.28	83.62	87	65	100	78.5
Execution%	97.7	9.1	87	96.6	96.02	86.33	96	73.68	25	81.5
%Cost(variation)	19.75	47.4	0	-3.7	0.27	-3.13	-9.3	-11.7	300	-3.68

Measure	P11	P12	P13	P14	P15	P16	P17
Consumption %	9	92	0.5	37	8	34	52
Execution%	6.52	94	9	40	32.5	44	78
%Cost(variation)	38.03	-2.12	-94.4	-7.5	-75.38	-22.72	-33.33

Table 7

Variation in Project delays

Measure	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Consumption %	96.62	0.5	95.6	98.5	105	94.1	94	92	98	83.2
Execution%	97.7	9.1	87	96.6	96.02	86.3	96	73.68	25	81.5
% Time(variation)	-1.1	-94.5	9.96	1.96	9.352	9.1	-2.08	24.86	292	2.08

Measure	P11	P12	P13	P14	P15	P16	P17
Consumption %	33	115	300	87	45	60	215
Execution%	6.52	94	9	40	32.5	44	78
% Time(variation)	406.1	22.3	3233	117.5	38.46	36.36	175.64

Figure 3

Comparison of project costs and delays
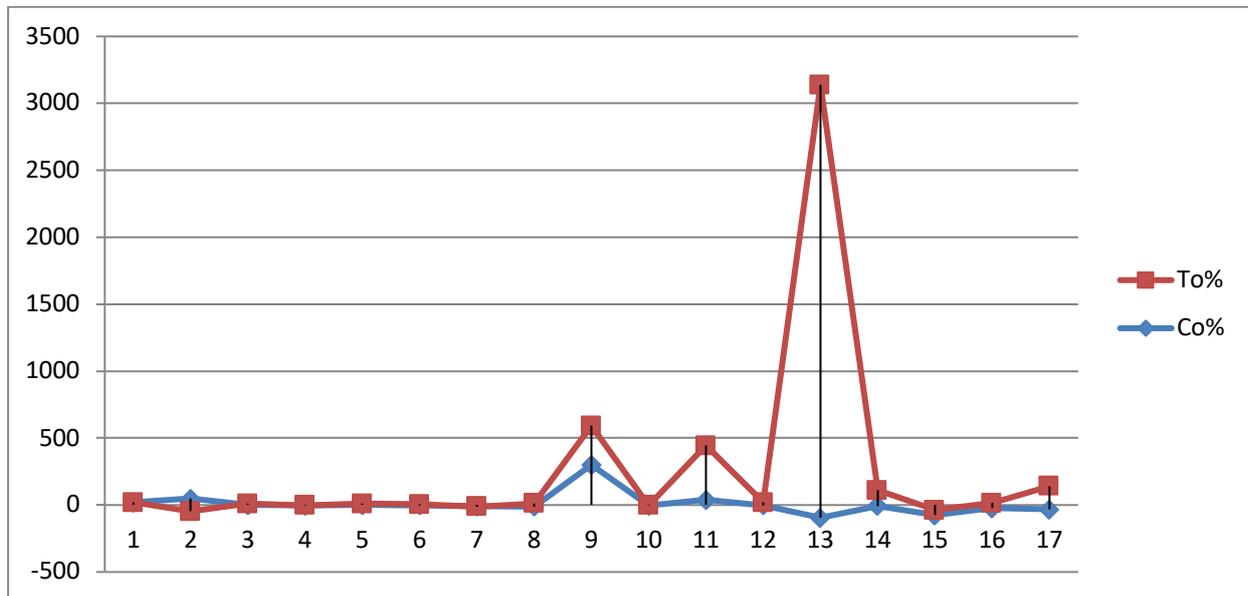
Table 8

Correlation test between project maturity variables, delays and costs

			Co	To	M1	M2	M3	M4	M5
						Spearman's rho Correlations			
Spearman's rho	M1	Correlation Coefficient	.212	.531**	1.000	.638**	-.035	-.249	-.061
		Sig. (2-tailed)	.041	.061	.	.006	.893	.336	.817
	M2	Correlation Coefficient	.131	.622**	.638**	1.000	.118	.059	.338
		Sig. (2-tailed)	.617	.208	.006	.	.651	.823	.184
	M3	Correlation Coefficient	.564**	.561**	-.035	.118	1.000	.348	.194
		Sig. (2-tailed)	.808	.816	.893	.651	.	.171	.456
	M4	Correlation Coefficient	-.167	.662**	-.249	.059	.348	1.000	.264
		Sig. (2-tailed)	.062	.521	.336	.823	.171	.	.306
	M5	Correlation Coefficient	-.300**	.738**	-.061	.338	.194	.264	1.000
		Sig. (2-tailed)	.242	.357	.817	.184	.456	.306	.

Note. **. Correlation is significant at the 0.01 level (2-tailed).

In Table 5, the results revealed that the overall maturity level of the selected projects according to the Experts was 68%. The results in Table 6 represent a calculation of the percentage of project cost overrun relative to the physical implementation level, using equation

(1). A positive cost overrun percentage means that the budget has exceeded or may exceed the required forecast, while a negative or zero value means that there would be no cost overrun in a given project. Similarly, using equation (1) and the same hypotheses used for costs, Table 6 represents a calculation of the time overrun percentages (delays) for each of the seventeen selected projects. Looking at the results in Table 8 above, it can be noted that the correlation coefficients show the scope and direction of the linear relationship between the project maturity variables and the sampled projects' success measures (cost and delay).

The P-value is shown along with the correlation coefficient for the matrix studied. The significance level shown is for the 1% level, which indicates a very high significance of the research. The results in Table 8 also show a significant correlation between the Maturity variables.

A Spearman correlation analysis reveals a positive correlation (r=.531**) between an appropriate opportunity/prefeasibility study (M1) and the time overrun (delay) of public investment projects, hence the acceptance of H1b (An appropriate opportunity study influences project delay). However, a weak positive correlation (r=.212) is found between M1 (appropriate opportunity study/prefeasibility) and project cost overrun, which means that even if the measure affects costs, other factors may have more influence, thus, H1a: appropriate opportunity study influences reducing the costs of a project are accepted. It can also be seen that the correlations between an appropriate feasibility study (M2) and time/delay overrun (r=.622**) or cost overrun (r=.131**) are both significantly positive, with a higher influence on project time overrun, thus accepting the two hypotheses. H2a: An appropriate feasibility study influences reducing the costs of a project and H2b: An appropriate feasibility study influences the reduction of project lead times.

By investigating the relationship between adequate project financing method and plan (M3) and duration/delay overrun (r=.561**) or cost overrun (r=. 564**), the Spearman correlation coefficients were both weakly positive, but there was sufficient evidence to accept both hypotheses H3a : An adequate method and financing influences reducing the costs of a project and H3b : An adequate method and financing plan influences the reduction of project lead times.

We also note that the correlation between an adequate project implementation schedule (M4) is strongly related to time overrun and delays (r=.662**) but negatively related to cost overrun (r=-.167 **), therefore, there is sufficient evidence to reject H4a: An adequate project implementation schedule influences reducing the costs of a project but not enough to reject H4b: An adequate project implementation schedule influences the reduction of project lead times. Similarly, when testing the influence of having an incomplete technical file (M5) on project execution time and cost overrun, a weak negative correlation (r=-.300**) was revealed with cost overrun and a weak positive correlation was found with time overrun, suggesting that there is a weak influence of complete technical files on time overrun but a negative correlation with cost overrun, thus H5a : An complete technical study influences reducing the costs of a project is rejected while H5b : An complete technical study influences the reduction of project times is accepted, with a strong positive r=.738**.

Table 9 below summarizes all hypotheses and their status. It can be seen that seven of the ten stated hypotheses were accepted, thus, the main hypotheses that: The level of maturity of a public investment project in Cameroon positively affects its delivery is accepted, while, the maturity variables do not significantly explain the costs, therefore, there is sufficient evidence to reject the hypotheses on the influence of costs. This means that costs are not only influenced by maturity, but by other factors that should be induced in future studies.

Table 9
Hypothesis Testing Using Correlation Analysis

No	Hypothesis	Status
1	H1a : An appropriate opportunity study influences reducing the costs of a project;	Accepted
2	H1b : An appropriate opportunity study influences the reduction of project lead times of a project;	Accepted
3	H2a : An appropriate feasibility study influences reducing the costs of a project;	Accepted
4	H2b : An appropriate feasibility study influences the reduction of project lead times;	Accepted
5	H3a : An adequate method and financing influences reducing the costs of a project;	Accepted
6	H3b : An adequate method and financing plan influences the reduction of project lead times ;	Accepted
7	H4a : An adequate project implementation schedule influences reducing the costs of a project ;	Rejected
8	H4b: An adequate project implementation schedule influences the reduction of project lead times;	Accepted
9	H5a : An complete technical study influences reducing the costs of a project ;	Rejected
10	H5b : An complete technical study influences the reduction of project lead times;	Accepted

Discussion and conclusion

The overall maturity level for this study was 68%. In investigating project management maturity and project management success in the engineering and construction industries in Southern Africa, , Pretorius et al., (2012) found that the average perceived project management maturity level was 2.88 (57.6%), which is lower than the results found in these studies. One of the objectives of this study was to assess how the maturity level of a public investment project in Cameroon affects its delivery time and costs. The results revealed that the maturity level of a public investment project in Cameroon positively affects its delivery while the maturity variables do not significantly explain the costs with its parameters M1 and M5, but affect with others, therefore, the costs may not be simply influenced by maturity alone, but other factors should be induced.

Similarly, , Spalek (2013) found that an increasing level of project management maturity can influence the cost reduction of projects managed by the company, and Yazici (2009) proved that an increasing project management maturity as well as improved results. The oriented organizational culture improves the competitiveness of an organization, which translates into cost savings and increased sales. However, the strength of this influence depends on various factors. In addition, many other researchers have found a strong relationship between maturity and project completion duration. In Nigeria, Salawu and Abdullah, (2015) suggested that the overall risk management maturity level of contractors is "novice," which can still lead to project time overrun or even cancellations. These findings significantly support the results found in Cameroon.

This study shows that the hypothesis that the level of maturity of a public investment project in Cameroon positively affects its delivery time is accepted, while costs are not only

influenced by maturity, but by other factors that should be induced in future studies. Several recommendations would help Cameroonian utilities manage the current scenario. Certain measures need to be adopted to overcome the impacts of unpredictable scenarios in the future and thus continue to support sustainable growth. Guides and standards will help improve project performance and more efficient use of project resources.

There is a need in Cameroon to improve the level of maturity of public investment projects. It is necessary to establish consultancy and project management assistance firms in the structures in charge of public investment projects and to develop a project management maturity model that is inclusive of local realities. Benchmarking and lessons learned from previous projects are essential.

Operation and maintenance costs of completed projects must be integrated during the project maturation phase. Responsibilities must be clarified. The ministry in charge of Public Contracts should assume responsibility for each project, and the parliament should have a committee on major infrastructure projects. Training in public finance should be provided for project managers.

For project time management, Cameroon should adopt different methodologies such as the critical chain methodology and results-based methodologies when designing project delay management strategies. There is also a need to improve project integration. General reporting, statistics, monitoring and feedback need to be implemented in the most important projects.

Project quality and risk management must be implemented at every stage of the project. To this end, it is recommended that change control process for each project is established and followed to minimize the "erosion" of project quality. Quality and risk management of Public Investment projects are areas for future research. These two aspects will be addressed in a future scientific article.

This study tried to show the scope of project maturity problems on execution delays and cost overruns of public investment projects in Cameroon. The results revealed that the level of maturity of a public investment project in Cameroon positively affects its delivery delay, which is not the case with the project cost.

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VALUATION ATTRIBUTED BY PROJECT PRACTITIONERS FROM PMI - LIMA CHAPTER TO THE INTEGRATION OF SUSTAINABILITY CRITERIA IN THE PUBLIC INVESTMENT PROJECT (PIP) IN PERU

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Abstract. All countries are committed to Sustainable Development Goals, seeking a balance between economic growth, environmental conservation, and social welfare, however, it seems that there is a risk of not achieving them or making very little progress by 2030. Public investment projects (PIP) due to their high impact, could be the engines to achieve them; and PIP practitioners play an important role as agents of change. The present study; quantitative, cross-sectional, and descriptive, carried out through self-administered surveys; sought to answer, from the perception of experienced practitioners, members of Project Management Institute (PMI) - Lima Chapter, the following questions concerning PIPs in Peru: 1) To what extent are sustainability criteria considered? 2) Do the criteria corresponding to any of the dimensions of sustainability tend to be more considered? and 3) What are the main barriers to the integration of sustainability criteria? The results show the ranking of the 12 criteria considered in the study, of which the criteria of the social dimension are taken into account more than the criteria of the economic and environmental dimensions. Likewise, the main barriers identified for the integration of sustainability criteria in PIPs were grouped into the following topics: Regulatory framework; Corruption, bribery, and transparency; The investment system; Capacities and competencies; and Promotion, dissemination, awareness, and values. This study represents a contribution as a baseline for the action of the State, organizations, and academia.

Keywords: Sustainability, Public Investment Projects, Sustainable Development, Sustainability criteria.

VALORACIÓN ATRIBUIDA POR LOS PROFESIONALES DE PROYECTOS DEL PMI – CAPÍTULO DE LIMA A LA INTEGRACÓN DE CRITERIOS DE SOSTENIBILIDAD EN LOS PROYECTOS DE INVERSIÓN PÚBLICA (PIP) EN PERU

Resumen. Todos los países están comprometidos con los Objetivos de Desarrollo Sostenible, buscando el equilibrio entre el crecimiento económico, la conservación del medio ambiente y el bienestar social, sin embargo, parece que se corre el riesgo de no alcanzarlos o avanzar muy poco al 2030. Los proyectos de inversión pública

(PIP) por su alto impacto, podrían ser los motores para alcanzarlos; y los profesionales de PIP juegan un papel importante como agentes de cambio. El presente estudio; cuantitativo, transversal y descriptivo, realizado mediante encuestas autoadministradas; buscó responder, desde la percepción de los profesionales con experiencia, miembros del Project Management Institute (PMI) - Capítulo de Lima, las siguientes preguntas en relación a los PIP en Perú: 1) ¿En qué medida se consideran los criterios de sostenibilidad? 2) ¿Los criterios correspondientes a alguna de las dimensiones de sostenibilidad tienden a ser más considerados? y 3) ¿Cuáles son las principales barreras que para la integración de los criterios de sostenibilidad? Los resultados muestran el ranking de los 12 criterios considerados en el estudio, de los cuales se tienen más en cuenta los criterios de la dimensión social que los criterios de las dimensiones económica y ambiental. Asimismo, las principales barreras identificadas para la integración de los criterios de sostenibilidad en los PIP se agruparon los siguientes temas: Marco normativo; Corrupción, soborno y transparencia; El sistema de inversión; Capacidades y competencias; y Promoción, difusión, sensibilización y valores. Este estudio representa un aporte como línea base para la acción del Estado, las organizaciones y la academia.

Palabras clave: Sostenibilidad, Proyectos de Inversión Pública, Desarrollo Sostenible, Criterios de sostenibilidad.

Introduction

One of the main challenges involving human beings is Sustainable Development, which seeks a balance between economic growth, environmental conservation, and social welfare, raised in 1983 in the United Nations Report Our Common Future, which served as the basis for Agenda 21 in 1992, the Millennium Development Goals in 2000 and the World Agenda 2030 with the 17 Sustainable Development Goals (United Nations, 2015). However, despite the global consensus on sustainability importance, the truth is that is complex to ground these concepts in daily human activities. Likewise, although sustainability began to gain relevance in business in the 1990s with the creation of the Business Council for Sustainable Development Forum and the publication of the book Changing Course, emphasizing corporate responsibility for sustainable development, this approach does not finish landing, until the beginning of the new millennium. Sabini, Muzio & Alderman(2019) reviewed 770 publications from the last 25 years on sustainable projects, finding that 73% of them correspond to the last 4 years.

Although the integration of sustainability concepts in projects is still in its initial stages, the shared consensus is that projects are one of the main mechanisms to generate organizational change toward sustainable development (Silvius & Schipper, 2020; Castellani, Olarreaga, Paniza & Zhou; 2019), in this line of thought, specifically public investment projects (PIP) play a predominant role in responding to the needs and priorities of each country with great impacts, closing the gaps to achieve the Sustainable Development Goals by 2030. In Peru, several gaps have been identified that need to prioritize many of them because of inefficiencies in public investment (IDB, 2018; IDB, 2020a; IDB, 2020b; Centro Nacional de Planeamiento Estratégico, 2018 and 2020). Likewise, the National Infrastructure Plan for Competitiveness (Gobierno del Perú – Ministerio de Economía y Finanzas, 2019) - the first effort of the Peruvian State to define vision and objectives, prioritize projects, and articulate investments - is recognized that to achieve a "country developed, competitive and sustainable, it is necessary to improve the quality of life of the population, with a social and decentralist vision and at the same time advance in the closing of infrastructure gaps and enhance all our productive capacities", however, the methodology prioritized was focused mainly on economic indicators, without considering a comprehensive and standardized concept of sustainability, the environmental component being the most absent. The weighting was based on 60% productive impact (economic potential, competitiveness, and implementation), 30% social impact (poverty-population), and 10% financial impact (ability to attract private investment).

On the other side, there are some studies to address sustainability in projects, especially in the construction sector, proposing indicators or criteria based on recognized references or certifications models like LEED, LBC, BREEAM, GREEN GLOBES, EDGE, Barcelona Urban Ecology Agency, or Economic Commission for Latin America and the Caribbean (Aguilar, 2016; Alvarado & Saenz, 2018; Lecca & Prado, 2019; Cabrera & Paredes, 2016).

In 2000 the National Public Investment System was created to optimize public resources for investment, which was replaced in 2016 with the new National System for Multiannual Programming and Investments Management hoping to improve the weak aspects of the previous system such as the investments´ disconnection with the closing of gaps and the budget allocation, insufficient quality of the project due to lack of capacities, and disorder or slowness in management (Torres, 2019; IDB, 2019; Diaz, 2017). While there may be multiple stakeholders involved in responsibility for integrating sustainability into PIPs (Sabini et al., 2019), the project practitioners play a preponderant role in all stages of the public investment cycle because they are responsible for the projects or can influence /impact in them, seeking that they are formulated, evaluated, executed, and operated according to the settle down criteria. So, the question arises, To what extent is sustainability considered or taken into account in Public Investment Projects in Peru, as perceived by project practitioners experienced in those projects? Do the criteria corresponding to any of the dimensions tend to be more considered? And in any case, what barriers have been identified for it?

The results provide a first approximation to the state of the art on the subject as a baseline for the academy for further research and the identification of training gaps and to the national public investment system executives for decision-making concerning the integration of these criteria, through normative and guidelines.

Method

The present research is quantitative, cross-sectional, and descriptive. The data was collected through a self-administered questionnaire applied on the Survey Monkey platform. The questionnaire was validated by 05 expert project practitioners with results greater than 90% in validity, objectivity, and reliability; and over 92% of Pearson or Spearman coefficients for each sustainability dimension.

The study variable *Valuation of the sustainability integration in PIP* is evaluated in its three dimensions (social, environmental, and economic), each one includes four criteria with their respective sub-criteria and questions. There are 12 criteria, 41 sub-criteria (see Table 2), 116 close questions (Likert alternative responses with 4 levels), and 05 open questions.

The PMI Lima – Peru chapter is the representative organization that brings together practitioners from different areas committed to improving organizations through the application of good project management practices, which is why it was considered the source for determining the population and the sample to be interviewed. The pre-established selection criteria were: *Project practitioner who has experience in the formulation, evaluation, or execution of at least one public investment project in Peru*. To determine the population that meets the established criteria, an initial survey was carried out among all members, identifying a population of 64 practitioners who met the established criteria (of 159 people who responded), of which 58 were willing to participate in the study of research. Therefore, the random sample corresponding to 50 practitioners was calculated and taken, with a confidence level of 95%. Table 1, shows the relevant characteristics of this sample.

The data was collected between May and June 2021, and were evaluated using the statistical packages IBM SPSS Statistics. To describe and analyze the data, the results are presented by the mean of the answers scored from 1 to 4 scale, where 1=never, 2=Sometimes, 3=Most of the time, and 4=Always. McDonald's Omega test and Cronbach's Alpha test were applied to each of the twelve criteria and the three dimensions, finding coefficients of 0.83 to 0.96; and 0.84 to 0.93, respectively, values considered good or excellent (Frías-Navarro, 2021). The student t-test for independent samples and the one-way Anova test were carried out to compare the means of the social, environmental, and economic dimensions with each of the variables from Table 1 that characterize the sample (e.g., age, academic level, experience, PIP type in which they have participated, etc.) finding no significant differences between the sub-groups of these categories. The paired sample t-test was applied for the social vs. economic dimension, social vs. environmental dimension, and economic vs. environmental dimension, finding significant differences in the two first cases. Finally, the t-test or Wilcoxon's signed-rank test for related samples was applied to each criterion data depending on their different distribution finding.

Finding

The findings are presented in two parts: The first part intends to answer the two first questions: 1) To what extent is sustainability considered in Public Investment Projects in Peru, as perceived by project practitioners experienced in those projects? 2) Do the criteria corresponding to any of the dimensions tend to be more considered? The second part intends to answer question 3) What are the main barriers that the interviewees have identified regarding the integration of the criteria proposed in the formulation, evaluation, or execution of the PIPs in Perú?

Table 1
Sample Characterization

Variable	Ranges	Percentage (%
Age	35 - 55	62
	≤ 35	20
	≥ 56	18
Highest academic level	Master's or doctorate	60
	Bachelor, Specialization, or diploma	40
Project certifications	PMP	70
	Others	28
	none	2
Practitioner´s experience in projects (years)	≥ 10	70
	< 10	30
PIP number in which they have worked	≥ 5	54
	1-<5	46
The position they have held in work experience	At the operational level	38
	At a strategic or tactical level	24
	Others	38
Largest PIP in which they have participated (Millions of US $)	≥ 10	66
	<10	34
Sectors in which they have worked	Transport and communication	40
	Housing and Development	32
	Agriculture, fishing, or industry	30
	Education, culture, or sport	28
	Energy or mines	26

Integration of sustainability criteria in PIPs in Peru

Table 2 summarizes the results globally as averages (means) at the level of the sub-criteria, criteria, and dimensions of sustainability. Most of the sustainability criteria (10 out of 12) have been rated between 2 and 3, and only 2 criteria reached values slightly higher than 3: *C3-Human rights* and *C4-Ethical behavior*, which are significantly different from all the other criteria but not with each other. Likewise, it was found that the *C6-Energy* criterion is the lowest with a value significantly different from all the other criteria. The values of the criteria corresponding to the Social Dimension stand out from the criteria of the other two dimensions, which leads to the following ranking by dimension: Social Dimension (2.86), Economic Dimension (2.59), and Environmental Dimension (2.47). There are no significant differences between the means of the economic dimension and the environmental dimension, however, each of these two dimensions has statistically significant differences concerning the social dimension.

The criteria corresponding to the social dimension are the criteria most considered and taken into account. Of the 4 criteria that make up the dimension, 3 of them have the highest

score of the 12 criteria: *C3-Human Rights, C4-Ethical behavior, C2-Society, clients, and consumers*, however, the *C1-Labor practices, and decent wor*k is one of the lowest criteria among all. This last criterion considers 6 sub-criteria, of which the following brought the average down: *Local competence development, Employment and staffing, Training and education,* and *Organizational learning* (See Table 2 and Figure 1).

The criteria corresponding to the environmental dimension are the criteria least considered and taken into account. The evaluation ranking of the criteria is as follows: *C7-Land, air, and water, C5-Transport, C-8-Consumption, C6- Energy, presenting significant differences between them, except C5-Transport* and *C8-Consumption*. Criterion *C6- Energy*, which has the lowest score and differs significantly from all other criteria, includes the following sub-criteria, all with low scores: *SC-Energy consumption, SC-CO2 Emission, SC-Clean, and renewable energy*. In addition to the sub-criteria corresponding to criterion 6, the following were evaluated at low levels: *SC-Logistics*; *SC-Recycling, reuse, and waste generation*, *SC-Water consumption, and sanitary water displacement* (see Table 2 and Figure 1).

The criteria corresponding to the economic dimension, are considered practically the same as the environmental criteria (there is no significant difference between them). The evaluation ranking of the criteria is as follows: *C9-Business case analysis and investment evaluation*, *C10-Effectiveness and efficiency of the processes*, and *C12-Economic stimulation*; which are statistically equal; and finally, there is *C11-Business agility*, which is significantly different from the other 3 criteria of this dimension. C11-criterion includes *SC-Flexibility/Optionality*, related to opportunities to adjust the requirements to achieve a higher degree of sustainability and creative ideas are sought to generate additional benefits.

C9-criterion included *SC34-Project evaluation and selection* and *SC35-Indicators* used in the evaluation and selection of projects, which were investigated through multiple-choice questions. The results show that PIPs are predominantly evaluated and selected based on the fund's availability to invest (58%) and the social and political pressure (50%). Likewise, the indicators predominantly considered are the Cost-Benefit Ratio (70%), Net Present Value (70%), and Internal Rate of Return (62%).

Main identified barriers to the integration of sustainability criteria in PIPs

At the end of each block of questions corresponding to the social, environmental, and economic criteria, an open question was asked in the survey, investigating which are the two main barriers that limit the integration of the sustainability criteria that had been assessed in the PIPs. The responses, corresponding to the three dimensions, were grouped and classified, by association, into the following five topics:

1. The regulatory framework, including barriers like:

   - The inflexible applicable regulatory framework. including mainly the law on contracting with the state by the *lump sum* contracting system;

   - The lack of state incentives to manage the projects with a global sustainability approach:

   - Insufficient state supervision for compliance with sustainability criteria included in sector regulations (for example, labor regulations).

   - There is no regulatory framework to require or promote sustainability criteria throughout the supply chain.

2. Corruption, bribery, and transparency, which include the following issues:

- Informality, corruption, bribery, unequal commercial conditions, and other types of collusion distort processes or policies and incorporate bureaucratic barriers.

- Limited transparency mechanism of the state contracting system.

- Anti-corruption regulations are not sufficiently publicized.

- Little interest in some companies meeting sustainability criteria if it reduces the project profitability.

- Bad political practices between authorities.

- Relaxation of society in the face of corruption at all levels.

Table 2

Consolidated results on the degree to which sustainability criteria are taken into account to be integrated into PIPs (Practitioners' perspective)

Sub-criterion (SC)	SC Mean	Criterion	Criterion Mean	Dimension Mean
Employment and staffing	2.39	C1 Labor practices and decent work	2.40	2.86* Social dimension
Project health and safety	2.60			
Training and Education	2.23			
Organizational learning	2.19			
Diversity and equal opportunity	2.59			
Local competence development	2.39			
Community support	2.44	C2 Society and customers	2.83	
Public policy/ Compliance	2.94			
Protection for local peoples	2.73			
Customer health and safety	2.95			
Customer Privacy	3.02			
Property and livelihoods	2.92			
Non-discrimination	2.93	C3 Human rights	3.18**	
Age-appropriate labor	3.54			
Voluntary labor	3.06			
Procurement practices	2.87	C4 Ethical behavior	3.03**	
Anti-corruption	3.09			
Fair competition	3.14			
Local procurement	2.87	C5 Transport	2.50	2.47 Environmental dimension
Traveling and communication	2.42			
Logistics	2.21			
Energy consumption	2.38	C6 Energy	2.25*	
CO2 emissions	2.16			
Clean and renewable energy	2.20			
Biological diversity	2.67	C7 Land, air, and water	2.67	
Water and air quality	3.02			
Water consumption and sanitary water displacement	2.34			
Recycling, reuse, and waste generation	2.24	C8 Consumption	2.50	
Disposal	2.58			
Contamination and pollution	2.69			
Financial analysis	2.78	C9 Business Case Analysis and investment evaluation	2.66	2.59 Economics dimension
Modeling and simulation	2.67			
Benefits	2.55			

Effectiveness	2.68	C10	
Efficiency	2.70	Effectiveness and efficiency of project processes	2.64
Project progress	2.54		
Flexibility /optionality	2.46	C11 Business agility	2.46
Local economic impact	2.72	C12	2.60
Indirect benefits	2.48	Economic stimulation	

Note. These criteria summarize those proposed by literature, such as Gareis, Huemann & Martinuzzi (2010), Tharp (2011), Silvius, Schipper, Planko, Van den Brink & Köhler (2012), Morfaw (2014), Martens & Carbalho (2016), Silvius (2019), Green Project Management (2019). A modified Likert scale of 1-4 was used. *Significant statistical difference compared to the other criteria or dimensions as appropriate. ** Significant statistical difference compared to the other two criteria but not each other.

Figure 1

Sustainability criteria ranking by dimension on the degree to which they are taken into account to be integrated into PIPs (Practitioners' perspective)
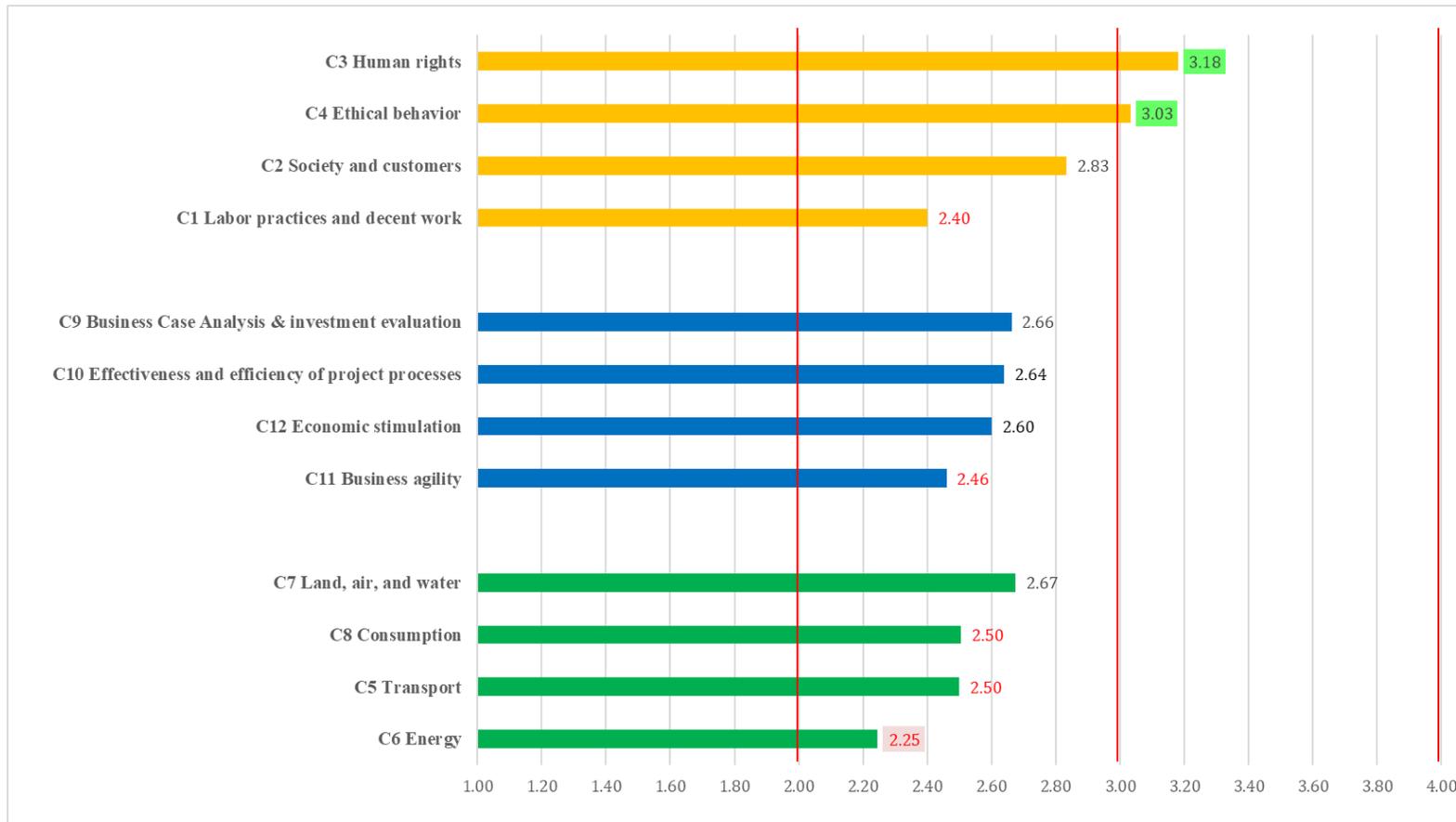
Note: First group (orange) is the social dimension; the second group (blue) is the economic dimension; the third group (green) is the environmental dimension.

3. Corruption, bribery, and transparency, which include the following issues:

- Informality, corruption, bribery, unequal commercial conditions, and other types of collusion distort processes or policies and incorporate bureaucratic barriers.

- Limited transparency mechanism of the state contracting system.

- Anti-corruption regulations are not sufficiently publicized.

- Little interest in some companies meeting sustainability criteria if it reduces the project profitability.

- Bad political practices between authorities.

- Relaxation of society in the face of corruption at all levels.

4. The investment system: A large number of sustainability barriers are included here:

- The PIPs are not aligned with international standards, for example, there is no Project Management Office (PMO), which manages projects within programs to achieve synergies, so management is pragmatic with a series project approach, selected and executed according to political pressures and social.

- The sustainability criteria, such as new technologies for clean and renewable energies, are not taken into account in the formulation and evaluation stage, where the requirements are given making it practically impossible to integrate them in the following stages without increasing cost and budgeting. For some interviewees, the main criteria at this stage are the availability of resources, cost minimization, and profitability.

- Project management deficiencies: poorly developed management plan (e.g., missing scope, costs, risk analysis); disruptive tools are not incorporated for the investment programming stage, which limits the solutions; failure in investment planning and programming; insufficient emphasis on monitoring and meeting goals at each stage; the performance of the project in execution is not analyzed; The collaborative work that would make the use of resources more efficient is not yet applied; lack of registration of suppliers that comply with international environmental protection standards.

- Lack of alignment between the different activities or elements of project management, for example, the provisions of the pre-investment formulation are not always fulfilled during the investment phase, a high time lag between the PIP formulation and the project execution, the investment is not made within the established deadlines, lack of coordination of the different areas involved prevents aligning or standardizing criteria; there is a large gap between estimated and actual social benefits.

- Conflicts between the different stakeholders from project formulation to closure; integration between the community, the company, and the government are not built.

- Change of local authorities and high turnover of management personnel and officials in public entities.

- Lessons learned from previous projects are not taken into account (there is no base or record of lessons learned); ex-post evaluations are not carried out in most cases, and it is not evaluated whether the financial-economic expectations are maintained in the project's execution (in many cases, the project's viability is lost due to the changes that occur), difficulty in quantifying benefits, the models focus on quantifying costs.

5. Capabilities and competencies: Within this topic, the following barriers have been grouped:

- Lack of knowledge, experience, awareness, and training especially at the level of public officials in the different stages regarding the subjects: procurement law and the integration of sustainability criteria in projects, including norms and procedures; best practices, technologies, and efficiency techniques.

- Lack of social studies, ignorance of the culture of the population, and lack of knowledge of the environment and society where the project is developed.

- Lack of specialized technical professionals and a multidisciplinary team. The public officials of the different state entities do not have adequate knowledge and management of procurement law. The work teams are dedicated to the technical development of the projects, there are neither personnel nor resources that allow a parallel sustainability analysis to be carried out.

- Local markets are not sufficiently developed to provide services to large projects. A limited supply of providers in rural areas causes executors to contract providers from other areas. Communities are not prepared to assume more responsibility.

6. Promotion, diffusion, awareness, and value: Within this topic, the following barriers have been grouped

- Lack of a culture of environmental protection, indifference, little interest, little appreciation, lack of commitment and involvement, lack of awareness, lack of responsibility, and resistance to change (of general people, business, and state) are barriers identified by the interviewees.

- Lack of promotion, communication, and awareness about environmental policies, new techniques, e impact on the environment, and the added value that PIPs generate in society when they take care of sustainability criteria.

Discussion

From the perception of public investment project (PIP) practitioners, the criteria of the social dimension are the most valued to be integrated into the stages of formulation, evaluation, and execution of PIP followed by economic and environmental criteria. These overall results were somewhat surprising at first since trends similar to those of other studies were expected, were the most valued/prioritized criteria were those corresponding to the economic dimension followed by the social and environmental dimension (Yuan, 2017; Martens and Carvalho, 2016); then we need to focus on each criterion and sub-criteria.

Within the Social dimension are the two best-valued criteria (statistically different from all 12 others): *C3-Human Rights* and *C4-Ethical Behavior*. The C3 criterion is associated with basic regulated legal issues like Non-discrimination, Not forced work, and Work according to age, whose non-compliance would mean sanctions and exposition to public scrutiny. This result validates the affirmation given by the interviewees in the identification of the barriers: "*if the criterion is regulated, it is fulfilled*". The C4 criterion includes Anti-corruption, anti-bribery, Fair competition, and Procurement practices. These issues are very sensitive in Peru, in recent years there have been several cases of corruption and bribery, giving rise to administrative and judicial processes with sanctioned, and even imprisoned authorities, reaching the highest levels of public administration, such as the same presidents. PIPs are also associated with social conflicts, although their origins lie in other issues such as land tenure or environmental impacts.

For example, by the end of December 2021, the Ombudsman's Office (Defensoría del Pueblo, 2021), reports a total of 202 cases of social conflicts, of which 129 (63.9%) correspond to socio-environmental conflicts, of which 86 (66.7%) are related to the Mining activity, followed by the activities of Hydrocarbons (18.6%) and Waste and sanitation (6.2%). Generally, these sensitive situations (corruption, bribery, and social conflicts) go together and possibly are the reason because the high score of interviewers for C4-Ethical Behavior.

This dimension also includes the second last valued criterion: *C1 – Labor practices and decent work*, with the following sub-criteria that bring down the average: *Employment and staffing*, *Local competence development*, *Training and education*, and *Organizational learning*. Concerning *Employment and staffing*, it includes payment of living wages, equal pay for equal work, and adequate employment conditions (health care, vacations, parental care, fair dismissal, and healthy work-life balance and personal), all of them corresponding to the relationship between the worker and the state provider that executes the PIP. These aspects are related to the high rate of informal work, which in 2020 corresponded to 3 out of 4 Peruvians (INEI, 2020). The other sub-criteria, include the identification and development of skills and competencies of the project team and the personnel who will operate or maintain the services of products generated by the project, incorporating lessons learned from past projects, and engaging with stakeholders to promote organizational learning of local communities for project resource planning and incorporating local employment targets into supplier contracts. The low ratings for these criteria are aligned with the barriers identified by the same interviewees that have been grouped in the Capabilities and competencies, for example, lack of knowledge, experience, awareness, and training, especially among the investment system officials usually due to high turnover making it difficult to close complete cycles of application of policies, guidelines or regulations that allow evaluations and feedback. Some interviewees indicated that "*adequate ex-post evaluations are not carried out*" and that "*there is no record of lessons learned*". After the survey of this work, the General Methodological Guidelines for the Ex post Evaluation of Investments were issued, where one of its objectives is "to generate knowledge to provide feedback on the phases of the investment cycle and the management of investments for future planning of investment initiatives" (MEF-DGPMI, 2021), indicating that the recommendations and lessons learned from the ex-post evaluation "should be sent to the entities involved in the phases of the investment cycle and other related organizations so that they can be used and are applied". It would also be important that the process contemplates as a requirement, in the formulation and evaluation stage, the review of the lessons learned in similar projects, to identify risks and promote the cycle of continuous improvement based on the experience that is generated as part of the same system.

The Environmental dimension includes the lowest valued criterion: *C6 – Energy* which includes new topics to Peru's context that requires national politics, capacity development, technology, innovation, and therefore greater investment. Among them are, for example, the use of energy-efficient materials, renewable energies, design principles that prioritize energy efficiency, carbon footprint, alternative energy solutions, products/services designs that emit less CO_2, and offsetting CO_2 when residual emissions occur. Likewise, the other criteria from this dimension include issues like carbon footprint reduction, use of materials and chemical products that do not harm the planet, reuse, recovery/recycling and minimizing waste, circular economy, water, and air quality, restoration of livelihoods, and biological diversity.

The low scores are aligned to the identified barriers like the design of projects that do not incorporate new technologies, lack of multidisciplinary teams that include environmental professionals, lack of international environmental standards implementation, and lack of knowledge of new sustainable and efficient practices, technology, and techniques. These results are associated with the diagnostic data presented in Decreto Supremo N°023-2021-MINAM

that approve the National Environmental Policy by 2030, where it is indicated that only in the year 2019, the state has invested 2102.52 million soles in budget programs aimed at solving environmental problems. Among the identified problems underlying the Environmental Policy are, for example, intensive use of low-efficiency and carbon-intensive technology; insufficient incentives for the implementation of eco-efficient and sustainable businesses; limited use of renewable energies and use of clean fuels; inefficient and unsustainable use of water resources; breach of environmental obligations; inadequate management of chemical substances; environmental liabilities with limited attention; inadequate solid waste management; high discharges of residual waters; high emissions of polluting gases; Insufficient environmental technological and scientific knowledge for environmental management, innovation and sustainable development; among others.

According to the General Guide for the Identification, Formulation, and Evaluation of Investment Projects (MEF-DGPMI, 2022), the PIP evaluation process includes seven elements, including the sustainability analysis, which is defined as the process that seeks "measure the capacity to produce goods and services planned, uninterruptedly throughout the useful life of the Project", being a "particularly important aspect of sustainability to analyze the financial capacity of the Project to cover its operation and maintenance costs". This approach is more economical, but also includes the social evaluation and the estimation of social profitability indicators through cost-benefit or cost-effectiveness, but little or nothing explicitly related to the environmental dimension is included. However, recently practically these environmental criteria considered in this study have been incorporated into the methodology for prioritizing the 72 infrastructure projects for the period 2022-2025 (Gobierno del Perú - Ministerio de Economía y Finanzas, 2022). These are resilience and adaptation to climate change; disaster risk management; natural infrastructure and nature-based solutions; Improving and monitoring environmental quality (air, water, and soil); Efficient use of resources and circular economy; Water and energy efficiency; Waste management and recycling, and GHG quantification. The impact of these new regulatory guidelines will be seen in the coming years.

The Economics dimension includes the third lowest criterion: C11: *Business agility*, which includes recognizing that changes are inevitable and decisions are carried out at the appropriate time that allows flexibility in the execution of the project and whether requirements are adjusted to achieve a higher sustainability degree, and finally if creative ideas are sought to generate additional profits. The low score is consistent with the following identified barriers: inflexible regulatory framework; the investment system does not incorporate disruptive tools for the investment programming stage which limits the solutions; current regulations do not recognize contingency amounts for adequate risk management; there is not only concurrent participation of the Comptroller's Office, but also as an issuer of recommendations, so any modification of the project may be questioned and lead to civil or criminal sanctions.

The rigid regulatory framework includes the law on contracting with the state, where most investments are managed through a budget based on the lump sum contracting system, which applies "when the quantities, magnitudes, and qualities of the provision are defined in the technical specifications, in the terms of reference or the case of works, in the plans, technical specifications, descriptive memory or respective work budget…" (Decreto Supremo N°344-2018-EF), therefore, the price factor prevails during the adjudication of State tenders. This condition generates that, if the sustainability criterion is not defined as requirements of the work, product, or service, it is not considered by the bidders so as not to generate additional expenses that could put them at a disadvantage compared to their competition. According to Sologuren (2017), in some sectors, such as in the case of works, more than 70% of selection processes are carried out by lump sum, presenting recurring events in which deficiencies, omissions, defects, or gaps are identified that prevent the proper execution of the work, giving

rise to the executor assuming costs of activities not contemplated in the technical file and the fact that public entities do not recognize it and therefore determine arbitration processes. According to interviewees, there should be incentives by the state, for example by a policy deployed in the regulations, so that the sustainability criteria were integrated from its conceptualization of the PIP and become operational in the technical file.

The Economic dimension also includes the *SC-Indirect benefits* valued with a low score (≤ 2.5), related to additional risks and opportunities and additional costs and benefits (see Table 2). These results are related to the identified barrier like the *lack of a PMO* to manage projects into a program so exploit synergies achieving greater benefits; or the *lack of alignment between different activities or elements of the PIP cycle*, leading to inefficiency which, according to the IDB (2019, p.6) is because countries cannot meet the quantity and quality of necessary investment or according to Garcés (2021) because the problem was not only in the Peruvian internal investment system but in the seven external systems such as the National Multiannual Programming and Investment Management System, the Budget and Indebtedness System, Supply System, the Treasury System, the Human Resources System, and the National Control System; therefore, to improve the effectiveness of the process, is necessary to look at the macro system as a whole, so that everything flows just in time. In the last National Plan for Sustainable Infrastructure for Competitiveness 2022-2025, the importance of PMOs has also been recognized as a lesson learned (already included in 2022 regulations such as DL N°1543 for Public Private Partnership projects) as well as the need to implement measures to standardize and optimize critical procedures.

Several of the weak sustainability criteria identified in this study have also been identified in similar studies from other contexts, such as low scores for aspects related to waste management, promotion of diversity and equal opportunities, improvement of the social and cultural values of local communities (Michaelides, Bryde & Ohaeri; 2014); lack of sustainability knowledge, lack of awareness and concern at project practitioner, companies and public level, high implementation cost, insufficient research and development, limited knowledge transfer, and finally inadequate policy and legislation (Zuofa & Ochieng (2016) where a state strategic role could significantly impact to achievement of the goals committed in the framework of the United Nations agreements (IDB, p.10, 2019).

The IDB proposes a common vision of sustainability by establishing the meaning of the sustainability criteria for the economic and financial, environmental and climate, social and institutional resilience dimensions, through 14 sub-dimensions with areas of action (IDB, 2019). Being precisely the IDB that provided technical assistance to Peru for the preparation of the National Plan of Sustainable Infrastructure for Competitiveness 2022 – 2025 (Gobierno del Perú - Ministerio de Economía y Finanzas, 2022), this plan now includes significant changes in favor of sustainability. In principle, it is recognized, as a lesson learned from the previous plan, that in Peru there is no definition of sustainable infrastructure, whose approach is included in the public and public-private investment systems, with prioritization indicators like those of IDB; so the new plan seeks to incorporate an approach based on the development of sustainable infrastructure, where the "projects are planned, designed, built, operated and dismantled in a way that guarantees economic and financial sustainability, social, environmental (including climate resilience) and institutional throughout the life cycle of the Project". Likewise, it seeks to align with "international infrastructure sustainability standards included in the Organization for Economic Cooperation and Development and the United Nations Sustainable Development Goals" (Gobierno del Perú - Ministerio de Economía y Finanzas, 2022, p. 7 - 8). This model seeks to cover the entire life cycle of the project, also considering that these dimensions are already part of the investment analysis and risk management of creditors, investors, and insurers around the world. Therefore, in this plan 2022 -2025, the indicators for the prioritization,

monitoring, and evaluation of projects in strategic sectors, include 07 indicators of the financial-economic component with a weight of 36.4%, 6 indicators of the social component with a weight of 32.4%, 2 indicators of the institutional with a weight of 10.2% and 5 indicators of the environmental component (which includes climate resilience) with a weight of 21.1%.

Although it has been a significant advance incorporating these new components, to provide a more comprehensive approach to sustainability, however, it is still necessary to continue complementing the measures in an accelerated manner to achieve the essential impact on the SDGs. For example, it is needed to establish similar applicable criteria, for the selection, monitoring, and evaluation of the other types of PIP that allow them to be compared with each other and even better if they are aligned with international criteria that allow us to compare ourselves with other countries.

It is also important to take into count that there are two approaches to target sustainability, one through the results of the PIP, for example, the construction of a solar photovoltaic plant to diversify energy sources; and the other approach is by sustainable management of each of the PIP that are carried out, considering sustainability criteria like the evaluated in the present study. National strategies, through PIPs, can deploy in both ways, but of course with specific methodologies and evaluation tools.

Finally, just as it is important to establish a mechanism to assess to what extent sustainable PIPs and the sustainable management of PIPs close the gaps for the achievement of the SDGs, in the same way it is important to have baselines to be able to monitor progress. and measure the effectiveness of strategies. The results of this study, coming from the perspective of practitioners with experience in PIPs, can serve as a basis to be related or contrasted with other studies that consider other types of primary sources, either before or after the implementation of sustainability criteria in the different types of PIPs.

Conclusion

From the 12 criteria studied, *C3-Human rights*, and *C4-Etichal behaviors*, are the most valued with scores over 3 (1 to 4 scale), while the other 10 were valued between 2 and 3, where criterion *C6-Energy* was the lowest one; which means that there is needed policies, provisions, and work plans to promote them.

The trends found were that the criteria of the social dimension are integrated to a greater degree than the criteria of the other two dimensions: economic and environmental.

Finally, there were very interesting barriers identified by the practitioners interviewed, those were grouped into six topics: Regulatory framework; Corruption, bribery, and transparency; Capabilities and competencies; and Promotion, diffusion, awareness, and values.

The results contribute to a baseline for taking action, for example, to the academy, several fronts of studies are proposed: 1) best instrument for measuring the integration of sustainability in PIPs, considering the best practices, the different phases of the investment cycle, the different kinds of public investments, and the framework and criteria proposed by the BID for sustainable infrastructure or by National Plan of Sustainable Infrastructure for Competitiveness 2022 - 2025; and 2) To measure the integration of sustainability into PIP from the formulation, evaluation, or execution data projects from invierte.com web. For the Peruvian state, this study sheds light on the main sustainability criteria that can be prioritized in a strategy to integrate sustainability in the PIPs for the achievement of the Sustainable Development Goals by 2030.

Limitations

One of the main limitations of the study is the population since there is no list of all the practitioners who work in PIPs in Peru, for which the organization, formally most representative in project management was identified, the PMI Lima Peru chapter. Nor was there a list of all the practitioner members of this organization who meet the criteria of the population (who have experience in at least one PIP), so an initial survey was carried out to identify them, presenting a probable bias since we worked from those who responded indicating that they met the criteria established for the population.

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FREE APPLICATION SOFTWARES: SCENARIO AND MOTIVATIONS FOR USE BY PEOPLE AND COMPANIES IN BRAZIL

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Abstract. The use of business-oriented software is indispensable for companies and people to keep them competitive in an increasingly dynamic, fast and complex market. It happens that, many times, the acquisition and licensing of these programs can represent a relevant budget constraint, since these investments demand a considerable slice of capital resources. In this context, the objective of this research was to measure and justify the use of free application software by people and companies in Brazil, since these programs can be an alternative to proprietary software. For this, a descriptive survey was carried out, such as a survey, which applied a questionnaire to collect the data to be analyzed. Closed and open, quantitative and qualitative questions were addressed. The main results obtained were: the existence of positive correlations in the use of free applications between legal entities and individuals; factors such as cost-benefit and cost being the most related as motivating elements for the use of these applications by the target audience; and, gratuity is the element of deviation in the ratio of rational use / random use by legal entities, something that is not verified in the individual respondents.

Keywords: free application software, correlations, cost-benefit.

SOFTWARES DE APLICAÇÃO LIVRES: CENÁRIO E MOTIVAÇÕES DE USO POR PESSOAS E POR EMPRESAS NO BRASIL

Resumo. O uso de softwares orientados aos negócios é indispensável às empresas e às pessoas para mantê-las competitivas num mercado cada vez mais dinâmico, veloz e complexo. Ocorre que, muitas vezes, a aquisição e o licenciamento desses programas – em especial, software proprietário – podem representar uma restrição orçamentária para muitos empreendimentos e para pessoas físicas, uma vez que esses investimentos demandam uma considerável fatia de recursos capitais, nem sempre acessíveis. Nesse contexto, o objetivo da presente pesquisa foi medir e justificar o uso de softwares de aplicação livres por pessoas e por empresas no Brasil, visto que esses programas podem ser uma alternativa aos softwares proprietários. Para tanto, foi realizada uma pesquisa descritiva, tipo *survey*, a qual aplicou um questionário para colher os dados a serem analisados. Foram abordadas questões fechadas e abertas, quantitativas e qualitativas. Os principais resultados obtidos foram: a existência de correlações positivas no uso de aplicativos livres entre pessoas jurídicas e pessoas físicas; fatores como custo-benefício e custo sendo os mais relacionados como os elementos de motivação para o uso desses aplicativos pelo público-alvo; e, a gratuidade como sendo o elemento de desvio na relação uso racional/uso aleatório por pessoas jurídicas, algo que não é verificado nos respondentes pessoas físicas.

Palavras-chave: softwares de aplicação livres, correlações, custo-benefício.

SOFTWARE DE APLICACIÓN GRATUITA: ESCENARIO Y MOTIVACIONES PARA USO DE PERSONAS Y EMPRESAS EN BRASIL

Resumen. El uso de software orientado a los negocios es indispensable para que las empresas y las personas los mantengan competitivos en un mercado cada vez más dinámico, rápido y complejo. Ocurre que, muchas veces, la adquisición y licencia de estos programas, en particular, software propietario, puede representar una restricción presupuestaria para muchas empresas y para individuos, ya que estas inversiones demandan una porción considerable de recursos de capital, que no siempre son accesibles. En este contexto, el objetivo de esta investigación fue medir y justificar el uso de software de aplicación gratuita por parte de personas y empresas en Brasil, ya que estos programas pueden ser una alternativa al software propietario. Para esto, se realizó una encuesta descriptiva, como una encuesta, que aplicó un cuestionario para recolectar los datos a analizar. Se abordaron preguntas cerradas y abiertas, cuantitativas y cualitativas. Los principales resultados obtenidos fueron: la existencia de correlaciones positivas en el uso de aplicaciones gratuitas entre personas jurídicas y particulares; factores como el costo-beneficio y el costo son los más relacionados como elementos motivadores para el uso de estas aplicaciones por parte del público objetivo; y, la propina como elemento de desviación en la relación uso racional / uso aleatorio por parte de personas jurídicas, algo que no se verifica en los individuos encuestados.

Palabras clave: software de aplicación gratuito, correlaciones, costo-beneficio.

Introduction

It's not new to be reminded of the importance of technology in our personal and professional lives. Far beyond mere entertainment or leisure, it is geared towards facilitating the lives of citizens and companies, where it plays various roles, fulfilling a fundamental role that encompasses relational dynamics and management processes in the search for greater efficiency and effectiveness in the use of organizational resources (Amorim, 2015).

So far, nothing new. However, although the use of information and communication technologies (ICTs) has been extremely popular for some time, most recently in Brazilian homes (Andrade and Ramos, 2013), the complexity lies in knowing what this transformation actually requires and will require of people, companies and managers and how it can and will benefit them, in an evolutionary phase that we can call the information age (Drucker, 2010).

Another thing we know is the price of acquiring these technologies, which is generally very high. This is due to the market dynamics of expanding and modernizing these programs, combined with the low level of competition at the time, which could lead to a reduction in prices. This is typical of proprietary software, where there are multiple applications but high licensing and support costs (Garcia, Santos, Pereira and Rossi, 2010; Souza, Dias and Alfinito, 2014; Amorim, 2015).

An alternative to proprietary software is free software. This can be recognized as software that respects freedom and a sense of collaboration between users. In short, this means that users have the freedoms to run, copy, distribute, study, modify, improve and market the software, allowing them to control the program and what it does for them, not the other way around (Amorim, 2015; Free Software Foundation, 2018). In proprietary software, these freedoms cannot be fully achieved.

The reality is that most of the software on the market comes from intellectual property (IP). Although many of these programs are free, they are characterized as freeware or shareware, i.e. software that has some limitations in terms of use and scope (Souza, Dias and Alfinito, 2014; Amorim, 2015). This can be a problem, especially for companies, which have budget restrictions and at the same time need to align their strategies with their long-term business objectives.

In view of these points and knowing the numerous restrictions on access to paid technologies by individuals and companies due to the justifications explained, it becomes relevant to know: what are the main motivations for the use of free application software by individuals and institutions? The aim of this study is to identify and measure the use of free application software by both individuals (citizens) and legal entities (companies) in Brazil.

The purpose of this research is to achieve these justifications in a broader way, not being restricted to a specific audience in the ICT sector, for example. The development of the text will ratify the methodology adopted as pertinent to the questions perceived as essential in the possibility of elucidating the facts raised as substantial.

Theoretical Framework

The theoretical framework that will underpin this study will contain summaries of the emergence of free software - FS, the concepts of free software and free application software and the FS movement in the global environment.

The emergence of free software: time differences

To talk about the origins of free software is to relive a story from different perspectives. Some authors point to the period before the 1970s, when software was usually distributed along with its source code (Drake, 2017). From a commercial point of view, the technology suppliers of the time didn't see software as something separate from hardware, so it was common to deliver the software along with its source code, in order to make it possible to adapt, correct faults and add features to the program so that it would run properly on the non-standard computers of the time (Wikipedia, 2018).

The use of computers in this period was more restricted to academic and research users in business environments, who shared and encouraged collaborative software development (Drake, 2017). There are records dating back to the 1950s, when software began to be distributed along with its unrestricted source code in specific groups such as SHARE and DECUS. Another fact that points to the emergence of free software is the US government's decision to ban the AT&T company from entering the software trade in 1956, which later led it to distribute its Unix freely in 1969 (CCSL, 2012).

From another perspective, other authors identify the emergence of free software from the work carried out by Richard Stallman in the 1980s and the founding of the FSF - Free Software Foundation - in 1985 by Stallman himself (Kuszka, 2013; Wikibooks, 2014). In 1983, Stallman created GNU - the project for a completely free operating system. There, he explains its principles and relates the emerging needs to create a new Unix and revive a global collaborative spirit of unrestricted freedom to visualize, edit and distribute software. Thus, the GNU project can be seen both as a response to the emergence of proprietary software and as a revival of the philosophy of collaboration and software development in free environments (CCSL, 2012, Drake, 2017).

Something important to note is that when technology companies understood that software should be separated from hardware for strategic reasons, around 1970, the trade in proprietary software licenses began (CCSL, 2012, Drake, 2017). One thing that many people end up forgetting about software development is how it should be licensed. The license determines how the source code can be accessed and distributed by end users, which impacts on the potential adoption of this or that technology. Most modern software is sold under a proprietary license that allows the publisher or creator to retain the intellectual property rights

of the software, which is seen as a restrictive factor in the potential growth dynamics of new technologies and innovations (Drake, 2017).

As you can see, the idea that users can view, edit and share the source code of programs without legal consequences is nothing new. Another point that should be noted concerns the so-called free software movement, also Stallman's idea (Drake, 2017). At the end of the 1980s, this movement gave rise to two philosophical strands called *free* and *open*. The first, based on the understanding of unrestricted freedom for users, but linked to the exclusive use of free software; the second, although it brings the original concept behind the free philosophy, understands that both free and proprietary models can coexist in harmony with the common goal of achieving the best possible quality from the openness of source codes (Evangelista, 2014).

The concept of free software: unrestricted freedom

When designing the free software label, Stallman did not foresee the conceptual confusion that would arise from the indiscriminate use of the concept for software that does not derive from the philosophy created by the FSF (Evangelista, 2014; Souza, Dias and Alfinito, 2014; Drake, 2017). The definition of free software includes four essential freedoms: (1) the unrestricted freedom to use the program as you see fit; (2) the freedom to study and edit the program, which presupposes access to the source code; (3) the freedom to redistribute copies, whether or not you charge; and (4) the freedom to distribute modified copies, whether or not you charge, which also presupposes access to the source code (Andrade and Ramos, 2013; Souza, Dias and Alfinito, 2014; Amorim, 2015; Drake, 2017; FSF, 2018).

In coining the term free, Stallman related the idea that users would be "free" to change and share the source code in any way they preferred (Drake, 2017). This is exactly what has caused confusion over the years about the relationship between freedom and gratuitousness, which are different things, although they can complement each other. These considerations allow us to recognize that free software is not synonymous with free or zero-cost (Amorim, 2015; FSF, 2018). As the FSF itself warns on this issue: when we talk about free software, it's best to avoid terms like "given away" or "for free", because these terms imply that the issue is price, not freedom (FSF, 2018).

The concept of free software is of great importance in the world of technology and computing, given the elements presented. Studies show that the largest companies around the world use free software because it is less susceptible to piracy (Garcia, Santos, Pereira and Rossi, 2010). A common paradigm in this market is how *open source* companies make money. The secret lies in its collaborative business model, where the software is created and approved by the community through testing, stability and support. This sells subscriptions, not licenses (Kuszka, 2013).

Authors such as Garcia, Santos, Pereira and Rossi (2010), Santos Jr (2010) and Souza, Dias and Alfinito (2014) point out that the use and development of free software has already reached both for-profit and non-profit companies, as well as large organizations in the ICT sector and governments. By opening up their internal boundaries to the outside world, these organizations that produce information technology are transforming proprietary software into free software by making the source code of these programs available (Santos Jr, 2010), making them available for the community to access, study, modify and redistribute, reflecting a series of disruptive innovations in structures and processes.

Free application software: it's not linux!

We know that for a computer to work, it needs an operating system - OS - that responds to its user's commands. It must interpret the actions and transform the data into

binary codes, which can then be processed by the machine. Also known as system software, it is an essential part of the computer's functional dynamics, either managing software or controlling hardware (Amorim, 2015; Vinhaes, 2015). Some examples of software that are characterized as system software include: OS (Linux, Windows, Mac OS), utility programs (for specific functions such as: disk scanning, backups, file compressors, antivirus, etc.), and middleware (acts in communication and data management for distributed applications such as: database, servers, messaging, web, transaction processing, etc.).

On the other hand, application software is a program that runs specific applications within the operating system, but is not linked to its operation. Examples of this type of software include Word, Excel, Paint, Notepad, and calculator. Other examples of application software include browsers, video games, databases and industrial automation systems (Amorim, 2015; Vinhaes, 2015). In other words, the function of application software is to help the user perform specific tasks, generally associated with processing data. This includes text, audio and video processing, where these tasks are dispensable for the operation of the machine, as they only depend on the user's voluntary decision to use or not use the application software.

The classification of software according to Vinhaes (2015) comprises: (1)proprietary systems: those that are paid for and whose source code is not freely available (Windows, Hp-ux, Mac Os); (2)free systems: those that are not paid for, but whose source code is also not freely accessible (Beos, various antivirus, Freeware); (3) *Open Source*systems: those whose source code is open (Unix), but cannot be modified; and, (4)free systems: those that are *Open Source*, and whose source code can be freely modified (GNU/Linux, Bsd). This reinforces the unrestricted access, modification and redistribution of free software, both systems and applications.

The free software movement: some peculiarities

The early 1980s were marked by the first standard structural projects in the direction of what was established, organizationally and conceptually, as free software. In the figure of Richard Stallman, credited as the founder of the free software movement, the GNU project began on September 27, 1983, with the aim of creating an operating program capable of running on any computer from a kernel with free and unrestricted access, which could be studied, replicated, modified, distributed and redistributed by physical and legal users. The first organized free software movement we know of was the founding of the FSF by Stallman on October 4, 1985 (CCSL, 2012; Wikipedia, 2018).

The term free software was coined by Stallman in 1984, through his open letter known as the GNU manifesto, which focused on presenting and defining the objectives of the GNU project and calling for the support and participation of the hacker community (CCSL, 2012; Wikipedia, 2018). A few years passed between the start of the project and its consolidation, which came with the construction of the first free kernel called Linux, created by Linus Torvalds and made available on December 21, 1991. The first stable version of the software was distributed in March 1994. The Linux kernel covered the lack of the GNU kernel and the first completely free operating system was finally ready: GNU/Linux (CCSL, 2012; Kuszka, 2013; Wikipedia, 2018).

Four years later, in 1998, a group led by Eric Raymond and Linus Torvalds, who were dissatisfied with the FSF's ideological stance - which was against the use of proprietary software - founded the *Open Source Initiative* - OSI. The OSI uses the term Open Source instead of Free Software to refer to the term free software, and has a less philosophical and more pragmatic ideological stance than the FSF, as it accepts the combination of proprietary software and free software as a source of innovation. In addition, they recreate the definition

of open source through 10 criteria that must be met to recognize software as open source (Kuszka, 2013; Wikipedia, 2018).

As far as most people are concerned, the difference in meaning between "free software" and "open source software" is insignificant and stems from a tiny difference in approach or philosophy. For the OSI, both terms mean the same thing and can be used and adapted in parallel in any context. For them, the difference in terminology is simply due to the need to update the concept and definitions surrounding the use of free software. However, for the FSF, the OSI does not fully convey the importance of the movement and the potential long-term ethical problems that can arise from the use of proprietary software, which restricts users' rights (Evangelista, 2014; Drake, 2017).

Whether a particular piece of software is free or open source depends on which license it uses and whether this is approved by the OSI, the FSF or both (Drake, 2017). The most widely used license is the General Public License - GPL, created by Stallman in 1989. The GPL has a rule that restricts the appropriation of modifications, so any changes made to the software become common among all those who share the program (CCSL, 2012; Kuszka, 2013; Evangelista, 2014). The concept of copyleft is based on compliance with the four freedoms stipulated by the FSF, which is the basis for the creation of the GPL. Copyleft says that anyone who distributes the software, with or without modifications, has to pass on the freedom to copy and modify the program again. It ensures that all users have freedom. In other words, if you have received a piece of software with a free license that includes copyleft clauses, and if you choose to redistribute it - modified or not, you will have to keep it under the same license with which you received it (Wikepedia, 2018).

Methodology

This research is of an applied nature, as it involves local truths and interests. Its aim is to identify and measure the use of free application software by both individuals (citizens) and legal entities (companies) in Brazil. It is descriptive in nature, as it seeks to observe, record, analyze, classify and interpret the occurrence of data without the interference of the researcher. Generally speaking, it uses a questionnaire to analyze the data collected. With regard to the procedures adopted, this study comprises: bibliographical research - materials that have already been published: books, technical and scientific articles, monographs, texts on the internet, etc.; documentary research - materials that have not been processed: newspaper reports, technical documents, research and business reports, statistical tables, etc.; and a sample survey - where, using statistical procedures, a sample has been selected that will be the subject of the investigation. (Prodanov and Freitas, 2013)

From the point of view of the approach, this empirical study comprises quantification and qualification, i.e. it encompasses quantitative and qualitative research to translate the data collected through the application of a questionnaire. Therefore, analysis tools from traditional statistics will be used - for questions 1 to 6 - and multilevel analysis tools, specifically Correspondence Analysis - for question 7. Correspondence Analysis (CA) is a technique used in contingency tables whose aim is to determine the degree of global association between its rows and columns, in order to identify how these variables are correlated. (Madeira, Lopes, Giampaoli and Silveira, 2011).

The aforementioned questionnaire was created using the free application known as Google Forms®, available on the virtual platform called G Suite®. As this is an integrated platform that can be accessed via a valid Gmail® account, the author logged in and created the questionnaire in his personal account, which was then sent to the respondents via a direct access link to the survey.

The sample comprised an estimated 1,423,786 potential respondents, including individuals and companies. The questionnaire was the data collection tool chosen to support this study, which was disseminated through the LinkedIn® and Facebook® social networks, as well as by sending a personalized email. Figure 1 summarizes the score achieved by applying the questionnaire and then disseminating the results.

Figure 1

Universe, sample, reliability and margin of error

| | | UNIVERSO | | | |
		LinkedIn	Facebook	e-mail	TOTAL
	Conexões	3442	361	150	1423786
	Grupos	1294691	125142		
	Visualizações	208			216
	Compartilhamentos	2	6		

	SIMULAÇÃO/AMOSTRA		AMOSTRA		
	Margem de erro	Necessária	Real	Efetiva	
Confiabilidade (90%)	4%	426	119	113	113
	5%	273			
	6%	190			
	7%	139			
			AMOSTRA: 113		
Confiabilidade (95%)	4%	600	Confiabilidade	Margem de erro	
	5%	385	90%	7,76%	
	6%	267	95%	9,22%	
	7%	196	99%	12,13%	

Figure 1 gives a detailed reading of the conditions presented by this study, providing an adequate estimate by means of a simulation previously adjusted before the questionnaire was administered. The universe refers to the potential number of respondents and the sample refers to their effectiveness. It is also possible to identify two relevant points: (1) The number of views and shares of the questionnaire represent a mere 0.0152% of the sample universe, which means a low response rate in the study. (2)The actual sample and the effective sample have a deviation of 5% due to the inconsistencies identified by 6 questionnaires. These problematic questionnaires were excluded from the sample.

The reliability of the sample brings with it a probability of margin of error proportional to its weight (confidence level), as shown in Figure 1 in its lower right margin. This means that if we want to achieve a 90% confidence level from the actual sample taken, our margin of error will be 7.76p.p (percentage points). In this example, the percentage will vary between plus or minus 3.38p.p. Note that the margin of error increases according to the desired confidence level. If we want to obtain the maximum level of confidence supported by traditional statistics, i.e. 99%, this sample will reflect a margin of error of 12.13%. In other words, 5.57p.p more or less.

Moving on, we have Figure 2. The questionnaire was administered in two phases: (1) In the first, it was considered to leave it open for voluntary participation from 17/02/19 to 24/02/2019. During this period, the campaign to promote the survey was limited to the standard daily post on social networks and the sending of 50 emails. Only 47 respondents took part. (2)Due to the low participation in the survey, it was decided to reopen it for another 4 days, from 25/02/19 to 28/02/19. A more active campaign was carried out, with exclusive posts (no longer standardized) on social networks and via email. It was found that participation increased to 119, i.e. 53.2% more in half the time used in the first application period. In this case, the survey was open for 12 consecutive days.

Figure 2
Questionnaire application schedule

	DATA	Participação	TOTAL
1ª FASE	17/2/2019	6	
	18/2/2019	5	
	19/2/2019	4	
	20/2/2019	2	47
	21/2/2019	5	
	22/2/2019	8	
	23/2/2019	8	
	24/2/2019	9	
2ª FASE	25/2/2019	10	
	26/2/2019	20	72
	27/2/2019	25	
	28/2/2019	17	
			119

It is important to note that there was no pre-survey, i.e. no prior test to assess the reception and interpretation of the questions in the questionnaire by potential respondents. This is an important process for both traditional and virtual surveys, as it allows information to be gathered about the objectives, aspects covered, confidentiality; as well as the form's graphics, format, question wording, etc. (Freitas, Janissek-Muniz and Moscarola, 2004). This point became clear when it was realized that in the first phase of the questionnaire, 10.64% of the forms showed inconsistencies and were therefore excluded. In the second phase, only 1.39% of the questionnaires showed contradictions, which also led to their exclusion. However, the impact was much less when the two phases are compared. This substantial drop was the result of minor adjustments to the presentation and some of the questions in the questionnaire, as well as dissemination to more specific audiences, as will become clearer in the results of this survey.

Results

The questionnaire was made up of 7 quantitative and qualitative questions, with closed and open questions. For all the questions, traditional positivist statistics were used, except for question 7, which was subjected to multilevel analysis using the AC technique already described - for reasons of space and purpose, the technique itself will not be demonstrated, only the results and their corresponding analysis.

The questionnaire gave a brief introduction to the topic and objective proposed by this study, summarizing and exemplifying the concept of free software and reinforcing the importance of understanding it before answering the proposed questions. This was deemed necessary because the target audience was diverse, not restricted to the ICT sector - Information and Communication Technologies - but encompassing the whole world.

Although no pre-survey was adopted, care was taken to make the questions as clear and straightforward as possible so as to enable the lay public in particular to understand them better with less noise and interpretative distortions. As has already been pointed out, the second phase of implementing the research performed better than the first, precisely because of the continuous search to improve the text and the dissemination of the content.

The questionnaire resulted in 113 actual respondents - already described in Figure 1 - divided into 34 companies and 79 individuals, of different ages, professions and branches of

activity. Moving on to the analysis itself, it will be divided into two subchapters: (1) Subchapter 4.1 - which will deal with the analysis from the perspective of descriptive statistics; and (2) Subchapter 4.2 - which will deal with the analysis from the perspective of multilevel statistics.

Descriptive Statistical Analysis

Descriptive statistics will be used to analyze questions 1 to 6. It consists of traditional statistical methods based on positivist thinking of linearity (reductionism) and systematization (holistic) to organize, summarize and describe the important aspects of a set of data or compare them between two or more sets. These descriptive tools include various types of graphs, tables and summary measures such as percentages, indices and averages. (Reis and Reis, 2002; Mariotti, 2017)

Question 1: Are you (or do you represent)?

The first question aimed to identify the respondent, whether they were an individual or a legal entity. As a result, the proportionality between the participants in this study emerged as shown in Figure 3.

Figure 3
Representativeness of respondents
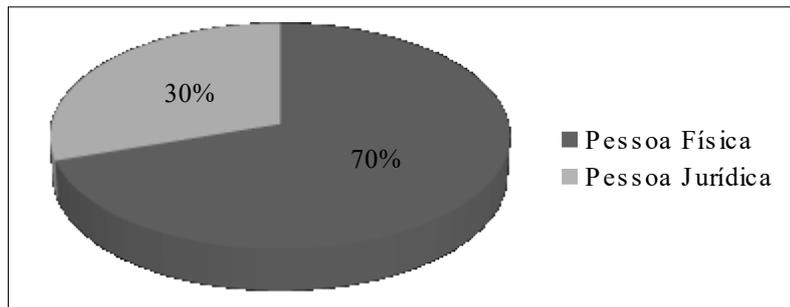

Figure 3 shows the following: 34 legal entities and 79 individuals took part, which quantitatively corresponds to 30.09% and 69.91% respectively.

Question 2: How old are you (If a company, how long have you been in business)?

The second question asked about the respondent's age - if an individual - or length of time in the market - if a legal entity - as shown in Figures 4 and 5 below.

Figure 4
Length of time in the Legal Entities (companies) market
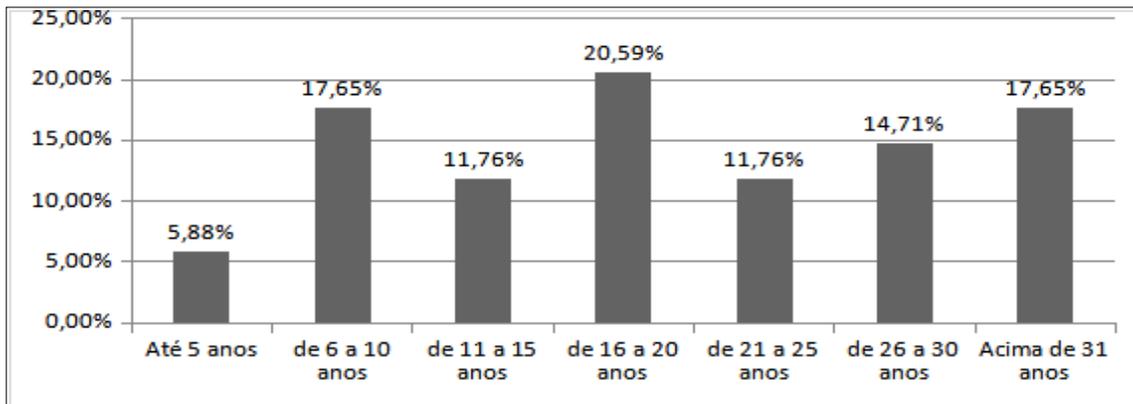
Figure 5
Age of Individuals (Citizens)
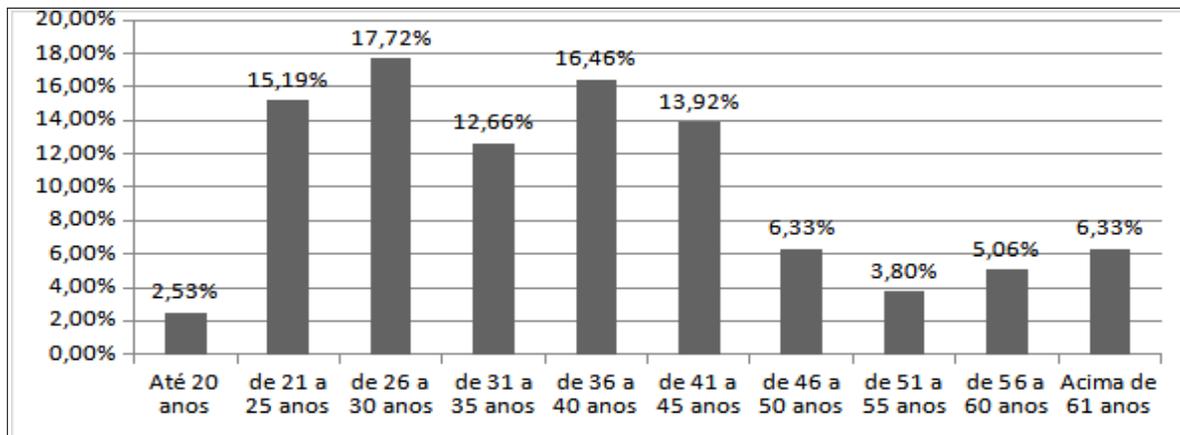
Figure 4 - corresponding to legal entities - shows that the majority of the companies interviewed have been operating in the market for over 6 years (94.12% or 32 companies), with the largest proportion concentrated in the 16 to 20 years range (20.59% or 7 companies).

According to recent technical reports by Sebrae[1] (2016) and IBGE[2] (2017), the first two to five years of business are a watershed between failure and survival for Brazilian companies in general. This reinforces the invaluable value of being able to count on respondents - legal entities - with such business experience, something that can bring greater support to the decision to use or disuse free application software.

Relating to Figure 5, we have individuals. It shows that the highest concentration of respondents is in the 26 to 30 age group (17.72% or 14 people). It can also be seen that the age groups between 21 and 45 account for 75.95% (or 60 people) of the total. In contrast, only 2.53% of respondents were up to 20 years old (or 2 people).

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[1] According to the report, the survival rate of companies (excluding MEIs) is 58%, when considering the first two years of activity. For more information visit: https://datasebrae.com.br/wp-content/uploads/2017/04/ Survival of Companies in Brazil-2016-FINAL.pdf.

[2] This technical report found that, after 5 years, the survival rate of companies is 57.8% (workforce of up to 10 people) and 67.1% (workforce of over 10 people). For more information visit: https://biblioteca.ibge.gov.br/visualizacao/livros /liv101151.pdf.

Question 3: What is your profession (if you are an individual) or sector of activity (if you are a legal entity)?

The third question asked about profession - if an individual - or sector of activity - if a legal entity. The aim was to identify the scope - whether specific or diversified - of the use or disuse of free application software.

Figure 6
Profession - Individual
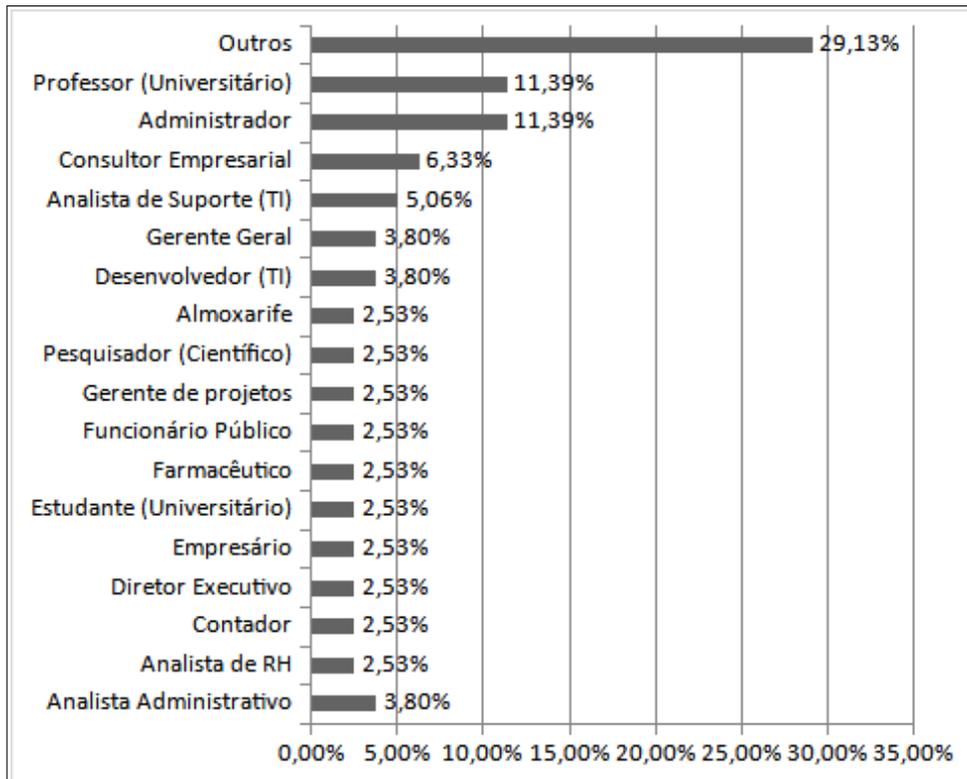
Figure 6 elucidates the diversity of the public served by this research, including knowledge workers and operational workers, as well as decision-makers (such as entrepreneurs, directors and administrators, for example). There are two major concentrations here: (a)Other, refers to those declared trades that amounted to only 1.27% of the total activities surveyed. Some of these are: international relations, musician, oil rig operator, editor, economist, office assistant, architect, etc. As they didn't reach 2.53% - the minimum percentage established - they were allocated to a single identifier; and, (b) University professors and administrators correspond to 22.78% (or 18 professionals) of the total, i.e. they concentrate the majority of the occupations declared.

Figure 7
Sector of activity - Legal entity
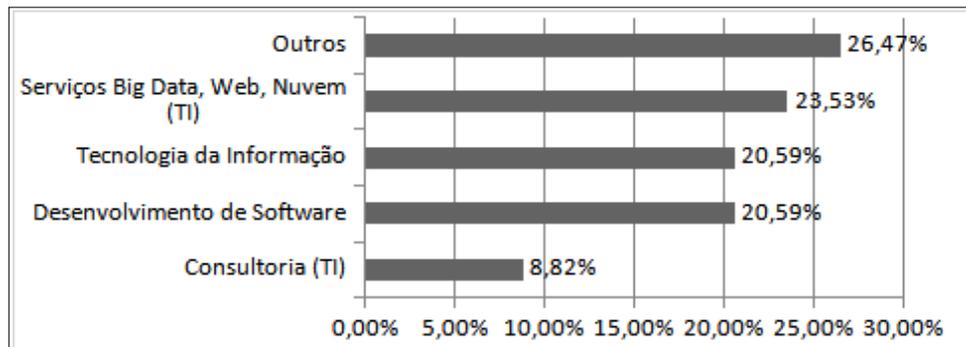
Figure 7, with reference to legal entities, shows a large concentration of respondents in the Information Technology (IT) sector - 73.53% or 25 companies. This reinforces the possibility that this survey will provide results that adhere to the reality of Brazilian business, given that the respondents from this sector are, in principle, more technical and have a higher level of experience in relation to the different technologies and their potential advantages and disadvantages in terms of their use.

Question 4: Do you or have you ever used free application software?

The fourth question looked at whether or not people and companies currently use free application software, as shown in Figure 8.

Figure 8
Use of free application software by legal entities
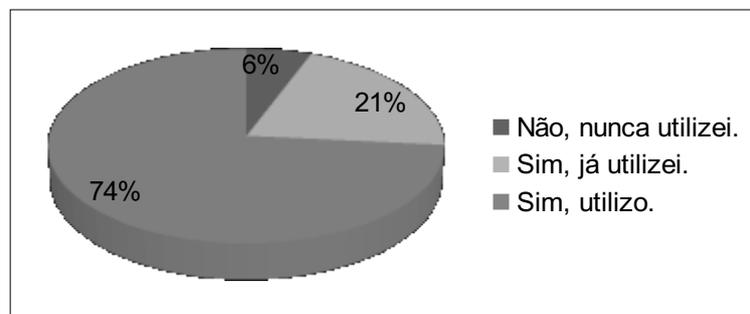
Figure 8 shows a large turnout of companies that said they currently use free software in their work activities (73.53% or 25 companies). The other companies said they had already used it at some point (20.59% or 7 companies) or had never used it in their routine activities (5.88% or 2 companies).

Figure 9

Use of free application software by individuals
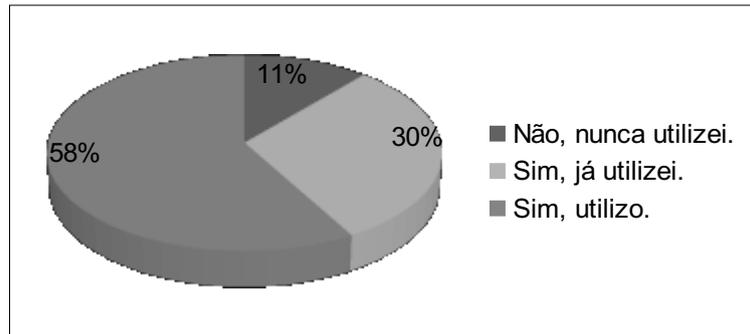
Figure 9, on the other hand, on the use of free application software by people, shows a clustering of those who said they used it routinely (58.23% or 46 people). On the other hand, 30.38% - or 24 people - said they had used it at some point, while 11.39% - or 9 people - said they had never used it.

At this point, two things should be highlighted: (a)When companies and individuals are compared, it can be seen that the former proportionally use free application software more (15.3% more use); and, (b)Similarly, when evaluating the disuse of these programs, companies appear more inclined to use them than individuals (5.51% less disuse).

It is also important to note that the questionnaire contained a brief introduction justifying the purpose of the research, its objectives, its focus and its relevance. This presentation highlighted the concept of free application software, reinforcing the FSF (*Free Software Foundation*) concept cited by Amorim (2015) on the term and emphasizing that free software is not synonymous with free. This was necessary because the audience investigated, as already mentioned, was diverse and the possible difficulties in interpreting the proposed topic were taken into account.

Question 5: Which free software programs do you use or have you ever used?

The fifth question asked which free software program(s) companies and individuals use or have used, according to Figure 10. It's important to note that the question offered the respondent previous options to choose from, including productivity programs, file readers, audio and video editors, image editors, internet browsers, content managers, servers, databases and development tools. In addition to the "never used" and "other" options. It was possible for the respondent to select more than one choice.

Figure 10 - for legal entities - illustrates the enormous popularity of the Mozilla Firefox web browser (94.12% or 32 companies); the MySQL database and the WordPress content manager (64.71% for both or 22 companies); the LibreOffice office suite (61.76% or 21 companies); the Apache server (58.82% or 20 companies); and the VLC audio and video editor (52.94% or 18 companies).

Figure 10
Free software programs used by legal entities
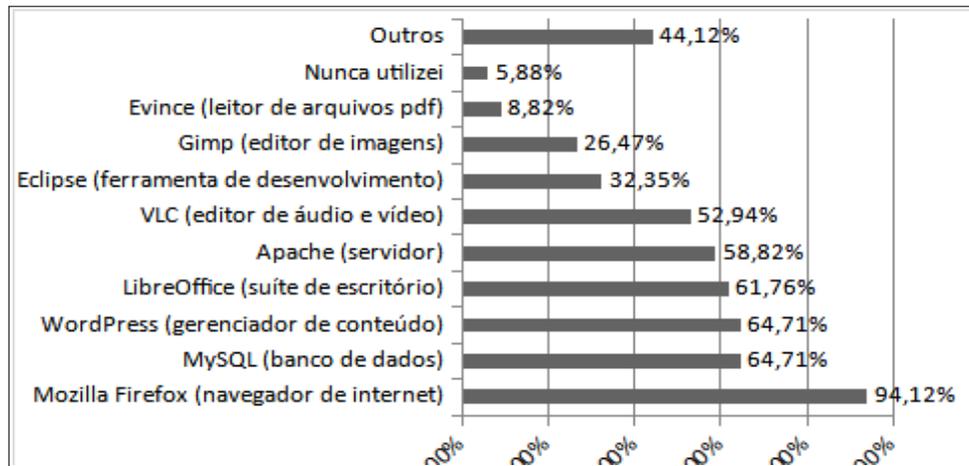
Not so popular or common for the rest of the companies are the development tool Eclipse (32.35% or 11 companies); the image editor Gimp (26.47% or 9 companies); and the pdf file reader Evince (8.82% or 3 companies). Those who said they had not used any free application programs amounted to 5.88% (or 2 companies). Those that reported using other free application programs accounted for 44.12% (or 15 companies).

With regard to the latter, it was not considered relevant to list the other free software programs highlighted by the respondents, since these choices either do not correlate with the nomenclature or do not fit the definition of free application software because they are system software (in the latter case, the answers that did not fit the concept of free application software were not counted).

Figure 11
Free software programs used by individuals
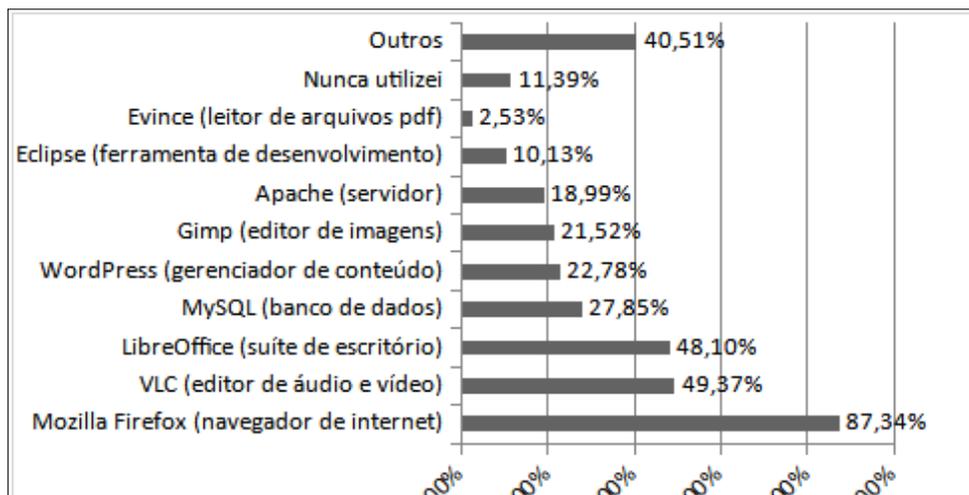
Figure 11 - for individuals - shows the most popular free software application programs to be: the Mozilla Firefox internet browser (87.34% or 69 people); the VLC audio and video editor (49.37% or 39 people); and the LibreOficce office suite (48.10% or 38

people). Compared to legal entities, even the most popular programs are used to a lesser extent by individuals.

Among the least popular or little used programs by individuals are: the MySQL database (27.85% or 22 people); the WordPress content manager (22.78% or 18 people); the Gimp image editor (21.52% or 17 people); the Apache server (18.99% or 15 people); the Eclipse development tool (10.13% or 8 people); and the Evince pdf file reader (2.53% or 2 people).

On the other hand, those who said they had never used a free application program amounted to 11.39% (or 9 people). Those who reported using other free application programs accounted for 40.51% (or 32 people). Likewise, we chose not to detail the other programs listed by respondents under the "other" option, since there were no significant number of programs with the same nomenclature registered. Likewise, programs that were not related to the concept of this study were excluded.

Question 6: Why do you use or have you used Free Application Software compared to Proprietary Application Software? (You can select more than one alternative)

The sixth question related the usefulness of free application software for both individuals and companies. Again, fixed propositions were established, in addition to the options "other" and "never used/not applicable". The choice of the list of pre-established "justifications" was built according to information sought from various sources on the internet about the use of free software, specifically discussion forums on blog pages and websites on topics related to this research.

Figure 12 illustrates the main reasons why companies choose to use free application software. The main explanation lies in its cost-effectiveness, something that reaffirms the consensus generated by experts and various publications on the proposed topic. What is interesting, both from the business point of view and from the citizen's point of view - see Figure 13 - is that this consensus is aligned with the understanding that free application software competes with proprietary software almost exclusively through acquisition and maintenance costs, something that can be seen in Figure 14.

Figure 12
Reasons for the use of free application software by Legal Entities
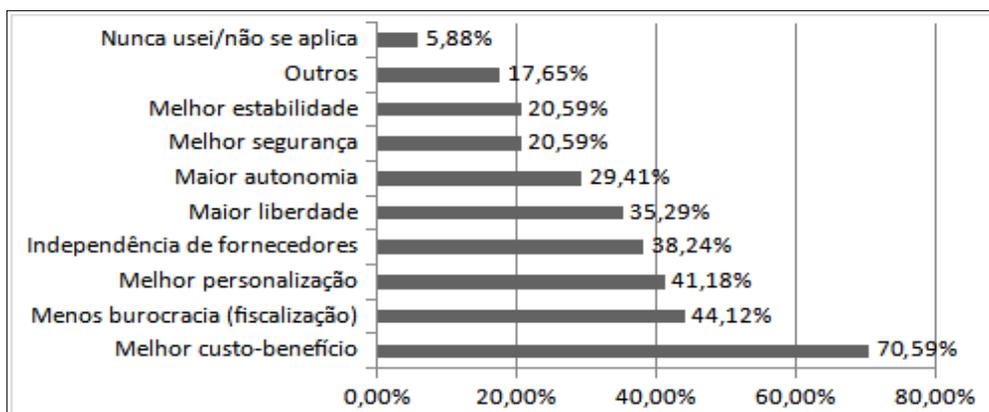
This understanding is corroborated by Melo and Carvalho (2013), when the authors state that free software has been incorporated into socio-educational inclusion projects for various reasons, the most superficial of which is related to economics, as maintenance costs

using this software are much lower when compared to proprietary software. Free software is compatible with machines that are considered obsolete, increasing their useful life cycle, reducing the costs of buying new equipment and reducing the amount of electronic waste to be disposed of, thus also acting on socio-environmental issues.

Another highlight of this choice is that the philosophical understanding of the concept of free software is exercised more by individuals than by legal entities. The latter associate the use of free application software with gratuitousness, something that has already been described as diverging from the concept of free software (Amorim 2015; Ansol, n.d.; FSF, 2018). This becomes clearer when comparing Figures 14 and 15.

In Figure 12, the rest of the choices follow the following order of preference: less bureaucracy (44.12% or 15 companies); better customization (41.18% or 14 companies); independence from suppliers (38.24% or 13 companies); greater freedom (35.29% or 12 companies); greater autonomy (29.41% or 10 companies); better security (20.59% or 7 companies); and, better stability (20.59% or 7 companies). Those companies that listed other various reasons accounted for 17.65% (or 6 companies) and those that said they had never used free application software accounted for 5.88% (or 2 companies).

Figure 13

Reasons for the use of free application software by individuals
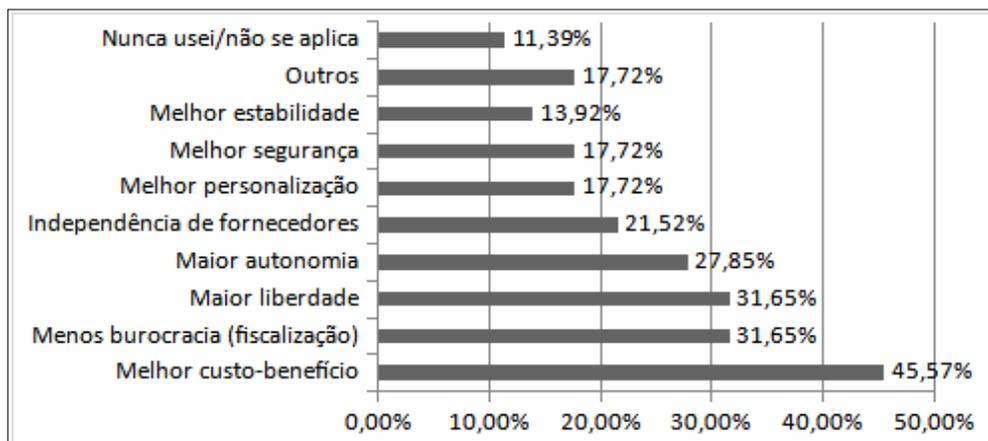
Figure 13, concerning the use of free application software by individuals, provides some similarities with Figure 12. The elements of better stability (13.92% or 11 people) and better security (17.72% or 14 people) are the least requested by both individual and corporate respondents - while the elements of better cost-benefit and less bureaucracy are the most requested by both.

Multilevel Statistical Analysis

Multilevel statistics will be used to analyze question 7. It is the basis of Morinian complex thinking, which is an alternative to positivism because it addresses totality, covering the complementarity and transactionality between linear (reductionist) and holistic (systemic) conceptions, which are the basis of positivist thinking in traditional science (Mariotti, 2017). Complex thinking has a much greater capacity than systems thinking to understand complex phenomena and processes (Dimitrov, 2018), and is deemed suitable for analyzing issue 7 as complex.

Question 7: Justify the previous question (give a little more detail on your choices)

The seventh question was actually a sequel to the previous question, as it asked the respondent - both individuals and companies - to justify all of their choices. As this is an open-ended, long-answer question, Quantitative Propositional Analysis (QPA) was used here, with Correspondence Analysis (CA) as the analytical technique - described in Chapter 3.

As already explained, the APQ and CA methods used to construct Figures 14 and 15 will not be detailed here, as they would be beyond the scope of this study, as well as going beyond the spatial limits of the text. However, it is possible to summarize the following path for measuring the explicit data shown in Figures 14 and 15: the texts (justifications) went through 3 processes - summarization, textual segmentation into propositions and grouping of propositions by theme. This data was tabulated and sorted in an Excel® spreadsheet, where the frequency of each theme (element) addressed was checked. This frequency generated a percentage scale which is illustrated in Figures 14 and 15.

Figure 14
Justifications for use or disuse of free application software by Legal Entities
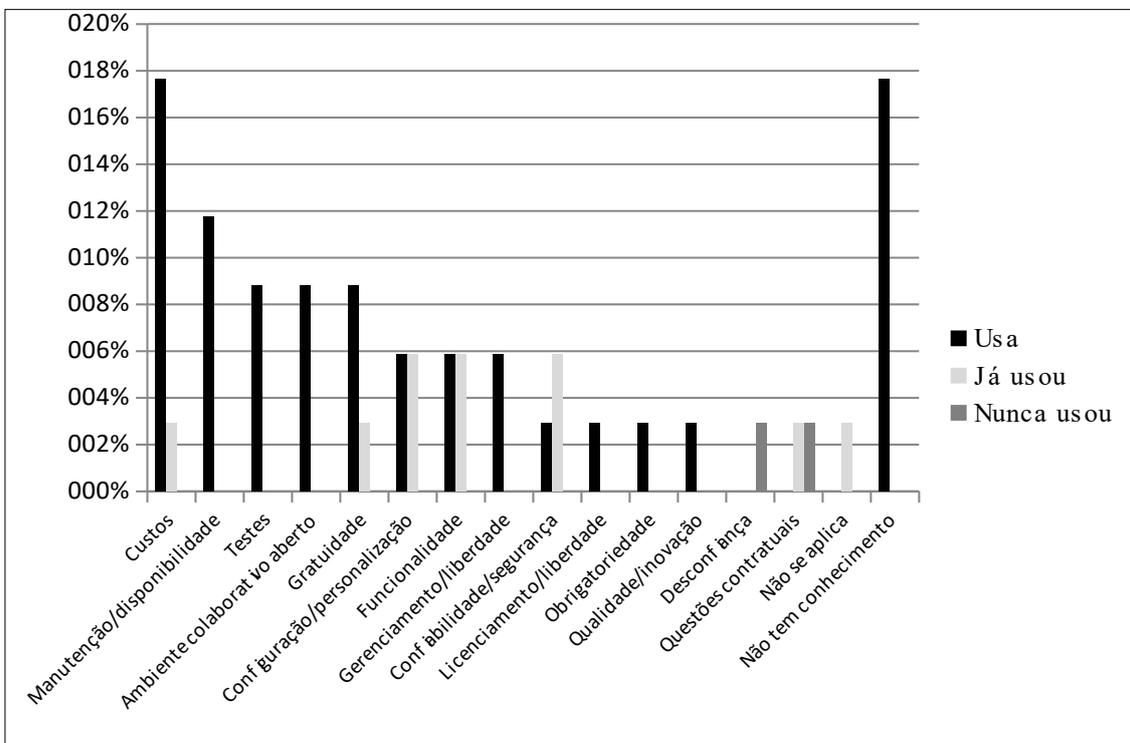
Figure 14 - concerning the justifications for the use or disuse of free application software by legal entities - shows something interesting: the alternatives "no in-depth knowledge" and "not applicable" represent 17.65% (or 6 companies) and 2.94% (or 1 company) respectively. If we relate this information to the data in Figures 8, 10 and 12 (where the information is identical for 5.88% or 2 companies), we can identify an imbalance with regard to the rational choice for the use or disuse of free software programs by companies. This is confirmed when we compare the alternatives "no in-depth knowledge" (17.65%) with "never used" (5.88%).

This means that some of the business respondents use free application software, unaware of its technical and/or philosophical potential. Perhaps this explains why "free" reached a significant level of 11.76% (or 4 companies). Comparing the choices, for

individuals - Figure 15 - this percentage reaches 3.80% (or 3 people), i.e. about 3 times less incidence.

Moving on to the business justifications for using free application software, we have: maintenance/availability (11.76% or 4 companies); testing (8.82% or 3 companies); open collaborative environment (8.82% or 3 companies); configuration/customization (11.76% or 4 companies); functionality (11.76% or 4 companies); management/freedom (5.88% or 2 companies); and; reliability/security (8.82% or 3 companies). The other justifications were not addressed by more than one company.

Among the reasons for companies not using free application software are those related to contractual issues (5.88% or 2 companies) and mistrust (2.88% or 1 company). With regard to the first alternative, the respondents reported having partnerships with proprietary software suppliers.

Figure 15

Justification for use or disuse of free application software by Individuals
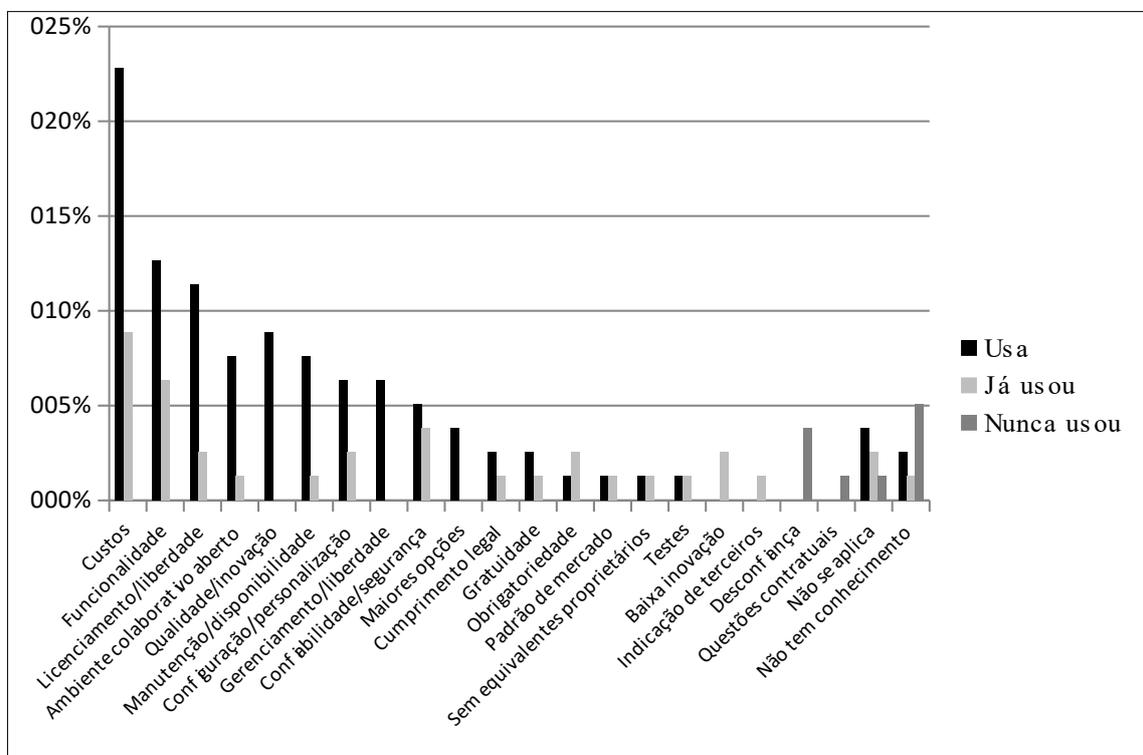
Figure 15 - on the motivations for individuals to use or disuse free application software - shows the following: the alternatives "no in-depth knowledge" and "not applicable" represent 8.86% (or 7 people) and 7.59% (or 6 people). Likewise, by relating this information to the data in Figures 9, 11 and 13 (where the information is identical for 11.39% or 9 people), we can identify a more rational choice process regarding the use or disuse of free software programs by people. This is confirmed when we compare the alternatives "no in-depth knowledge" (8.86%) with "never used" (11.39%).

Following the analysis in Figure 15 we have: functionality (18.99% or 15 people); licensing/freedom (13.92% or 11 people); open collaborative environment (8.86% or 7 people); quality/innovation (8.86% or 7 people); maintenance/availability (8.86% or 7 people); configuration/customization (8.86% or 7 people); management/freedom (6.33% or 5 people); reliability/security (8.86% or 7 people); greater options (3.80% or 3 people); legal

compliance (3.80% or 3 people); and, obligation (3.80% or 3 people); The other justifications were not suggested by more than 2 people.

The reasons for not using free application software were: distrust (3.80% or 3 people) and contractual issues (1.27% or 1 person). With regard to the first alternative, respondents stated that, when compared to proprietary software, most equivalent free software is inferior in technical and functional terms, as well as having poor or non-existent documentation.

Discussion and conclusions

The use of new technologies by companies and individuals is more than a trend and is already meeting the most emerging needs for efficiency and effectiveness, in other words, we are increasingly seeking to do more with less. And this is exactly what technologies can offer, in a market that is evolving in dynamics, speed and complexity and where people need to make critical decisions on an even shorter time scale. For companies in particular, reducing costs without jeopardizing their long-term growth can be a decisive factor in remaining competitive, just as much as the budget can be a limiting factor in the reality of many businesses.

Knowing that the acquisition and maintenance of proprietary software can be a costly investment for many companies of various sizes and sectors, free software can be an excellent alternative to enable business continuity based on a free technology that offers freedom as its main sustainable characteristic. It has been widely discussed in this study that free software is not synonymous with free (Garcia, Santos, Pereira and Rossi, 2010; Andrade and Ramos, 2013; Evangelista, 2014; Souza, Dias and Alfinito, 2014; Amorim, 2015; Drake, 2017; FSF, 2018). In addition, it was found that in order for software to be called free, it must comply with four basic freedoms: study, modify, distribute and redistribute. Therefore, open source is an essential requirement and the license of use must comply with the copyleft terms.

Given this context, the aim of this research was to identify and measure the use of free application software by both individuals and companies in Brazil. A descriptive survey was carried out using an electronic questionnaire. Thirty-four companies and 79 people of various occupations, industries and ages took part in the survey. The data collected was processed using descriptive and multilevel statistics. The sample was drawn from social networks such as LinkedIn® and Facebook®, as well as emails. The participation of respondents reached a level of 7.76% to 12.13% margin of error for a reliability that varied, respectively, from 90% to 99%.

The questionnaire was administered in two phases: (1) In the first, the response rate was 47 respondents in 8 days; in the second, there was a significant increase in participation to 72 respondents in 4 days. In other words, there was an increase of 53.2% compared to the number of respondents in the first phase. Taking the two phases together, 119 respondents participated voluntarily, but due to inconsistencies in the answers to some questionnaires, it was decided to exclude 6 of them. Therefore, the real count was 113 questionnaires actually answered.

Moving on to the results of the survey, the following was identified: (a)7 out of 10 respondents were individuals; (b)94.12% of the companies had been operating for more than 6 years, with 64.71% having been in business for more than 16 years; 75.95% of the people were aged between 21 and 45, with 64.56% aged 31 or over; (c)73.53% of the companies were in the IT sector, and 22.78% of the people were university professors or bachelors in business administration; (d)73.53% of the companies and 58.23% of the people said they used free software in their daily work and leisure; (e)the Mozilla Firefox internet browser was the free application software most remembered by 94.12% of the companies and 87.34% of the

people; (f) the cost-benefit ratio when using free application software was the factor identified most by 70.59% of companies and 45.57% of people, while the term stability was only mentioned by 20.59% of companies and 13.92% of people; (g) with regard to the justification for the choices made, cost was the predominant factor for 20.59% of companies and 31.65% of people, and with regard to testing free software, 8.82% of companies said they tried it, while only 2.53% of people did so; (h) the free element was a decisive factor for 11.76% of companies and 3.8% of people; and, (i) there is a counterpoint between the rational use and random use of free software by individuals which is not identified by legal entities. The justification "no knowledge" is 11.78% higher than the motivation "not applicable or never used".

The results of this survey lead to the conclusion that free application software is part of the routine of the vast majority of companies and individuals interviewed; that both know and use the best-known and most popular free application programs; that the cost-benefit and cost elements are the most related as justifications for the use of free application software by legal entities and individuals; and that gratuitousness is the deviating element in the rational use/random use relationship for legal entities, something that is not verified in the individual respondents.

This survey achieved its objective by illustrating and measuring the use of free application software by companies and individuals, characterizing them and detailing their preferences and motivations for using these programs. In addition, it showed positive correlations in the use of free applications by companies and individuals, especially with regard to the factor that determines their use. It also identified that the preference for free application software encompasses a diversity of solutions in application programs for the most varied uses and specific needs, such as an office suite, file reader, audio and video editor, image editor, internet browser, content manager, server, database, development tools, among others.

Therefore, this study has made it possible to recognize the importance of free application software for companies and people, highlighting its relevance in everyday work and leisure life. Future research could focus on issues related to the philosophy and politics of free software movements and their relationship to use by companies and individuals, for example. This would be extremely important if we were to understand whether and to what degree people choose this software because of some political/philosophical link.

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HOLISTIC MODEL FOR TECHNOLOGICAL INNOVATION IN SMALL BUSINESSES IN PANAMA

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Abstract. The main mover to conduct this research was the urgent need to give answer to the inadequate level of automation and technological innovation in small companies in Panama. This issue is of great relevance in the country, as it is part of the efforts to remain competitive in both the local and global environment. The approach of the research is explanatory, since it concentrates on identifying the cause of the problem, and so tackle it with the proposed solution. After an extensive literature review on the subject, state of the art, diagnostics and data analysis, the focus was on exponential technologies, which offer the greatest potential to achieve a more sustainable solution over time. The results primarily show weaknesses in relation to digital literacy and skills. Due to the urgency to solve the problem, and considering the existing gaps, the proposal focuses on cloud-based packaged solutions, which can provide all the necessary elements to offer a solution to the problem. All this should be paired with a training plan to get the most out of the proposal, and allow the small companies to be more competitive.

Keywords: SaaS, Packaged software, Ecommerce, digital literacy, small enterprises.

MODELO HOLÍSTICO PARA LA INNOVACIÓN TECNOLÓGICA EN LA PEQUEÑA EMPRESA EN PANAMÁ

Resumen. Se decidió realizar esta investigación, para intentar resolver una problemática muy actual y muy real, y a la vez urgente, en relación a la innovación tecnológica y nivel de automatización en las pequeñas empresas en Panamá. Este tema es de gran relevancia en el país, al formar parte de los esfuerzos para mantenerse competitivos en el entorno tanto local como global. El enfoque de la investigación es explicativo, pues se concentra en identificar la raíz o causa del problema, para entonces así, atacarlo con la propuesta de solución ofrecida. Luego de una extensa revisión bibliográfica en torno al tema, estado del arte, análisis de datos y diagnósticos, el enfoque estuvo en las tecnologías exponenciales, por ofrecer el mayor potencial de lograr una solución más sostenible en el tiempo. Los resultados principalmente arrojan debilidades en relación a conocimientos de alfabetización digital y competencias digitales. Debido a la urgencia para dar solución a la problemática, y tomando en cuenta los vacíos

existentes, la propuesta se enfoca en soluciones empaquetadas en la nube informática, que provean de todos los elementos necesarios para dar respuesta a la problemática. Todo esto deberá ir acompañado de un plan de capacitación para sacarle el mayor provecho, y situar a la pequeña empresa en un lugar de mayor competitividad.

Palabras clave: SaaS, Software empaquetado, e-commerce, alfabetización digital, pequeña empresa.

Introduction

There is a need for digital transformation, not only at the global level, but especially at the regional and local level in the Republic of Panama. It is a reality that companies are competing globally, so it is necessary to innovate in order to prosper and grow. This has been a known fact for several years, and continues to increase; especially marked by the current circumstances due to the Covid-19 pandemic.

Small businesses are key in the development-generating transformation of a country, as shown by figures from the study developed by the Economic Commission for Latin America and the Caribbean (ECLAC) in 2020 (Dini & Stumpo, 2020). However, they have not yet managed to accelerate their innovation process; they continue to operate with obsolete technology or manual processes and contribute only 25% of GDP. Most small companies do not have the resources to develop technologically and achieve the required and desired competitiveness.

Innovation today is not a luxury; it is a necessity. It is no longer a question of reaching the technological level where we should be, but rather, that this be achieved in a sustainable and adaptable way to the changes to come.

All this has been the motivation to try to fill the existing gap, being the first question: "what causes the low adoption of information technologies in small businesses in Panama?". In addition, being aware of the limitations of small businesses in terms of resources and knowledge to cope with the situation, it is necessary to seek or design solutions that are closer and more accessible to them. Technology today offers options never before envisioned, which promise possible solutions to the problem (*Future Today Institute's 2021 Tech Trend Report - Artificial Intelligence (AI) | World Bank Group*, n.d.).

On the other hand, this scenario does not only imply challenges in terms of digital transformation. It also entails important changes related to the human capital of organizations. The challenge lies in the training of people. It is necessary to promote education policies that allow for comprehensive training so that small and medium-sized companies can compete adequately in this area. (*Latin America, Fertile Ground For Ecommerce - Forbes Colombia*, n.d.) (Vargas-Ortiz et al., 2019).

So far, the problem has been identified, but no solutions have been developed at the practical or research level, in a manner similar to that offered in this study. So far, there is data on how much automation exists in small companies, general guidelines are offered, but no alternatives are provided to turn ideas into concrete actions to solve the problem. (National Competitiveness Center, 2021b), (Fundación País Digital & Inter-American Development Bank (IDB), 2020). A summary of the identified causes of the problem is shown in Figure 1.

Figure 1

Ishikawa diagram showing the main causes of low technology adoption in the sector under study
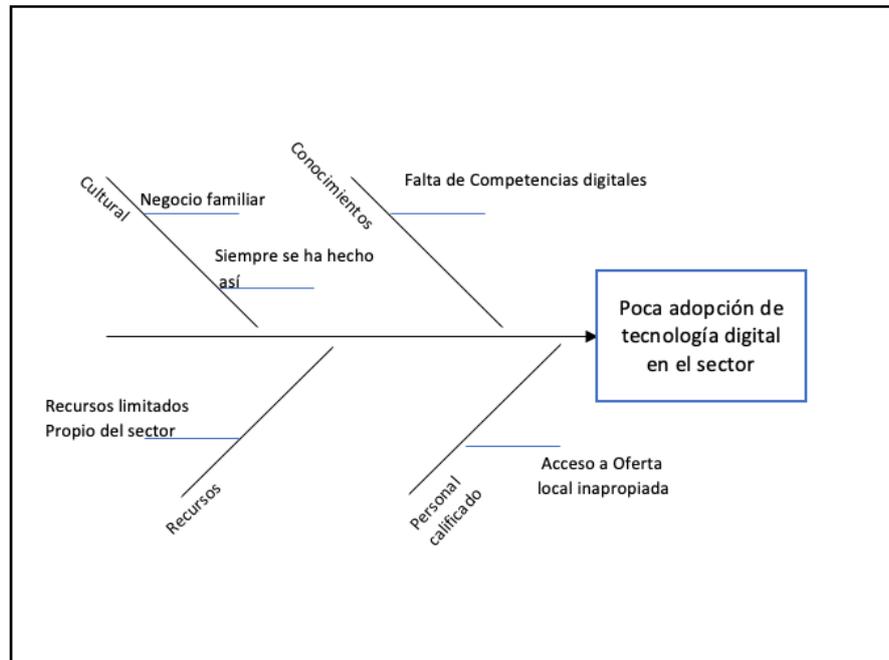
Note. Own elaboration with data from Socioeconomic Impact Study, UNPYME.

Using the need for technological improvement as a spearhead, a proposal is presented through a holistic approach, which takes into account digital technology, but not in isolation or independently, but as part of a whole that also includes business strategy and digital competence. It is committed to emerging or exponential technologies, to achieve the adoption of technology and digital business models, in an accessible and viable way.

Once the research question was formulated, the hypotheses that attempt to answer it have been:

- The complexity and difficulty of the development and implementation of IT solutions
- Little knowledge of the subject
- Little interest in the subject
- Cost

As stated by (Manuel & Lovelle, n.d.) complexity is inherent in the development and implementation of solutions and/or software applications, which hinders the adoption of digital technology. This complexity derives from four elements: (Booch, cited by Manuel & Lovelle, n.d.).

- The complexity of the problem domain
- The difficulty of managing the development process
- The detail that can be achieved through the software
- The problem of characterizing the behavior of discrete systems

This value, the level of interest and knowledge of the subject in the study sector were analyzed in order to develop a model that attempts to respond to the problem.

After defining the subject and the problem, the general and specific objectives of the study were defined.

General Objective

Designing a holistic model for the adoption of technology and e-commerce in small businesses in Panama".

To achieve this objective, it was necessary to carry out intermediate steps to test the proposed hypotheses. These intermediate steps then become the specific objectives of the study:

Specific Objectives

- Elaborate a local diagnosis of the degree of automation of the study's target population
- Elaborate a local diagnosis of the reasons for the non-adoption of information technologies and/or e-commerce
- Demonstrate and project the benefits of e-commerce and information technology adoption through analysis of actual data from standardized surveys
- Substantiate the benefits and urgency of adopting emerging information technologies
- Delineate a digital culture teaching plan for the study's target population
    Table 1 shows how the hypotheses are related to the general objective and
    Table **2** summarizes the reasons and contributions of the different specific objectives. Both tables show how the research question, general and specific objectives and hypotheses are related.

Table 1
Relationship between the research question, the hypotheses they attempt to answer, and the overall objective

Research Question	Hypothesis	General Objective
What causes the low adoption of information technologies in small companies in Panama?	H1. The complexity of the process H2. Lack of knowledge H3. The lack of interest H4. Cost	Design a holistic model for the adoption of technology and e-commerce in small businesses in Panama

Table 2
Relationship between general and specific objectives, the hypotheses, the reason for the specific objective, and the contribution to the study

General Objective	Specific objectives	Reason for seeking target	Result contributed to the study
Design a holistic model for the adoption of technology and e-commerce in small businesses in Panama	SO1. Elaborate local diagnosis of the degree of automation	Verify that there is indeed little automation in the sector	The research question is tested and answered
	SO2. Elaborate a diagnosis of the reasons for non-adoption	Test the hypotheses for non-adoption of technology in the sector	The hypothesis is tested through field work
	SO3. Demonstrate adoption benefits	Substantiate why it is beneficial	Support for proposal development
	SO4. Supporting the adoption of emerging technologies	Substantiate why the use of emerging technologies is necessary	Support for proposal development
	SO5. Delineating a teaching plan for digital competencies	Necessary to get the most out of automation	Plan aligned to the general objective that seeks to achieve SO5

The sector under study, presents a number of needs and gaps in relation to the adoption of digital technology, e-commerce, business strategy issues, and other topics, as explained in the previous paragraphs. Table 3 summarizes these main shortcomings, with the proposed solution, leading to the presentation of the model.

Table 3

Summary of gaps and needs of the sector of study in relation to the adoption of digital technologies

Identified gap	Proposal to fill a gap
Little knowledge	Digital skills training program
Low resources	Free solutions, CSR[1], academic, research and governance support
ICT lagging behind	Use of exponential technologies

Note. Own elaboration with data from (UNPYME & AMPYME, 2022)

Proposed Solution

The proposed model for technological innovation for the sector is based on the triple helix model (Pedraza et al., 2014), and is presented from three approaches: conceptual, logical and implementation.

In order to achieve the proposed objectives, products or services available in the market are used, leaving custom designs in the background.

In order to obtain applications that allow access to the full range of digital innovation possibilities, it is proposed to rely on free, open source or scalable licensing software, with implementation in the cloud for better access to resources. This type of solution automatically includes aspects that must be considered in a comprehensive e-commerce solution.

- Business functionality
- Ecommerce
- Computer security
- Backups
- Serverless computing
- Software updates
- Incorporation of exponential technologies

The applications, especially the suites, are used to introduce the concepts and fundamentals of business and business strategy. Packaged solutions usually include instructions, not only on the tool itself, but also on the concepts and fundamentals necessary for its use. See Figure 2.

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[1] *CSR: Corporate Social Responsibility*

Figure 2

Proposed Solution. The programs or packages include the necessary concepts and fundamentals
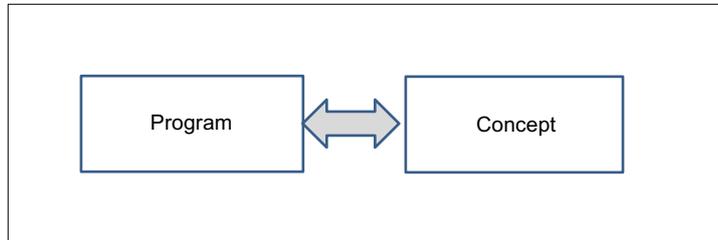
The Academy or the union institution in charge of training would support this approach, providing guidance and follow-up to the different executive levels within the organization.

Digital culturalization. It is necessary to make a leveling / homologation of basic concepts of digital competences. This can be achieved through programs and/or video tutorials produced by the academic sector. (an example could be selected students guided and/or face-to-face (cycles) or blended learning, promoted and moderated by the trade association (UNPYME[2]).

Figure 3 shows the diagram of the proposed conceptual model. It is based on the triple helix model, which incorporates teaching, e-commerce, strategy and exponential technologies.

Figure 3

High level diagram of the main components of the proposed model
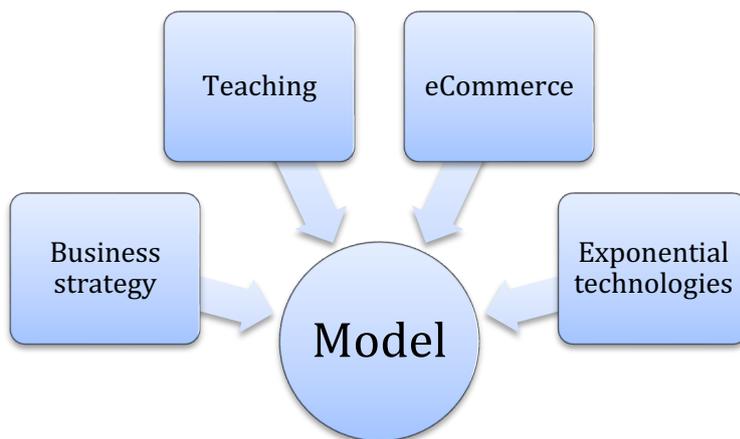
Figure 4 shows the implementation model, with the actors through which the implementation of the proposal would be carried out. It includes packaged software, academia, Corporate Social Responsibility (CSR) support, and the intervention of the trade sector as a guiding thread and facilitator.

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[2] National Union of Small and Medium Enterprises

Figure 4

Implementation model showing the actors and their functions

Packaged software
- ecommerce
- business strategy
- business concepts
- marketplaces

Academy
- Research
- Manpower
- Teaching
- Laboratory
- Training for the entire corporate hierarchy
- Training professionals

CSR "know-how" support

Gremial
- Governance
- Inter-company knowledge and skills inventory
- Networking place
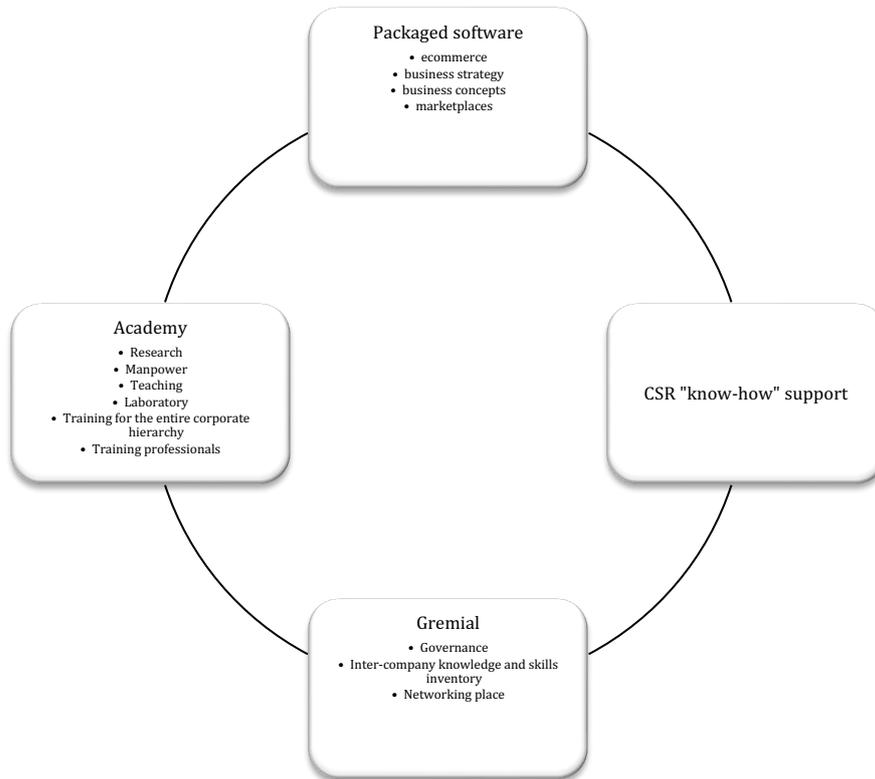
Method

This research followed a non-experimental, correlational, cross-sectional design.

The research sought to find the relationship between the non-adoption of digital technology and its possible causes, in a sample of the population, selected non-randomly, taken at the current time, or time of data collection.

The research does not include observations over a period of time, so it is a cross-sectional investigation.

No variables were manipulated to observe their effects; therefore, this was not an experimental investigation.

The aim was to test or confirm the hypotheses described in a measurable way, initially by checking that the reasons were the ones assumed, and then by relating these responses to data from other tests and/or surveys and documentary analysis of research sources.

Scope of the investigation

This study attempts to solve a problem by looking for solutions in emerging and exponential digital technologies. Such technologies, by their very nature and innovative character, constitute a highly dynamic field, for which there are not enough scientific studies to demonstrate their effectiveness. As these are new or novel concepts, they are relatively new to the market and have not yet had sufficient time to demonstrate their effectiveness or failure. This study relies on accepted industry standards, such as trend markers like the Gartner Hype Cycle and the Future Today Institute's predictions, and their recommendations to best ensure a successful outcome. With this innovative element, this research has an exploratory component, focusing on the limits of the frontier of technological trends. On the other hand, the scope of the research is also of a correlational, explanatory nature.

First, we have sought to confirm that there is a correlation between two or more variables (the reason for non-adoption of technology, and software complexity), and subsequently, we have explored the possible reasons or whys of such correlations.

All this was necessary to confirm (or discard) the hypotheses on which the conclusions and proposed solution model are based.

It can be considered an intervention project, in that it seeks to solve a specific problem (poor digitization) within an area (small business) and a specific sector (Panama). In this particular case, only the design is covered; neither the execution nor the evaluation is included. However, the suggestions for carrying them out are left as a guideline. On the other hand, the research project must follow certain standards established in the community of business projects with digital technology. (PMI, CMMI, modeling, teaching, strategy, digital literacy). From this point of view, the research was carried out under the model designs established in the industry.

Population and sample

The unit of analysis for the research is the small companies in Panama. According to Panamanian legislation, the definition of small business through law 33 of July 25, 2000, are those that have annual sales between B/.150,000.00 and B/.1,000,000.00. The total number of small businesses in Panama, as of 2018 were a total of 7,065 registered, according to data from the Office of the Comptroller General of the Republic, data cited by (Centro Nacional de Competitividad, 2021a).

These small companies are distributed by size and province, as shown in Figure 5.

Figure 5

Distribution of micro, small and medium-sized enterprises by size and province, 2018
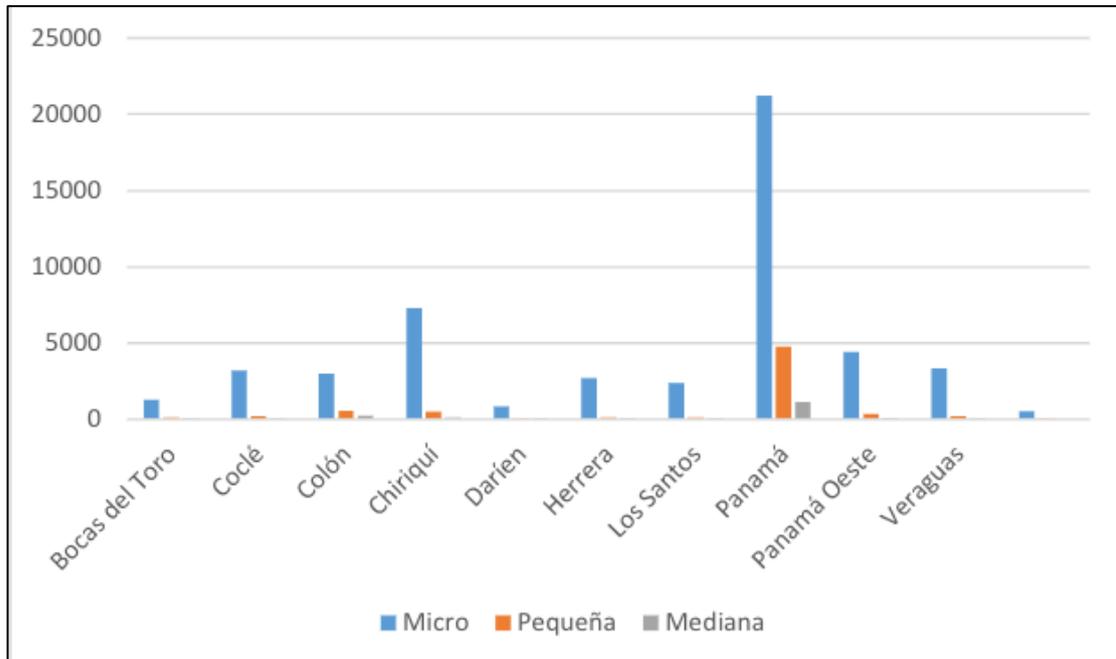
Note. Source: National Competitiveness Center (CNC), with data from the National Institute of Statistics and Census (INEC)

Working with the entire population of small businesses is impractical and not desired in this study. Not only because of their unmanageable number, but also because of the broad scope of the sector, which includes many different economic sectors. For this reason, it is necessary to delimit this population in order to achieve the greatest possible precision in the results. To this end, the criteria for delimiting the population should be aimed at successfully answering the research question. Taking this into account, the population delimitation criteria were determined:

• Small companies that want to access global markets, use digital technologies and e-commerce, but cannot (due to lack of resources), or do not know how to do so.
• Small companies that are not interested in participating in global markets, e-commerce or digital technologies, and find out why.

A non-probabilistic sample was defined, by means of volunteers for each stratum or group of interest studied, and case-types selected according to criteria of interest for the research. We worked in collaboration with UNPYME[3] and CNC[4], who, understanding the objectives of the research, guided the achievement of the case-types.

Sociodemographic characteristics of interest in this study are the age of the directors or managers of the companies or the person answering the survey, and the geographic distribution within the republic, in the different provinces, as well as the distribution by sector of economic activity of the company.

The age of the person actually constitutes an intervening variable in the sample, and is relevant because of the generational characteristics in relation to the predisposition to adopt new digital technologies.

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[3] National Union of Small and Medium Enterprises
[4] National Competitiveness Center

The distribution by province and economic sector of the sample is used to characterize behavior from a cultural and environmental point of view, as well as economic activities. That is to say, a province dedicated mainly to agriculture, or another to the industrial sector, will have different needs than a business in the capital.

In all research, measurements are needed. What needs to be measured is dictated by the hypotheses, since it is what you want to prove or disprove. These hypotheses, stated in the form of prose or statements, should be expressed by means of measurable and verifiable variables. To this end, we return to the research question and hypotheses.

By means of the process known as the operationalization of the variables, it is possible to express the hypotheses in a measurable form. The process consists of breaking down the general definitions into the particulars of the study, and then expressed in a measurable way, as shown below.

Variable 1: "Complexity of software development" (What you want to measure)
Conceptual definition:

- Complexity: Complex quality. Something that is made up of different elements that are interrelated. Complex systems: systems composed of a series of interrelated elements whose behavior and properties are not obvious to the naked eye. Complex systems are the result of an intricate network of simple operations. [5]

- Complexity of software development
  - La complejidad es inherente al software y se deriva de cuatro elementos Booch, cited by (Manuel & Lovelle, n.d.)
  - The complexity of the problem domain
  - The difficulty of managing the development process
  - The detail that can be achieved through the software
  - The problem of characterizing the behavior of discrete systems

Operational definition

It is necessary to compare the level of software complexity between two development and implementation styles. For this purpose, a dependent variable and an independent variable are defined. In other words, the dependent variable will obtain different values depending on the independent variable.

Dependent variable: "Degree of complexity of solution development / implementation."
Independent variable: "Development approach or style (Custom or Packaged)

The dependent variable is still a complex variable, which makes it difficult to measure. It should be broken down into more elementary parts, which are unambiguously measurable, and which in turn lead to indicators that can be used to analyze results.

Taking Hypothesis 2 as a basis, the following variables are identified for analysis.

Description of Hypothesis 2: Lack of or little knowledge of technology and e-commerce prevents the adoption of both concepts.

The latter must be expressed in a measurable way. This leads us to express it: The greater the knowledge of technology and e-commerce, the greater the willingness to adopt both concepts.

Variable 2: "Willingness to adopt digital technology."

- Dependent variable: "Willingness to adopt digital technology."
- Independent variable: "Level of digital technology literacy"

In the case of Variable 2, it is necessary to define several variables involved in the measurement, since the results may vary according to different cases.

Intervening variables:

- Sector of economic activity (commerce, industry, services)

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[5] *Definition retrieved from www.significados.com retrieved April 3, 2022*

- Age of executives
- Age of the company
- Schooling of managers
- Others
- Business style (traditional or avant-garde)
    Variable 3: "Reason for non-adoption of digital technologies."

Trying to measure the reason for non-adoption of digital technologies can be very complex. Although the first response might suggest that it is related to cost, there may be other reasons. For this reason, a short questionnaire is used, but it is complemented by interviews with open-ended questions that can provide more information.

Measuring instruments and techniques

The instruments used for the fieldwork were a questionnaire, interviews and documentary analysis.

A simple questionnaire was used for field work. It was validated by a selected group of the target sector, prior to being used in the entire sample of the population. The answers to this questionnaire are used to collect quantifiable data before making the diagnosis necessary to confirm the hypotheses.

In addition, interviews were conducted, after passing through a first filter of the questionnaire. The interviews were open-ended questions, through which it was possible to go deeper into the answers, and were carried out with the collaboration of volunteers.

Procedures and literature review

In order to achieve the objective of this study, the starting point was the identification and justification of a need. Background research work was carried out and the hypotheses and measurement method were identified. Subsequently, field work was carried out, after designing a simple survey aimed at a sample of the specific population. With the collaboration of experts, both in the scientific field and in the population sector, the questionnaires and questions were validated before being sent to the sample group. This work has made it possible to prepare a diagnosis of the real situation in the sector. With these data, and the data from the references of previously published studies, statistical analyses were performed, the results of which were used as the basis for the conceptual elaboration of the proposed model. In addition, the corresponding operational and financial feasibility study was prepared in order to prepare the final complete proposal, together with the conclusions.

Statistical analysis

In order to carry out the statistical analysis using the variables already identified, it was necessary to decompose them from complex variables into simpler variables and indicators. Similarly, the qualitative values also needed to be coded into numerical values in order to perform the analysis using statistical tools.

It is necessary to compare the complexity of software development in its two modalities analyzed in this study to support the suggested hypotheses.
    Decomposition of variables
- Variable 1: "Complexity of Software Development and Implementation."
    Complexity of the problem domain (Ordinal qualitative variable).
    This variable refers to the difficulty in specifying requirements.
        Values:
        - High
        - Medium
        - Under
    Difficulty in managing the development process (Qualitative ordinal variable)
        Values:
        - High

- Medium
- Under

The detail that can be achieved through the software. It is broken down into two variables: (Both ordinal qualitative variables). The higher the level of standardization, the better the quality of the software, or the lower the complexity)

Use of standards
- Adequate 1
- Little 2

Whether or not to develop everything from scratch (re-use of code, "harness" functions, functions, objects, tools, GUIs, algorithms) (As it is being measured in degree of complexity, the highest value is assigned to the greatest detail. In other words, the greater the detail, the greater the complexity.)

- High degree of detail development 3
- Medium level of detail development 2
- Adequate level of detail development 1

The problem of characterizing the behavior of discrete systems. It is decomposed into four variables (all ordinal qualitative)

- Software quality
- Data integrity
- Integration
- Security

Values:
- High Complexity 3
- Complexity Low 1

- Variable 2: "Willingness to adopt digital technology" (Qualitative ordinal variable)
Values: High, Medium, Low (3,2,1)
- Variable 3: "Reason for not adopting digital technologies" (Nominal qualitative variable)
Values: Cost, don't need it, Complex, lack of personnel, not the time.

Tables 6, 7, 8 and 9 summarize the operationalization and decomposition of the variables needed to test the hypotheses in the field, and identify the possible values and ranges for each one.

Table 6

Decomposition of variables Hypothesis 1

	Hypothesis 1			
Expressed in prose	"The complexity inherent in the development and implementation of IT solutions and/or applications hinders the adoption of digital technology."			
Variable 1	"Complexity of software development"			
Expressed in measurable form:	The complexity of software development can be broken down into four dimensions			
		Values		Type
Dimension 1	1)Complexity of the problem domain			
Dimension 2	2) Difficulty in managing the process			
Dimension 3	3rd) Standardization level	High	Medium	Under	Qualitative Ordinal
	3b) Develop everything from scratch			
Dimension 4	4th) Software Quality			
	4b) Data integrity			
	4c) Integration			
	4d) Safety			

Note: operationalization of the variable that measures the level of complexity of the development and implementation of IT solutions.

Table 7

Variables of the proposed assumption

	Assumption - Proposal		
	"Packaged solutions are less complex than custom solutions."		
		Values	
Dependent variable	Degree of complexity	High	Under
Independent variable	Development style	Packaging	Tailor-made

Note: Variables required to measure the assumption supporting the proposal to favor the use of packaged software over custom-developed software. Own elaboration.

Table 8

Decomposition of variables - Hypothesis 2

	Hypothesis 2				
Expressed in prose	"Lack of or little knowledge of technology and e-commerce prevents adoption of both concepts."				
Expressed in measurable form	"The greater the knowledge of technology and e-commerce, the greater the readiness for both concepts."				
		Values			
Dependent variable	Willingness to adopt digital technology	1	2	3	4
Independent variable	Level of knowledge of digital technology	1	2	3	4
	Intervening variables				
		Values			
Variable 1	Sector of economic activity	Trade	Agro	Industry	Services
Variable 2	Age	Numerical value			
Variable 3	Age of the company	Numerical value			
Variable 4	Grade of schooling	University	Technician	Secondary	None
Variable 5	Style or "cut of the company"	Traditional		Vanguard	

Note: Variables that measure the relationship between the level of knowledge of digital technologies and the willingness to use them. Own elaboration.

Table 9

Decomposition of variables Causes of non-adoption of the Technology

Variable	*Reason for non-adoption of technology*			
Why you need to measure	To understand the real reasons to support the proposed model			
Values	Cost	Very complex	Lack of qualified personnel	Lack of interest
Long answer question	The answer is requested in more detail: 1) Previous experiences (bad) 2) Abandonment 3) External and/or internal factors, not included in the survey			

Statistical analyses used

To demonstrate the comparison of the level of complexity of software development, it is necessary to compare the two development models: custom and packaged software, i.e. two groups. Descriptive and inferential statistics were used for this analysis. All the simple variables that compose the variable "software development complexity" are ordinal qualitative variables, since three levels of complexity were defined, in order to be able to compare in an unequivocal way. The tests indicated are nonparametric, since they are ordinal qualitative

variables. The test indicated for this case is the Mann-Whitney U test, by means of which relative comparisons can be established between two independent sample groups. In the case of the variable to be measured, it allows comparing whether one group is higher or lower than the other.

Descriptive statistical analysis is used to demonstrate the relationship between the level of knowledge of digital technology and willingness to use it. In this case, relative frequencies are described that demonstrate the hypothesis: the greater the knowledge of digital technology, the greater the willingness to use it. For this variable, a correlation analysis should be performed between the level of knowledge and willingness. Spearman's correlation test allows us to measure whether one variable increases when the other increases, for ordinal values.

Results

Using commercial references, a comparative table was drawn up to demonstrate the hypothesis. The results are shown in Table 10.

Table 10

Custom and Packaged Solutions Complexity Comparison Chart

Criteria	Package	Tailor-made
Complexity in the specification of requirements	Low Complexity	High Complexity
Difficulty in managing the development process	Difficulty Low	High Difficulty
Standardization level	High Level	Medium or Low Level
Detail that can be achieved in software development	High Level	Medium or Low Level
Software Quality	High Quality	High, Medium or Low Quality
Data integrity	High Level	High, Medium or Low Level
Integration	High Level	Medium or Low Level
Security	High Level	Medium or Low Level

Note. Comparative table of complexity level results according to aspects between customized solutions and packaged solutions. Own elaboration.

To confirm or rule out the second hypothesis, studies conducted and published by recognized institutions, following measurement standards, were used.

In the Diagnosis of Socioeconomic Impact conducted by UNPYME and AMPYME[6], in 2021, the effects of the COVID-19 pandemic on MSMEs in the Republic of Panama were measured.(UNPYME & AMPYME, 2022)

Two measurements were made in this study. A first measurement was made from December 1 to 15, 2020, and a second measurement was made from January 1 to 16, 2021, in order to verify the evolution of the indicators.

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[6] Micro, Small and Medium-Sized Enterprise Authority

Demographic characteristics of the sample

The study used data from 28 unions affiliated to UNPYME. The sample was taken from formally constituted companies, with taxpayer identification and tax returns. The survey was administered digitally.

The total population was 6274 companies in both measurements. In the second measurement, of interest for this research, 1858 surveys were received, representing 29.60 of the population, with a consistency reliability of 0.91.

As results of the study, it was found that the educational level of the small business owner is composed of 15% not studied, 24% primary school level, 23% middle school level, 29% high school level, and 9% with a higher education level.

On the other hand, only 36% of small businesses know about Ecommerce, 6% make sales over the Internet, 32% are interested in learning about the Internet, and 72% want to make sales over the Internet.

In addition, 89% of the small companies are family-owned.

Relationship to the Hypotheses and Objectives of the Study

The data from the aforementioned study that were useful for this research are those related to the hypotheses and measurement objectives of interest to us. Small business owners' educational level, current Ecommerce adoption, and interest in Ecommerce were used. Similarly, data related to the current use of digital tools and how they relate to interest in E-commerce, or selling over the Internet, was used.

Using the data from the UNPYME study, the average educational level of small business owners is pre-middle school education.

Figure 5 shows the relationship between the educational level of the business owner and his or her interest in ecommerce, and Figure 6 shows the relationship between the use of digital tools and interest in selling online. Figure 7 also shows the relationship between the owner's or manager's knowledge of Ecommerce and their interest in learning about it.

Figure 5

Relationship between educational level and willingness to Ecommerce
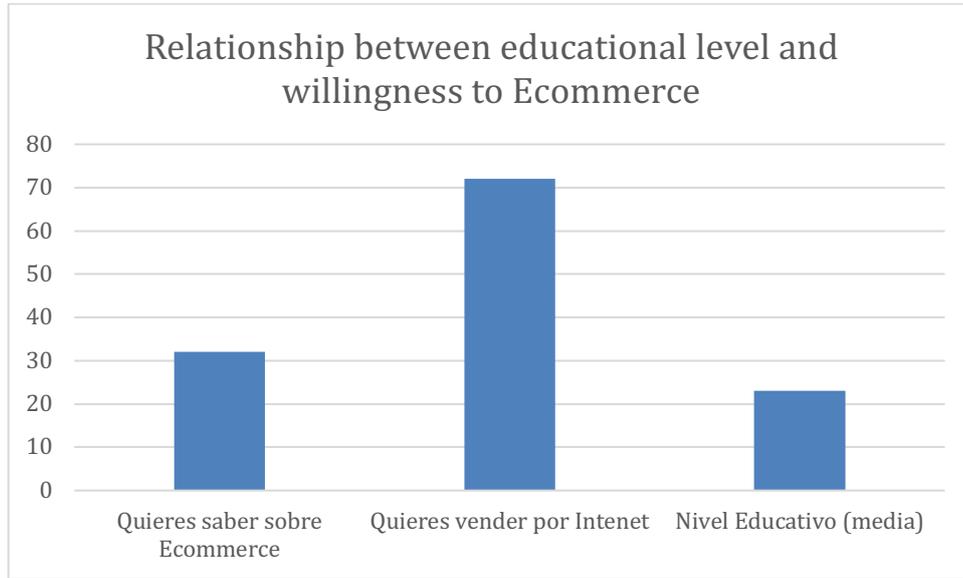
Note: Graph showing the relationship between the educational level of the company's management and their interest in Ecommerce. Own elaboration with data from (UNPYME & AMPYME, 2022)

Figure 6

Relationship between use of digital tools and internet sales
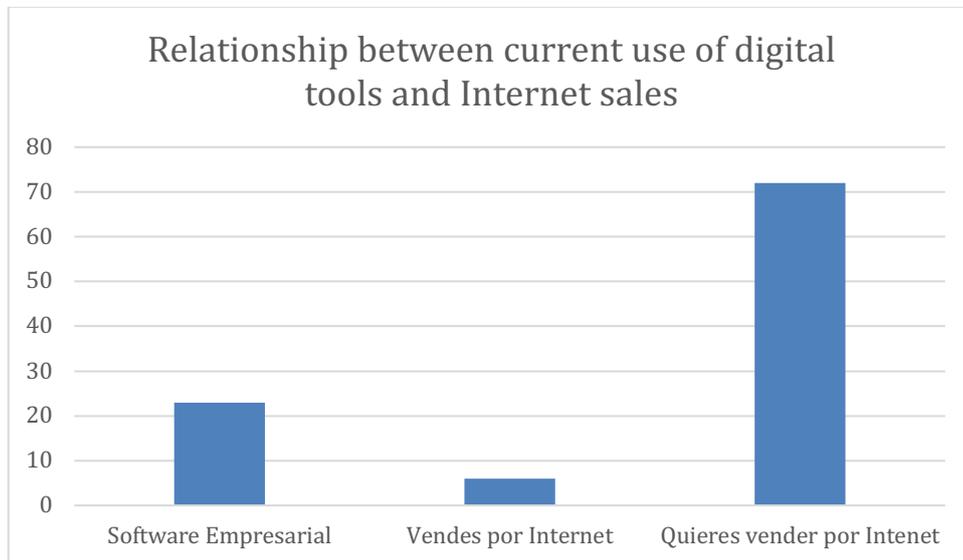
Note. Relationship between reported use of digital tools, current online sales, and interest in selling online. Own elaboration with data from (UNPYME & AMPYME, 2022)

Figure 7

Relationship between Ecommerce knowledge and interest in Ecommerce
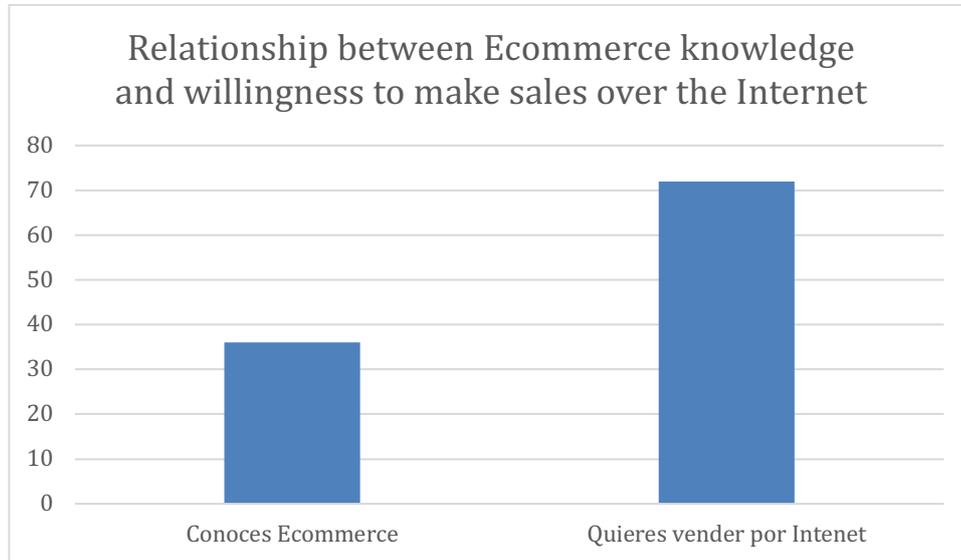
Note: Relationship between the level of knowledge of e-commerce and the willingness to use it on the part of the company's managers in the sector. Own elaboration with data from (UNPYME & AMPYME, 2022)

From these results, it can be seen that, regardless of the educational level of the owner or executive, there is a high percentage of interest in learning about Ecommerce. Similar results are observed in relation to Ecommerce knowledge. Despite the relatively low percentage of knowledge, this does not affect the fact that the level of interest in Ecommerce remains high. Table 11 shows a summary of the results and their relationship with the hypotheses proposed.

Table 11

Hypothesis, Objective, Result and Conclusion of the Objective

Hypothesis	Associated target for response	Method of obtaining response	Result	Conclusion of Objective
H1	SO3, SO4	Surveys, interviews and documentary analysis	The hypothesis is tested	The benefit of the use of packaged software is proven
H2	SO1, SO2, SO5		The hypothesis is discarded	Lack of knowledge is ruled out as a barrier to ecommerce adoption
H3	SO1, SO2, SO5		The hypothesis is discarded	It is ruled out that there is little interest
H4	SO3, SO4		The hypothesis is confirmed	Cost is confirmed to influence technology adoption

Note: Table synthesizing the relationship of the Hypothesis, the results and the related conclusion.

Discussion and conclusions

The purpose of this research was to identify the causes of the low adoption of digital technology and e-commerce in small businesses in Panama, in order to design and propose a solution model for the sector's problems.

The main findings of this study are discussed below.

- The results obtained in the study group show that, although there is a need and desire to automate and carry out e-commerce, the level of knowledge required to do so is not

reflected. In other words, you want to achieve the objective, but you do not know how to get there.

- Initially, one of the hypotheses raised was that there was no interest in achieving the objective, due to a lack of knowledge of the subject. However, this hypothesis was discarded with the results obtained, which demonstrate that, in spite of not having the necessary knowledge, the objective is desired.

- No previous studies are available where this type of relationship is made. There are descriptive studies that indicate these results separately, but without correlating them.

- It is proven, through simple statistical analysis, that the best way to achieve the proposed objectives is through the implementation of packaged software, particularly SaaS, as it provides the necessary capabilities and meets the requirements of the sector.

- A review of successful cases shows that it is necessary to adopt emerging technologies, as they offer a more sustainable solution over time.

- The results also show the great need to acquire digital skills knowledge, at different levels within the organizational structure. Generally, small companies are mainly family-owned, and the owner is also the most senior executive and decision-maker.

It is important to mention that this study was considerably limited in the field work, and the consultation of figures or results of previous studies. Studies on the subject are scarce. Official census and data institutions were consulted, but no results were obtained. This made it necessary to resort to studies by independent entities, such as the CNC, or trade groups such as UNPYME. On AMPYME's website, where a technology adoption survey is published, the results of the survey have not been published, and it is not known how many companies have answered the survey.

Although the contributions in this study are not sufficient, they do give an important idea about the problem raised, particularly with regard to the links or correlations between the known information. On the other hand, it certainly provides a tangible and workable solution; one that, while not perfect or exhaustive, goes a step beyond any previous attempt. In this sense, this study should be taken as a starting point to develop detailed action plans that will lead to the achievement of the objectives.

Possibly the hypothesis was discarded (if you want to automate, despite not having the knowledge), driven by the events that occurred due to the pandemic. During the pandemic, the immense need to automate and carry e-commerce became evident, possibly leading many who were previously uninterested to want to get it.

One of the shortcomings or gaps in the attempts to support the sector is the fact that no concrete proposals have been made that can be implemented. Nor has there been a study with indicators to measure progress on the subject, once the results of surveys have been published, or to make recommendations. There is no measurement of how many companies have improved their performance indicators, or if bankruptcies have been avoided, or any other favorable result, for example.

One of the most important conclusions of the study is the confirmation of the great need for digital education among members, managers or owners of companies in the sector. This is something that can never be valued enough.

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ACTOR STRATEGY AND PROSPECTIVE APPROACHES: AN ATTEMPT TO FORMALIZE POWER MECHANISMS WITHIN DEVELOPMENT PROJECTS AND PROGRAMS FINANCED BY INTERNATIONAL AID IN CAMEROON

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Abstract. This paper is based on the intelligent analysis of the actors' games within the Development Projects and Programs (DPP). Indeed, an empirical study was conducted with eleven (11) groups of essential actors of the DPP system in Cameroon, following the MACTOR approach (Method of Actors, Objectives, Power Relations). The aim was to analyze the structure of the influences between the actors and to define the position of each one with respect to the objectives. The actancial results recorded show that the power relationships are established in four (04) types: dominant, relay, dominated and autonomous. The results highlight the participatory management of the DPP system by the Technical and Financial Development Partner, the Regulator, the Technical Team Leader and to some extent the Steering Committee. In addition, a need for transparency, power organization and dynamization was identified as a necessity, in order to positively impact the performance of DPPs in Cameroon. Prospects for the development of the DPP system as a trial were proposed.

Keywords: MACTOR, International aid, Actors, DPP system, Cameroon.

ESTRATEGIA DE LOS ACTORES Y ENFOQUES PROSPECTIVOS : UN INTENTO DE FORMALIZAR LOS MECANISMOS DE PODER EN LOS PROYECTOS Y PROGRAMAS DE DESARROLLO FINANCIADOS POR LA AYUDA INTERNACIONAL EN CAMERÚN

Resumen. Este trabajo se basa en el análisis inteligente de los juegos de actores dentro de los Proyectos y Programas de Desarrollo (PPD). En efecto, se realizó un estudio empírico con once (11) grupos de actores esenciales del sistema de PPD en Camerún, siguiendo el enfoque MACTOR (Método de Actores, Objetivos, Relaciones de Poder). El objetivo era analizar la estructura de las influencias entre los actores y definir la posición

de cada uno con respecto a los objetivos. Los resultados actanciales registrados muestran que las relaciones de poder se establecen en cuatro (04) tipos: dominante, relevo, dominado y autónomo. Los resultados destacan la gestión participativa del sistema PPD por parte del Socio de Desarrollo Técnico y Financiero, el Regulador, el Jefe del Equipo Técnico y, en cierta medida, el Comité Directivo. Además, se identificó la necesidad de transparencia, organización del poder y dinamización, con el fin de impactar positivamente en el desempeño de los PPD en Camerún. Se propusieron perspectivas de desarrollo del sistema de PPD como ensayo.

Palabras clave: MACTOR, Ayuda internacional, Actores, Sistema PPD, Camerún

Introduction

Cameroon, like other French-speaking countries, is committed to ambitious programs for economic emergence by 2035. To achieve this, the country is based on four (04) poles of action, economic business for its emergence: the agricultural and environmental pole; the industrial pole of production and transformation; the pole of services and new technologies and the pole of governance. (MINEPAT, 2022). The pooling of these clusters, which have been consolidated, has resulted in the National Development Strategy 2020-2030 (NDS30). This strategy is based on four strategic axes: the structural transformation of the national economy; the development of human capital; the promotion of employment and the integration of young people into the economic circuit; and finally, governance, decentralization and strategic management of the State. (MINEPAT, 2020, p. 40).

What these Emergence plans have in common is that they all involve major investment and/or development projects. The DPPs in Cameroon are therefore the crucible of emergence. They are the opportunities to meet the specific and fundamental needs of the people of Cameroon. Through these DPPs, access to basic services should be assured (Assontia Djoudji, 2022). Although the rhetoric has not changed since independence, SND believes that the structural transformation of the economy will be achieved through DPPs as an additive to other structuring projects (MINEPAT, 2020). As such, they are places where actors come together.

Some authors, relying on MACTOR, consider these actors to be messy in the governance of protected areas (Kouassi, 2018), while others, following the MACTOR approach, highlight a participatory management of the tourism sector, but with a huge need for transparency and organization of power as the key point (Belfellah, & Gassemi, 2016). This same tool is used to illustrate the game of actors of geographic information (Bassaler, 2004). However, it remains little used in DPPs.

Development aid would be positioned in this case as a step towards a theory of social change. The objective of this work is to identify the main actors and their mechanisms of influence and power within a system called DPP in Cameroon. This study is a response to the following problem: Assuming that the DPP is a system that evolves according to a contractual logic, taking into consideration the NDS 30, how do the different actors in the system interact with each other in terms of their objectives and those of the NDS 30? Can the analysis of the game of actors by the MACTOR method lead to the development of this system?

This contribution is articulated around the theoretical and conceptual approach; the approach followed and the attempt of explanation and discussion.

Methodology

Theoretical and conceptual approach

In the perspective of this research, which starts with a documentary review and a series of interviews, which, in a cross-sectional framework, with a non-probabilistic convenience sample, as part of a combinatory approach to both the qualitative and quantitative in a mortgage-deductive approach, deals with the attempt to formalise power mechanisms within development projects and programmes financed by international aid in Cameroon; analyzed from a stakeholder strategy and prospective approach perspective backed by the MACTOR method.

Theory of planned change

Guy Rochet (1968) suggested that the theory of planned social change (ToC) be understood as any temporally identifiable and verifiable transformation that affects the functioning of a community. Thus, development aid justifies its existence by the externalities it generates, that is, by its results on the community. This seems to add to the complexity of measuring performance; the assessment of DPP performance is thus based on more or less objective criteria that can be easily and reliably measured with indicators, but also on more subtle aspects that are difficult to measure and result from the fact that "it is difficult to find activity indicators that are unequivocally linked to externalities" (Sponem, & Chatelain-Ponroy, 2009, p. 4).

According to this model, change is first conceived theoretically before being implemented in situ. In the design phase, the planner first identifies the need and then constructs potential solutions to the identified need. At the end of this conceptual process, he ensures the feasibility of the solutions considered. He looks for the financial, material, human and temporal resources that will allow him to reach the expected objectives. It also implements the program by carrying out the activities planned in the project's Logical Framework (LF). In this step, the planner anticipates assumptions and risks that may hinder the achievement of objectives: poor project design, resource shortfalls, or hazards beyond the planner's control. In fact, over the last two decades, there has been an increase in the use of ToC in the design and evaluation of DPPs (Tarazona, 2020). This is especially true since many DPPs have adopted it. Also, government agencies and other non-governmental organizations, in order to be consistent with their strategies, are embracing ToC as a solution to ensure that their day-to-day activities are aligned with their ultimate goals. ToC has become a key instrument in many DPP evaluations. (Augustyn, 2022). It also seems to be widely used in international development (Vogel, 2012) and community action. (Salathé-Beaulieu, & Léonard, 2018).

The concept of development

Development, or rather, the normative understanding of what it should be, is an extremely composite phenomenon, both in its genesis and definition and in its effects. (Assontia Djoudji, 2022). It appears to be a panacea for a range of social and political problems around the world. It has also succeeded in intruding into the contemporary economic and managerial field despite the contradictions it raises. Critics, often based on empirical studies showing the limits of this approach (Escobar, 1984), have drawn attention to the resiliencies and counter-discourses of both the so-called South and the so-called North, which pose a series of challenges to the understanding of the concept. This change is largely related to its malleability and versatility.

Kassé (2009) points out that this concept has suffered the wear and tear of a disjointed evolution, first as an objective among classical economists, then rejected by the dominant neo-

classicists. Today it is the subject of political, economic and sociological discourse. The notion of development is intimately linked to that of progress, industry, job creation and urban growth (Aliste et al., 2017). Yet, they continue, various social, political, economic, cultural and ecological tensions have made it difficult to realize the promises of this notion.

Tagou (2011) considers that the Anglo-Saxons are more precise with the social dimension and the poverty parameter, unlike the Francophones. The UNDP (1991), in its approach, does not define it explicitly, but describes its purpose, the objective of human development, the choices offered to the population, and participatory democracy. This description creates an ambiguity, which refers to an ideal and makes one think that "development does not exist" (Tagou, 2011, p.25). It is a state of mind, with variable geometric trajectories that must be followed by all entities that aspire to greater well-being.

In any case, the concept of development, regardless of the straitjacket it wears, is like a chameleon. In this paradigm shift, we must rely on people to lead human societies towards a planned change.

State of play/synoptic overview of DPPs in Cameroon

Following the Organizational Audit of the DPPs under the Ministry in charge of Agriculture and Rural Development (MINADER) in Cameroon, recommendations were made. Among these recommendations, the restructuring of the entities is strongly advocated. According to the terms of Decisions N° 00695 and 00696/MINADER/CAB/UCSP, some projects were dissolved, new projects were created, some reframing was done and finally others were maintained in their specific mandates (MINADER, 2016). This reform should theoretically put an end to the proliferation of duplication observed in the DPP arena. It should be noted that this reorganization does not concern DPPs financed partially or entirely by international aid funds. They provide an understanding of the system.

In 2008, the report of the Association Citoyenne de Défense des Intérêts Collectifs (ACDIC) highlighted illicit practices in the management of the corn project. It describes the creation of fictitious Common Initiative Groups (GIC) to use up budget lines, corruption and influence peddling. The intervention of the National Anti-Corruption Commission (CONAC) from December 22, 2008 to January 20, 2009, led to the interpellation of its coordinator.

The Agropoles Program (PAG) has in its turn come to account for the gaping hole in which the Cameroonian population is immersed. The site Cameroon-Info.Net in its communication of May 10, 2017, recalls that it was in 2012 that the State of Cameroon had announced the establishment of the "Agropoles Program", which aimed to reduce production deficits in the agricultural sector and consequently limit imports of certain foodstuffs. Two phases had then been decided, five (5) years later, this vast project in which the Government was to invest 9.8 billion FCFA (15 million Euros) seems not to produce the expected effects, notes the daily Le Messager of Tuesday, May 9, 2017.

Overall, the results of the 2018 evaluation, are not in line with expected hopes, no target achieved in the areas of crop, animal and fisheries production, according to the National Institute of Statistics (INS). Cameroon continues to experience deficits in its agricultural production. The security situation in the North-West, South-West and Far-North regions is not unrelated to this. However, it is important to note that the said program is housed and piloted by the Ministry in charge of Planning and Land Management (MINEPAT) instead of the Ministry in charge of Livestock, Fisheries and Animal Industries (MINEPIA) and MINADER.

Also, does this reason and many others not justify the disappearance, liquidation or restructuring at the origin of the systemic inadequacies of management and governance recorded in our development projects ? Obviously, we must not forget the cyclical and/or

structural ones. Issues related to social organization are hardly ever highlighted to justify the mixed results. In this regard, Picard et al. (2017) note that the mixed results of the program are primarily related to the scope of the program.

The Mission for the Regulation of the Supply of Consumer Products (MIRAP)

It is a structure for alerting, purchasing, importing and storing consumer products, with a view to supplying the market in the best conditions. A mission with potential failures, seems to wonder Sofack (2018). A concern shared by economic operators and civil society actors.

For Njonga (2011), MIRAP is a disaster for local production. According to Sofack (2018), this is a contradiction of public discourses that advocate packages of measures to strengthen Cameroon's food sovereignty. This is a contradiction of public discourses that advocate packages of measures to strengthen Cameroon's food sovereignty. Yet, paradoxically, the primary mission of this body is to ensure, through imports, the supply of basic foodstuffs to the markets.

Babissakana (2011), believes that MIRAP is a conceptual, methodological and institutional step backwards. This mission will undermine the functioning of a market economy. It cannot solve any problem in a sustainable way, beneficial for the economic and social progress of the country.

Duplicate Projects and Programs : SEMY vs SODERIM ; PD-COBIE vs PRODEL vs PD-CVEP

The case of duplication observed is SEMRY (Société d'Expansion et de la Modernisation de la Riziculture de Yagoua) and SODERIM (Société de Développement de la Riziculture dans la plaine des M'Bo), two development companies with comparable or even identical missions and objectives. In the end, Cameroon imports rice in abundance.

These same duplications are observed when one questions the missions and objectives of the Livestock Development and Marketing and Infrastructure Project (PD-COBIE), the Livestock Development Project (PRODEL) and the Livestock and Fish Farming Value Chain Development Project (PD-CVEP). There is no clear boundary between these entities, and if so, the PTDs are different. This leads to questions about the strategic development planning of the livestock sub-sector (MINEPIA, 2021).

National Rural Development Fund (FONADER)

Ndjogui et al. (2014) identified two endogenous and exogenous causes for the collapse and subsequent closure of FONADER.

Among the endogenous causes : excessive centralization, administrative red tape and also a lack of transparency in the monitoring of loan repayments. The most important exogenous factor is the disengagement of the State from the productive sectors.

The factors responsible for its failure have a common denominator in the systemic insufficiency of management and governance (Ndjogui et al., 2014). As a result, in their temporalities, projects carry within them the genes of their death.

Approach followed

Actors' strategy

In a given system, what is known as an Actor's strategy is in fact everything that will furnish his behavior to protect his interests (Crozier, & Friedberg, 1977). The Actor will thus surf on the relational fiber via alliances, collaborations, oppositions and even negotiations to build his margin of maneuver. What is important for the actor is to achieve his goals. Hatem

(1993), taken up by (Belfellah, & Gassemi, 2016, p. 30) defines the Actor as a person, a group or an organization, aiming at certain objectives and confronted with certain constraints, and which can, by its strategies and its means of action, influence the future of the system studied. In the same vein, Michel Godet (2007a) says that the Actor is a homogeneous group with common objectives and means of action, implementing the same strategy and displaying a balance of power in relation to other Actors. Thus, the Actors do not evolve on the same diapason, the zones of power are not definitively fixed, as Crozier, & Friedberg (1977) emphasize. They are constantly recomposed according to the evolution of the context. The coveted strategic objective is the control of the zone(s) of uncertainty which are the real source(s) of power. The goal of the strategic game is the control of the zones of uncertainty that are a source of power (Smida, 2003). In these zones of uncertainty, the actor takes inventory of his strengths and weaknesses and relies on these zones in turn to dominate, to exercise his power (Crozier, & Friedberg, 1977).

Thus, according to the authors of The Actor and the System, power in an organization is distributed over four (04) contextually dynamic zones : The first is hierarchical and emphasizes the Actor's status as an authority ; the second is called expert and refers to the Actor's competence in a given field; the third is devoted to information, i.e., the Actor holds decisive information; and the fourth is related to the environment, i.e., the link between the Actor and the organization's periphery.

In any case, the Actor seems to be more concrete in his actions because of the regulation mechanisms of which he is the sole holder. From then on, this "uncertain" construct, which is always "in the works", allows actors to establish, in difficult situations, the transactions necessary to maintain and continue their actions (Belfellah, & Gassemi, 2016).

In Cameroon, the DPPs symbolize a system of strategic games between actors. The NDS 30 constitutes fertile ground in the construction of an emerging Cameroon by 2035. However, it seems legitimate to question the consistency of the constituent actors, their goals, their objectives, their constraints, their means of action and strategic issues. Strategic games are of immense interest because they define the modes of cooperation and interaction between the different actors in a voice characterized by the pursuit of objectives and the establishment of sustainable relationships between these actors.

Data collection method

The methodological approach focused on a documentary review of the power themes and the strategy of the actors, particularly those of the DPPs in Cameroon. Then, interviews were conducted between August 2021 and January 2022 with nine (9) PPDs and financial and technical institutions that were willing to give their time to the problem raised by the research object. As a result, eleven (11) groups of actors were formed out of the fifty or so actors met and observed. The items discussed concerned the power games within the DPPs, the strategies of influence and dependence between Actors, the power relationships...

Data analysis method

MACTOR makes it possible to analyze the content of the actors' powers in the DPP system in Cameroon and to formalize an explanation of their actions with regard to the facts observed (Assontia Djoudji, 2022). Analysis of the game of actors, their strategies, conflicts and alliances, and examinations of their power relations are essential to highlight the evolution of strategic issues and pose key questions for the future of DPPs in Cameroon (Assontia et al., 2022).

MACTOR proposes a progression in seven (07) successive steps (Godet, 2004 ; Godet, 2007b), but for this theme, four (04) stops are retained:

- Identification of the actors in the PPD system in Cameroon.
- Identification of the issues and objectives pursued by these actors.
- Construction of basic matrices, i.e., the Actor/Actor matrix and the Actor/Objective matrix
- Interpretation of the results based on processing with the MACTOR software.

The MACTOR method was also used as a tool to analyze the power mechanisms of several studies, the logics of influence and the strategies of Actors (Lafourcade & Chapuy, 2000 ; Smida, 2003; Bendahan et al., 2004 ; Munteanu & Apetroae, 2007 ; Kotbi et al., 2011 ; Blanc, 2012; Elmsalmi & Hachicha, 2014; Saricam, Kalaoglu et al., 2014 ; Saricam, Polat, et al., 2014; Rees and MacDonell, 2017 ; Ben-Daoud et al., 2021). The present study is based on a forward-looking methodology, the MACTOR method. The analysis of the interplay of actors, their interactions and influence strategies, and the examination of their power relations (constraints and means of action) are essential to highlight the evolution of strategic issues and pose key questions for the future of DPPs in Cameroon (Assontia et al., 2022 ; Assontia Djoudji, 2022). The MACTOR method thus models the interactions between the various stakeholders in the DPPs.

Advantages and limitations of the MACTOR method

The advantage of the Mactor method is that it is highly operational for a wide variety of games involving numerous players in relation to a series of issues and associated objectives. The Mactor method has a number of limitations, particularly in terms of gathering the necessary information. In addition, this method assumes that the behaviour of each player is in line with its objectives, which is not always the case in reality (Assontia Djoudji (2022).

Identification of actors in the DPP system in Cameroon

A list of eleven (11) groups of actors (Table 1) was formalized, which are considered essential whose managerial logics have an impact on the performance of DPPs in Cameroon.

Table 1

Table of Identification and Grouped Distribution of DPP Actors in Cameroon

N°	Actors : long title	Short title
	GROUP OF INTERNAL ACTORS	
1	Coordinators	COORDO
2	Technical Assistants	TA
3	Project Management Units	PMU
	EXTERNAL ACTORS GROUP	
4	Régulateur (Etat)	REGUL
5	Technical Development Partners	TDP
6	Suppliers	SUPP
7	Team Technical Leader	TTL
8	Opponents	OPP
9	Beneficiaries	BENE
10	Opinion Makers	OP_Mak
11	Steering Committee	ST_Comm

Identification of the issues and objectives pursued by these actors

This phase of the MACTOR method consists of identifying the system's issues and the objectives (Table 2) associated with them in order to position each stakeholder in relation to each of its objectives. These actors have powers in the DPP system that may converge or diverge between them.

Table 2

Table on Issues and associated influencing objectives

Issues in the arena	Associated objectives (long title)	Short title
E1 : power and control (influence)	O_1 : Formalize the clientelist nature of development aid	CLIENT_APD
	O_2 : Giving a new meaning to budget support and support to DPs	NVO_SAB_ACCOM
	O_3 : Improving the capitalization of the achievements of development projects	CAPIT_ACQUI
	O_4 : Promoting the Regulator's control over development projects	EMPRI_REGUL
E2 : the social aspect of DPPs	O_5 : Involve and adjust beneficiaries' priorities in the definition of government objectives and DWPs	PRIORI_BENE
	O_6 : Ensure that the gender aspect is taken into account in the distribution of positions of responsibility in the DPPs	GENRE_RESP
	O_7 : Improve/ensure the living conditions of all populations involved in the DPPs	CONDI_VIE
E3 : Performance - DPP Management	O_8 : Reforming the effective funding and/or subsidization of the rural sector	FINANC_SUBV
	O_9 : Improving the management of DPPs and the impact of development actions on beneficiaries	MNGT+IMPACT
	O_{10} : Encourage "customer" listening (opponent - beneficiary - employee - supplier**)**	ECOUTE
	O_{11} : Improve the performance of the PPDs and adapt the Regulator and TDP indicators to the projects	PERF+INDICA
	O_{12} : Evaluate the effectiveness of the internal control and risk management system to remedy identified weaknesses	CTRL-INT+MNGT_RISK
	O_{13} : Ensure PMU control of planning and improve maturity of DPPs	PLAN+MA faTU
E4 : la Coordination des PPD	O_{14} : Improve coordination synergy in the implementation of DWP and Regulator recommendations within the PMU	SYNER-COORDI
	O_{15} : Improving the flow of information in the DPPs	CIRC_INFO
	O_{16} : Ensure effective funding of DPPs from earmarked funds	FIN_PPD
	O_{17} : Respecting the temporality in Development Projects and Programs	TEMPO_PPD

Construction of basic matrices: the Actor/Actor matrix and the Actor/objective matrix

The first matrix is the one that pits Actors against Actors, also known as the matrix of direct/indirect influences between actors (MIDI), and focuses, on the basis of a rating scale, on the powers that Actors have to influence each other. The second matrix or Actors/Objectives, reminds us that the Actors are not all driven by the same objectives, here we speak of the Valued Positions of the Actors on the objectives (tables 3 and 4).

Tables 3&4 present respectively the matrix of influences between actors and the positioning of each actor in relation to the objectives.

Table 3
Table of the Matrix of Direct and Indirect Influences (MIDI)

MIDI	TA	PMU	COORDO	REGUL	TDP	SUPP	TTL/TM/OTP	OPP	BENE	OP_Mak	ST_Comm	Ii
TA	-	14	17	13	13	11	8	5	14	4	9	108
PMU	7	-	11	11	9	9	5	4	10	4	5	75
COORDO	10	13	-	12	13	11	6	5	15	4	8	97
REGUL	10	16	17	-	14	10	9	5	16	4	9	110
TDP	13	15	19	16	-	11	9	5	13	4	8	113
SUPP	5	7	8	5	5	-	4	5	8	3	5	55
TTL/TM/OTP	11	12	15	12	11	11	-	4	13	4	8	101
OPP	3	4	5	3	4	3	3	-	5	2	3	35
BENE	5	7	6	6	6	5	4	5	-	3	5	52
OP_Mak	6	6	7	7	6	6	6	3	7	-	7	61
ST_Comm	8	9	10	8	8	8	7	5	10	4	-	77
Di	78	103	115	93	89	85	61	46	111	36	67	884

Table 4 shows that there is very little disagreement between actors on the subject of objectives. Thus, consideration of the positioning of actors in relation to the objectives using the Actors x Objectives matrix seems sufficient to highlight the epicenter of the game of actors in the DPP system in Cameroon.

Table 4
Table of Valued Stakeholder Positions on Objectives (of order 2) : Matrix 2MAO

2MAO	CLIENT_APD	NVO_SAB_ACC_OM	CAPA_ACQUI	EMPRI_REGUL	PRIORI_BENE	GENRE_RESP	CONDI_VIE	FINANC_SUBV	MNGT+IMPACT	ECOUTE_CLIENT	PERF+INDICA	EFFICA+MNGT	PLAN+MATU	SYNER-COORDI	CIRC_INFO	FIN_PPD	TEMPO_PPD	Somme absolue
TA	3	3	2	1	3	2	3	2	2	-1	2	2	1	1	2	2	3	35
PMU	3	3	2	2	3	2	2	2	3	3	3	3	3	2	3	1	2	42
COORDO	3	3	3	2	4	2	2	2	3	3	2	3	3	3	2	1	3	44
REGUL	4	3	2	3	3	2	3	4	3	2	2	3	2	2	2	2	3	45
TDP	4	2	2	1	3	3	2	1	2	1	2	2	3	2	1	2	3	36
SUPP	0	0	-2	-1	2	0	1	2	0	2	0	1	2	0	2	0	2	17
TTL/TM/	2	2	0	1	2	2	3	1	3	1	2	3	2	1	1	2	2	30
OPP	-1	0	0	0	-1	0	2	0	0	2	0	0	0	-1	1	0	-1	9
BENE	0	1	1	2	3	0	2	1	2	3	1	0	1	2	2	1	1	23
OP_Mak	0	-1	0	0	0	0	1	0	0	1	0	0	0	1	1	1	0	6
ST_Comm	0	1	1	2	2	2	3	2	2	2	2	1	2	1	2	2	2	29
Number of agreements	19	18	13	14	25	15	24	17	20	20	16	18	19	15	19	14	21	
Number of disagreements	-1	-1	-2	-1	-1	0	0	0	0	-1	0	0	0	-1	0	0	-1	
Number of positions	20	19	15	15	26	15	24	17	20	21	16	18	19	16	19	14	22	

*The intensity of its positioning, which characterizes the degree of priority of the objective for the actor and for which five levels have been distinguished :
4 : the objective challenges the actor's existence / is essential to its existence,
3 : the objective affects the fulfilment of the actor's missions / is indispensable to its missions,
2 : the objective calls into question the success of the actor's projects / is indispensable to its projects,
1 : the objective involves, in a limited way in time and space, the actor's operating processes (management, etc.) / is indispensable to its operating processes,
0 : the objective is of little consequence.

The application of MACTOR software to these data produced results that are analyzed in the following section.

Before making any attempt, it is important to make sense of the actors' issues (Table 2), which in this case are in fact the common threads that carry the objectives of each actor into the arena, the battlefields that are the DPPs in Cameroon.

Results and discussion

The NDS30 shows that the structural transformation of the economy will be achieved through the DPPs as an additive to other structuring projects (NDS30, 2020). As such, they are places where actors from all walks of life, potential strategists of influence, come together.

Analysis of the structure of influences between the different Actors

The analysis of the structure of influence between the different actors of the DPPs allows the most influential actors to be classified: Dominant, autonomous, relay and dominated Actors.

Analysis of direct and indirect influences (MIDI)

The MIDI matrix (Table 3) allows us to identify the direct and indirect influences of order 2 between Actors. The most influential actors in the Cameroonian DPP system are the PPD, REGUL, TA and TTL, a very significant dominance.

Analysis of the plan of influences and dependencies (PID)

The Plan of Influences and Dependencies (PID) shows a graphical representation of the positioning of the actors, according to their direct and indirect net influences and dependencies (I_i and D_i) (Figure 1). This positioning is automatically generated by the MACTOR software.

The MIDI matrix and the Influence-Dependence Plan (IDP) provide information about the DPP arena in Cameroon and maps the positions of the different actors in the system, the behavior of the groups of actors involved. Such a situation did not escape Godet (2007) when he recalled in 1978, although far away, and in the midst of the growth of world air transport, the actor Aéroport de Paris had no interest in charter airlines, because the latter were the weakest link in the balance of power of the European air transport system.

The mapping generated by MACTOR software highlights a PPD system in Cameroon divided into four parts (Figure 1), supported by the degree of influence (I_i) and dependency (D_i) (Table 3). The relay actors have a high degree of power because they can give the "green light" or block PPDs. By way of illustration, the PPD and REGUL as the secant marginal, in the sense of sociologists Crozier and Friedberg (1992) taken up by (Messalti, 2018), that is, "an actor who is a stakeholder in several systems of action in relation to each other and who can, as a result, play an indispensable role as an intermediary and interpreter between different, even contradictory, logics of action. In other words, for the first (PTD) can cancel out the activities of other actors, for example by cancelling out funding. For the second (REGUL), it can, for

example, cancel the implementation of a DPP. The dominant actors appear to be key mediators in the execution of the links between actors in the DPP system in Cameroon. This is the eloquent case of the TTLs, who are "alpha" and "omega" in the sense of the future of DPP funds in Cameroon. The so-called autonomous actors, who can still be described as offside actors (OP_Mak and OPP), are like the "leftovers". On the other hand, the dominated actors obey the different spillover effects of the Actors, regardless of their coalitions or conflicts, and their reaction is always positive, as illustrated by the case of the Suppliers and Beneficiaries.

Still from figure 1, the relay actors show a strong involvement/mobilization. The actors COORDO, PMU and REGUL lead this classification. The REGULATOR, as its name indicates, is responsible for regulating the DPP system in Cameroon by guaranteeing that the strategic and operational objectives of the DPPs are achieved, with respect to the various actors and particularly the visions of the various PTDs.

Figure 1

Graph showing the Pattern of Influences and Dependencies (PID) between stakeholder groups
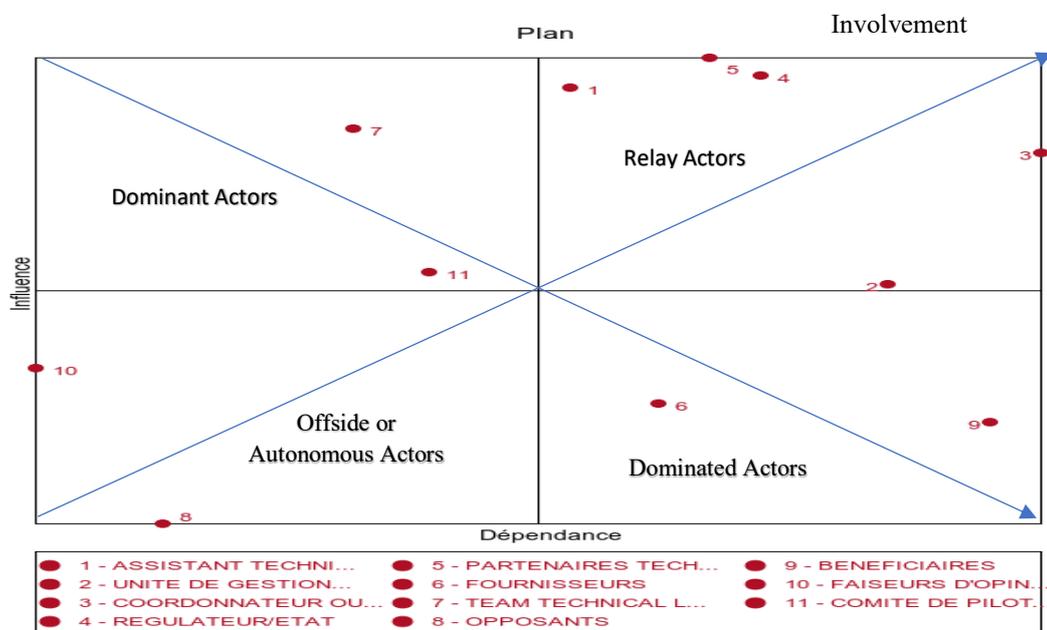
The histogram in Figure 2 shows the power relations of the entire DPP system under study. Three groups of actors emerge from this work. Firstly, there is the group of actors with a high-power ratio (Ri >1) composed of TTL, TDP, REGUL, COORDO and AT. On closer inspection, this is in fact the group of so-called dominant and relay actors in the PPD system. Secondly, the group of actors with a moderately high Ri (0.5≤Ri≤1), this group includes actors such as FOUR, FAIS_OP, PMU and ST_Comm. And third and last group ; These are the actors with low Ri (Ri<0.5). These are OPP and BENE. The particularity of these actors is paradoxically their strong dependence and weak influence on the other actors of the DPP system. In fact, the OPP actor seems to be more autonomous and/or sometimes out of the picture in relation to the DPP system.

Figure 2

Graph showing the power ratio or weight of each group of actors from MIDI

	Ri
TA	**1.51**
PMU	**0.73**
COORDO	**1.02**
REGUL	**1.41**
TDP	**1.5**
SUPP	**0.52**
TTL/TM/	**1.55**
OPP	**0.37**
BENE	**0.39**
OP_Mak	**0.99**
ST_Comm	**1**
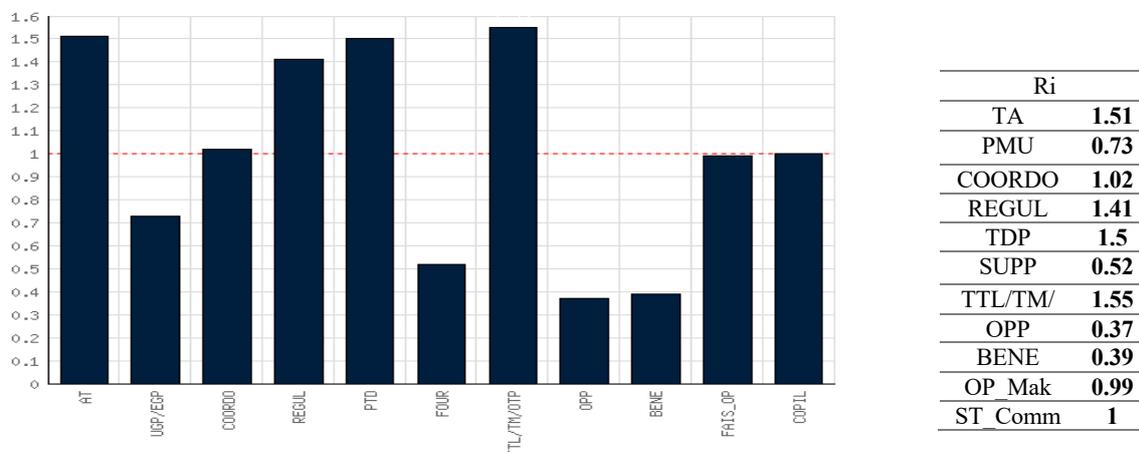
Identification of the apparent strategies of the actors in the DPP system in Cameroon

A synoptic synthesis of the apparent strategies of the Actors of the DPP system in Cameroon is highlighted in this section (Table 5).

Table 5

Synoptic summary table of the apparent strategies of the actors of the DPP system in Cameroon

Actors	Strategies
TDP	The marginal secant of the DPP system in Cameroon with a Relais position. Financial and economic power. Domination, self-interested political control.
BENE	Resilience and resignation. Abnegation, dominated actors, with limited power. Display high dependency.
SUPP	Dominated actors in the system, but still important to all others. Navigate between the desires of the system's principals.
REGU	The marginal secant of the PPD system in Cameroon, with a relay position, it has absolute power over the PPD system environment.
OP_Mak	Powerful communication networks, physical and human networks. Offside or Autonomous actors. Balancing Actors.
PPO	Pressure on decision-makers. Displays and defends an assumed or unclear position against the project.
TTL	A Dominant System Actor. Omnipresence in country strategy. Leadership. Lack of knowledge of country risk, financial power.
COORDO	The Marginal secant with a relay position. Strong involvement/mobilization. Social and political eminence.
TA	The crucial partner for the Regulator in its policy implementation. Aid clientelism. Actor relay, guarantor of PTD funds.
PMU	An important actor in the DPP system in Cameroon.
ST_Com	A dominant actor 'in spite of itself'. The guarantor of the smooth running of a project.

Note: Source : Extracted and adapted from Assontia Djoudji (2022).

Formulation of development prospects for DPPs in Cameroon

The forecasts in question refer to the dynamics of anticipation and the relevance of DPPs in Cameroon, together with scenarios based on the DELPHI method. This approach is a forecasting and decision support technique based on expert judgement (Landeta, 2006). Widely applied in the field of projects (Delphi method, n.d.), DELPHI is a systematic method for consensus (Dalkey & Helmer, 1963) or ranking after consecutive repetitions (Maleki, 2009).

The analysis of the discourse of the observed and met Actors highlighted a kind of degree of consensus related to each scenario. It emerged that the percentage of consensus on each scenario ranged from 80-90% in the first scenario, to 50-65% in the second and 55-70% in the third.

As a result, in Cameroon, the scenarios on the strategic analysis of the actors in the DPP system are based on three levers : the first lever is actancial, which is reflected in the mixed performance recorded by the DPPs precisely because of the conflicting and divergent logics and power relations of the actors. The second is contextualization and adaptability of the DPPs and the third and last is foresight, i.e., deep and intelligent anticipation of the DPP system in Cameroon.

Conclusion

The purpose of this paper was to analyse the strategy of actors in a prospective de-approach in the light of the mechanisms of provision within the PPDs in Cameroon.

The actual results show that the evaluation of the power relationships has allowed their hierarchization into four (04) types: dominant, relay, dominated and autonomous, and a participatory management of the system by the Technical and Financial Partner (TFP) of development, the Regulator (State), the Technical Team Leader (TTL) and to a certain extent the Steering Committee (St_Comm). In addition, there was also a great need for enlightenment, power organization and dynamization in order to have positive repercussions on the performance of DPPs in Cameroon.

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A CASE STUDY ON THE PRACTICE OF RECRUITMENT AND SELECTION IN SMES IN PUERTO RICO

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Abstract: This qualitative case study explores recruitment and selection practices in small businesses (SMEs) in Puerto Rico. The recruitment and selection process are one of the first activities within the human resources area that companies carry out to attract and integrate qualified and talented people. Recruiting and selecting the best talent, makes a distinctive difference between successful companies and therefore, improving recruitment and selection strategy proves to be an excellent vehicle for promoting productivity (Kumari, 2012). SMEs experience great difficulties due to their small size and limited knowledge about human resource management (Martínez, 2013). In general, they lack a formal strategy that allows them to recruit and select those resources that support the performance of their company (Torres, 2014). The literature review emphasizes recruitment and selection as the main drivers of business performance (Haruna & Hippolyte, 2017). To collect data, staff directly involved in the recruitment and selection process representing three SMEs in the service sector were interviewed. The interviews were based on a semi-structured question guide. The responses provided information about their recruitment and selection processes, which allowed the researcher to understand each participant's perspective. As a result of this research, participating companies lack a formal recruitment and selection strategy and policy. Its processes are traditional, using technological elements. They present challenges in the process that are common within Puerto Rican organizations.

Keywords: Strategy, SMEs, recruitment, human resources, selection.

UN ESTUDIO DE CASO SOBRE LA PRÁCTICA DE RECLUTAMIENTO Y SELECCIÓN EN LAS PYMES EN PUERTO RICO

Resumen: Este estudio de caso cualitativo explora las prácticas de reclutamiento y selección en las pequeñas empresas (pymes) en Puerto Rico. El proceso de reclutamiento y selección es una de las primeras actividades dentro del área de recursos humanos que realizan las empresas para atraer e integrar personas cualificadas y talentosas. Reclutar y seleccionar al mejor talento marca una diferencia distintiva entre las empresas exitosas, y por consiguiente, mejorar

la estrategia de reclutamiento y selección resulta ser un excelente vehículo para promover la productividad (Kumari, 2012). Las pymes experimentan grandes dificultades debido a su tamaño reducido y escasos conocimientos sobre la gestión del recurso humano (Martínez, 2013). Por lo general, carecen de una estrategia formal que les permita reclutar y seleccionar aquellos recursos que apoyen el desempeño de su empresa (Torres, 2014). La revisión de literatura enfatiza el reclutamiento y la selección como los principales impulsores del desempeño empresarial (Haruna & Hippolyte, 2017). Para recopilar datos, se entrevistó al personal directamente involucrado en el proceso de reclutamiento y selección que representa tres pymes en el sector de servicios. Las entrevistas se basaron en una guía de preguntas semiestructuradas. Las respuestas proporcionaron información sobre sus procesos de reclutamiento y selección, lo cual permitió al investigador comprender la perspectiva de cada participante. Como resultado de esta investigación, las empresas participantes carecen de una estrategia y política formal de reclutamiento y selección. Sus procesos son tradicionales, utilizando elementos tecnológicos. Presentan retos en el proceso que son comunes dentro de las organizaciones puertorriqueñas.

Palabras claves: Estrategia, pymes, reclutamiento, recursos humanos, selección.

Introduction

The success of an organization is based on implementing effective recruitment and selection practices (Ekwoaba, Ikeije, & Ufoma, 2015), as they enable companies to work with high-performing employees who are also satisfied with their work, which according to Oaya, Ogbu, and Remileken (2017) positively affects the company's bottom line, ensuring a competitive advantage over competitors.

Small and medium-sized enterprises (SMEs) are a key part of Puerto Rico's economy, and the human factor is an asset related to the success and competitiveness of this type of organization (Ley de Incentivos para la Generación y retención de empleos en PyMEs (2014). Effective recruitment and selection practices are critical to human resource management activities, especially for SMEs, to promote sustainable performance in order to retain top talent (Barney, Wright, & Ketchen, 2001).

Based on the above assumptions, a case study was conducted to explore the recruitment and selection practices in three SMEs in the service sector in Puerto Rico, based on the central question of the study: what are the practices and activities implemented by the personnel involved in the recruitment and selection processes? The study investigates the perceptions and experiences of the recruitment and selection processes carried out by the people responsible for this process.

In order to better understand the recruitment and selection practices of SMEs, we reviewed the literature on the topic of study, which focuses on the perspective of large companies, and comes largely from other countries, since the Puerto Rican literature is scarce.

In turn, it emphasizes recruitment and selection as the main drivers of business performance, with an emphasis on recruiting the best talent to maximize efficiency (Haruna & Hippolyte, 2017). Similarly, the theories presented are mainly related to human resources strategy and processes, emphasizing the contribution of human resources as the main unit of business success.

Method

The scope of the case study is exploratory. The main objective is to listen, explain and understand the experiences of those responsible for the recruitment and selection process in their natural environment and thus describe common elements from different experiences.

The data collection instrument is the researcher. According to Hernández-Sampieri, Fernández Collado and Baptista-Lucio, 2014, it is one of the fundamental characteristics of the qualitative process. Personnel directly involved in the recruitment and selection process were contacted directly through the interview technique. The interviews were based on a guide of semi-structured questions with some additional questions to clarify concepts and obtain additional information. The responses provided information about their recruitment and selection processes, which allowed the researcher to understand each participant's perspective.

The research design is phenomenological, since experiences were collected directly from the participants, allowing the researcher to obtain their statements about their knowledge, experiences and experiences on the topic studied. The unit of analysis object of the study are three service sector companies classified as SMEs. The study sample is non-probabilistic because they are cases that fit particular criteria. The analysis of the data is assisted by the MAXQDA program to segment, code, relate concepts, categories and research themes, allowing to analyze the research data qualitatively.

During the data analysis process, the variables related to the research were identified. Finally, inductive reasoning is used to infer about the phenomenon in a broader and more general way in the analysis of the data.

Results

The results of this case study reveal informative insights into recruitment and selection practices in SMEs in Puerto Rico. The participating companies follow fairly similar recruitment and selection processes to attract, evaluate and integrate qualified and talented people. They are constantly on the lookout to identify and integrate people who are potentially suitable to fill a vacancy, using a combination of traditional and modern techniques.

The role in the recruitment and selection process in the participating companies is shared between the human resources (HR) representative, manager and/or director. According to Arthur (2019) and Chiavenato, (2009), such collaboration is important to face the different challenges of carrying out the recruitment and selection process.

Contrary to the position of Martínez (2013) on the scarce professionalization in small and medium-sized companies, the interviewees and their managers responsible for the recruitment and selection process possess professionalism in this field despite their scarce formal training on the subject.

Respondents mentioned having legal knowledge about recruitment and selection from the point of view of employment law, diversity, fairness, fair processes and common sense practices. This explains their understanding of the importance of anti-discrimination laws. While they are no strangers to the legal aspect of recruitment and selection, both Arthur (2019) and Breaugh (2016)

emphasize the importance that a better understanding of the law will help them prevent unintentional violations or breaches that may lead to litigation.

Having a written recruitment and selection policy and procedure allows for better planning in identifying the human resources that are critical to the achievement of the organization's goals in a given period of time to achieve an efficient and productive process (Chiavenato, 2017; Arthur, 2019). It is also a communication and training tool to carry out the process in a congruent manner with all those responsible for recruitment and selection. An interviewee has a written policy for an equitable process among job applicants. Another interviewee has a policy that standardizes recruitment processes; however, it lacks a selection policy. Finally, the third interviewee is guided by a formal recruitment and selection process and makes decisions by consensus for the selection of the final candidate.

In general, the guidelines and policies used by the companies participating in this study cover two stages of the employment process: the search for candidates to fill a vacant position, how to identify and attract them and; secondly, the evaluation of the steps to select the most appropriate resource (Oaya et al., 2017).

The interviews conducted showed that the recruitment and selection practices of the participating companies are similar, a process that is illustrated in Figure 1:

Figure 1

Recruitment and selection process flow for participating companies
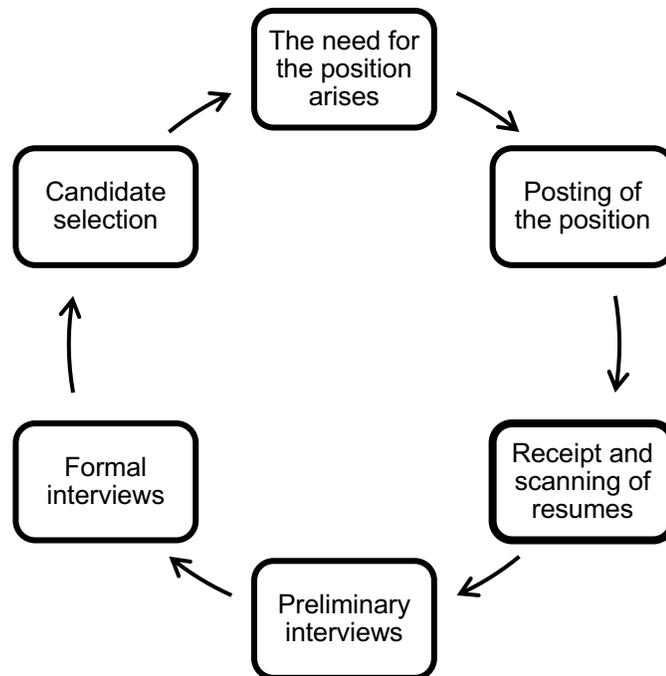
The process starts with the need to hire employees, when the company manager informs his HR representative about the need to start the hiring process. The first step is to create or review

the job description or vacancy with the department manager and the owner of the company to obtain the information for approval. Once approved, they proceed to publish it. Another interviewee mentions that as soon as the need arises, they consider how to handle the vacancy. The next interviewee mentions that they first identify the need; discuss it with the company's vice president to determine the need for the position, review or create the job description, and define the person's role in the business, and then proceed to approve the position.

According to the expressions of Mitchel and Gamlem (2017), interviewees stop to evaluate and point out the steps to follow as soon as the position became available or vacant before starting the recruitment process. The authors mention that this is the best opportunity to update the requirements and responsibilities of the position by analyzing the changes occurring inside and outside the organization.

In Mitchel and Gamlem's (2017) recommendations, all interviewees mentioned the need to create and/or modify the job description before starting the recruitment process. However, as part of the authors' recommendations, one of the interviewees stated that in addition to assessing the need for the position, they examine the budget available to fill it, whether it should be filled, and whether it helps the company achieve its objectives.

Once a position has been approved for posting, HR representatives use the external recruitment method: they conduct the search outside the organization by activating recruitment techniques to attract potential candidates (Society for Human Resource Management, n.d.). The interviewees refer that they use various media, mainly, social networks, to publicize the existence of employment opportunities (Chiavenato, 2017).

The internal recruitment method of the participating companies is virtually non-existent: they have no established process to encourage employees to apply for positions of interest that represent opportunities for career growth (Society for Human Resource Management, n.d.). One of these companies promotes employees on the recommendation of the manager; the second company creates development plans to take employees to the next career level; and the third company advertises the position only if there are employees interested in the position. However, none of the three companies are faithful in the internal publication of their posts.

As mentioned by Breaugh (2016), each recruitment method has its own advantages and disadvantages. None is better than the other. Each organization should develop its own combination of methods based on its nature and experience.

In this regard, the participating companies use various recruitment techniques to attract candidates and to advertise their vacancies. The most frequent are through social networks and job portals (Facebook, Indeed, LinkedIn). Respondents mentioned that they use them depending on the job classification. In the opinion of Arthur (2019), the use of these techniques is mainly in the employment decision-making process, and is the means mostly used by individuals seeking employment, and by employers to gather information about the employees they want to hire.

The least used techniques reported by interviewees were employee referrals, universities and job fairs. It should be noted that one of the companies only uses the company's website to receive resumes, while another reported that their company's referral program is very slow to generate candidates.

Respondents mentioned two hiring techniques that were not reflected in the Society for Human Resource Management (2017) survey. One of the participating companies advertises its

vacancies using an e-mail database of potential candidates. What is called in technical jargon *e-blast*: sending a copy of the same email to many people at once. One of the participating companies employs students as university interns and then hires them.

Below, Table 1 presents a list of the recruitment techniques reflected in the survey conducted by the *Society for Human Resource Management* (2017) and those used by the participating companies:

Table 1
Recruitment techniques used by participating companies

Recruitment Techniques	Percentage	P3	P2	P1
Employee referrals	90%	X	X	
Company website	85%		X	X
Free jobs website	71%	X		
Paid jobs website	68%			
Social networking website	67%	X	X	X
Informal networking	53%			
Employment agencies: temporary or regular	40%	X		
University field recruitment	39%			
On-site job fairs	39%	X	X	
Employment agencies: direct recruitment	36%			
Networking event	32%			
Printed publication	31%			
Online University Recruitment	30%			X
Commercial publications	11%			
Virtual job fairs	9%			
Radio advertising	8%	X		
Others	3%		X	X
TV advertising	2%			

Note. Adapted from Society for Human Resource Management (2017).

The companies participating in this study mainly use social networks and job portals compared to the results of the Society for Human Resource Management (2017) survey, where employee referrals are shown to be the most used. While respondents found a combination of these techniques to be the most effective method, one respondent mentioned that employee referrals were the most successful method of lead generation.

A survey conducted by the Society for Human Resource Management (2016) on the use of social media reflects that there has been an increase in the use of technology to attract job candidates who are smartphone users. However, participating companies do not use this technology as a recruiting technique.

One of the recruitment techniques used by the participating companies consists of receiving resumes from candidates interested in the vacancies posted. HR reads and scrutinizes the resumes received to select those who meet the job requirements. As part of this initiative, they begin by contacting selected candidates for preliminary interviews to first identify their interests and

determine whether or not they meet the job requirements (Arthur, 2019; Chiavenato, 2017; Mitchell & Gamlem, 2017).

In agreement with Chiavenato (2017), HR uses the preliminary interview as a first filter to separate the candidates who will continue the selection process from those who do not present the desired conditions to, then, proceed with a more in-depth interview conducted by the managers who need the position.

The formal interviews conducted by the managers of the participating companies are departmental and panel type (Arthur (2019). Sometimes they include HR. As Arthur (2019) mentions, an interview is an encounter between the candidate and one or more representatives during the selection process, and panel interviews allow interviewers to compare candidates' impressions when answering questions. Some interviewees stated that, depending on the situation and availability of the manager, one-on-one interviews could be arranged.

According to Restrepo, Ladino and Orozco (2008), the competency model is one of the most important in the recruitment and selection process. It should be noted that the competency method was not presented as one of the recruitment and selection techniques used by two of the participating companies. On the other hand, two of these companies use situational questions as a selection technique, while the third uses simulation questions.

Respondents mentioned that they use knowledge, technical and psychometric tests in their selection process. The knowledge and/or technical tests are prepared internally by the manager and sometimes in conjunction with HR, while the psychometric tests used by one of the companies are acquired through a supplier and validated by them.

Although two of the interviewees indicated the use of tests prepared and validated by them, it should be noted that any tests used in the selection process for employment decision making must be empirical or data that can be accurately inferred from scores on a given job selection objective (U.S. Equal Employment Opportunity Commission, n.d.). Validation of the tests will minimize any discriminatory employment claims.

All participating companies use employment references and background checks as part of their selection process. However, it is important to consider that the information obtained may exclude any applicant on the basis of race, color, religion, sex (including gender identity, sexual orientation, and pregnancy), national origin, age (40 years or older), and genetic information (U. S. Equal Employment Opportunity Commission, n.d.).

Participating companies have adopted virtual employment interviews due to the Covid-19 pandemic, which has transformed their recruitment processes by circumventing on-site candidate visits and their partial use in the candidate selection process (Klahre, 2020; Maurer, 2021). According to interviewees, in the last two years, Covid-19 has revolutionized the use of technology in the recruitment and selection process by facilitating interaction between potential candidates and the company, allowing instant and fast communication without them having to leave their homes (Chiavenato, 2009).

Recruitment and selection are activities related to the strategy of companies, adding value to both the organization and the people (Chiavenato, 2009). It is essential to measure the results and their impact on the organization's goals and the participants' satisfaction with the process. Interviewees acknowledge that they do not measure the effectiveness of the recruitment and selection process.

In contrast to the recruitment process model presented by Breaugh (2016), it can be inferred that the participating companies do not have specific objectives related to the strategic objectives of the organization; therefore, measurement and evaluation of the results of the efforts to determine their impact on the organization's goals and objectives is limited. This is despite the fact that one of the interviewees mentioned the use of metrics in their recruitment and selection process, such as return on investment, employee retention time, time and cost to hire, departmental effectiveness, and surveys of hired employees to learn about the effectiveness of their company's recruitment and selection process.

This does not negate the fact that recruitment and selection strategy plays an important role in the company's goals and objectives, as stated by Hay Group Pte Ltd (2004) and Cejas and Chirinos (2013). These indicate that a recruitment and selection process that is not aligned with the organization's philosophies and objectives can harm production, customer satisfaction, supplier relationships and overall quality of work.

Breaugh (2016) and Chiavenato (2017) show that outcome measurement and evaluation of recruitment efforts is a key activity in determining whether recruitment objectives have been met. However, they mention that many organizations informally evaluate their recruitment efforts.

Regarding the common challenges they face in the recruitment and selection processes, the interviewees in this study expressed difficulty in finding candidates who meet the minimum requirements of the position they are advertising, who are committed to the position, and who accept the job offer. They agreed that the situation worsened when the Covid-19 pandemic began in 2020, which represents one of the challenges that has affected their recruitment process to some extent. They cite government financial aid, salary and remote work instead of face-to-face work as reasons for attracting candidates.

Another challenge for the company is the lack of commitment from candidates: they do not return phone calls, do not prepare for interviews and are careless in the selection process. According to the interviewee, this situation adds time to the recruitment and selection process.

Similarly, the participating companies present additional challenges in attracting personnel involved in the use of technology in its different modalities. Also align the candidate's salary expectations with the market reality of your company.

An interesting finding during the interview process is that interviewees consider as an important characteristic in their selection process that the candidate must integrate well with their organizational culture, which encompasses their values, norms, beliefs, attitudes and behavior. This ties in with the words of Armstrong (2009) and Arthur (2019) when they mention that it is not necessary to merely identify the most qualified candidates, but also to identify the right person for the organization's culture.

It should be noted that, despite considering the characteristics of organizational culture in recruiting and selecting candidates, Chiavenato (2017), Mitchell and Gamlem (2017), and Fisher, Schoenfeldt, and Shaw. (2006) mention two disadvantages to consider: first, new employees need more time to integrate and learn the culture of the organization and, second, there is not much information about the candidate except what was said in the interview and information from employment references.

Discussion and conclusions

The results of this case study are based on the exploration of recruitment and selection practices through interviews with human resources personnel from three service industry companies representing SMEs in Puerto Rico. As part of the overall objective of the research, the participating companies were able to describe the practices and activities they perform in the recruitment and selection process by answering guiding questions from the researcher.

The answers provided by the participating companies showed that they carry out their recruitment and selection processes in collaboration with HR and managers, which leads to the conclusion that they manage to do it successfully because of this joint work. Failure to do so can prolong the hiring process or lead to poor selection decisions that often lead to morale and performance issues and ultimately turnover (Arthur, 2019).

The case study shows that in order to function effectively in the recruitment and selection process, skills, abilities, knowledge and experience are necessary to hire the best talent for the organization and minimize the legal labor risks that limit their development. While human resources representatives have demonstrated skills, knowledge, and experience in this field, it is important for the organization's managers to have first-hand knowledge of the labor laws related to the recruitment and selection process (Arthur, 2019).

According to HR, managers' expertise is derived from their experience in implementing the recruitment and selection process (Rodriguez-Moreno, 2012). However, HR, as well as managers, do not have formal training on this topic, especially as it relates to labor laws applicable to the recruitment and selection process.

Consistent with Arthur (2019), HR is responsible for ensuring full compliance with state and federal labor laws and regulations, as well as raising awareness of how they affect job applicants and employees. He adds that managers should familiarize themselves with basic information related to equal employment opportunity legislation, understand which employment questions are off limits, and be responsible for ensuring that the entire process is free of bias.

It should be noted that the success of any organization, regardless of its size, is strongly linked to the quality of the recruitment process (Breaugh, 2016), leading to the conclusion that attracting the best talent will bring a competitive advantage to any business (Chiavenato, 2017). From that perspective, participating companies join efforts with the objective of recruiting the best talent for their organization using traditional recruitment and selection techniques and procedures despite the evolution in that field, which is driven by strategic issues, social pressures and technological developments (Derous & Fruyt, 2016).

Arthur (2019) emphasizes that the way a company recruits affects the people it hires, as well as their expected performance or output. He adds that to achieve this objective, it is necessary to balance those recruitment initiatives carried out in the past, learned mostly by tradition, or custom and usage, by objectively assessing whether established recruitment policies and practices will help or hinder recruitment efforts.

Thus, it is concluded that the participating companies base their recruitment and selection efforts on their experience of the process and communicate their method of implementation without formal policies and procedures to support them in better recruitment, selection and retention of employees, which is consistent with the findings of Rodriguez-Moreno (2012).

Regarding the recruitment and selection practices carried out by the participating companies, it was concluded that they are closer to the best fit theory although they do not have a formal recruitment and selection strategy to help them direct their efforts more effectively. HR explained that their recruitment and selection practice aims to select the best talent to fit their company's position. They seek compatibility of the person with the job and the organization (Sekiguchi, 2004), which leads to the rejection of the resources and capabilities theory as the basis of this study, as it emphasizes the importance of strategic human resource management in order to engender organizational success by enhancing the firm's ability to acquire, develop, utilize, and retain employees with high levels of competence relevant to the firm's activities (Fisher et al., 2006).

According to Restrepo, Ladino and Orozco (2008), the competency model is one of the most important changes in the recruitment and selection processes. In contrast to traditional recruitment, these authors argue that the competency-based model does not simply look for candidates, but directs its efforts towards the search for competencies through different sources of talent acquisition. Alles (2009) defines the competency model as the set of processes related to the people who make up the organization and whose purpose is to align them with the company's objectives.

One of the objectives of this research was to explore how to implement the competency model in the participating companies. Although HR used the term competencies when explaining their recruitment and selection process, the use of such a model in their recruitment and selection practices could not be corroborated.

Although the recruitment and selection process of the participating companies is traditional, they have resorted to technology, combining virtual and face-to-face recruitment processes (Maurer, 2021). However, they have the opportunity to modify their hiring processes to adapt to the labor market, economic realities, and technological advances in order to attract and retain the quality of talent they require (Arthur, 2019; Derous & Fruyt, 2016; Maurer, 2021).

Two of the participating companies do not use the organization's website as a recruiting technique to market open positions, thus missing the opportunity to attract candidates and raise awareness of the company's brand. Galanaki (2002) and Owusu-Ansah and Nyarko (2014) note that a strong website and corporate brand image are beneficial in attracting higher quality candidates.

One of the techniques for recruiting candidates is mobile recruiting. According to a survey conducted by the Society for Human Resource Management (2016), 66% of companies surveyed use measures to recruit candidates via smartphones, also known as mobile and cellular devices. The participating companies do not use means that allow them to recruit candidates through mobile devices, which is a disadvantage when it comes to attracting talent to their organizations. As Headworth (2015) noted, candidates have constant access to cell phones, what changes is how they act when looking for jobs. Mobile devices must become an integral part of the recruitment and selection strategy, not only to reach candidates and attract them to the organization, but also to showcase a strong corporate brand. Therefore, participating companies should inquire different channels for talent sourcing (Deloitte Insight, 2019).

Measuring and evaluating recruitment results is critical to determine whether recruitment and selection objectives have been met (Breaugh, 2016). Only one of the participating companies measures and evaluates some aspects of its recruitment and selection process and shares the results with the leaders of its organization. Participating companies need reliable information to make

good decisions and help them strengthen the recruitment and selection process (Mitchell & Gamlem, 2017). As Dessler (2013) mentions, being able to measure what you do is an integral part of the HR strategy process.

Agreeing with Mitchell and Gamlem (2017), it is inferred that the trend of using metrics and analysis of the recruitment and selection process has been difficult for two of the participating companies. It is important that they understand that the use of data helps them to make better decisions, which can be better valued by the organization. In conclusion, to complete the recruitment and selection process, it is crucial to measure its effectiveness and success: the use of metrics helps to promote continuous improvement (Hay Group Pte Ltd, 2004; Dessler, 2013)

To add real value to the organization, it is imperative that HR professionals engage in strategic conversations within the organization to demonstrate how the recruitment and selection process can contribute to the company's bottom line (Mitchell & Gamlem, 2017; Dessler, 2013). Creating a strategy means formulating and implementing human resource policies and procedures that provide the necessary employee competencies and behaviors to achieve the organization's strategy (Dessler, 2013).

While there is an absence of a strategic recruitment and selection plan in line with the goals and objectives of the participating companies (Torres, 2014), what is certain is that the experience of the participating companies has led to changes in their recruitment and selection processes in the last five years due to environmental factors such as Hurricane Maria in 2017, the Covid-19 outbreak from 2020, as well as generational and technological demographic changes in the population. Therefore, the particular economic circumstances of recent years have posed great challenges for participating companies (Ley de Incentivos para la Generación y Retención de Empleos en PyMEs, 2014).

According to the information provided by interviewees, these changes have resulted in variations and challenges in their recruitment and selection process. Therefore, it can be argued that the companies that participated in this case study have an excellent opportunity to implement a recruitment and selection strategy that is consistent with other industry insights and economic realities, markets, social pressures, and technological developments, among other aspects (Breaugh, 2016; Derous & Fruyt, 2016; Maurer, 2021). The recruitment and selection function is necessary to combat the economic challenges presented by these companies and promote a competitive advantage in order to achieve sustainability goals and objectives (Oaya et al., 2017).

The Covid-19 pandemic crisis brought peculiar challenges to the participating companies in their recruitment and selection process, among other things, attracting candidates with the necessary competencies for the positions to be hired, especially those in the technology sector; competing for the same positions with other companies; offering salaries in line with candidates' expectations; specialized jobs due to the nature of service they offer to their customers; and finally, telecommuting versus face-to-face work (Maurer, 2021).

All of these challenges faced by the participating companies are common within organizations in Puerto Rico, regardless of their size. In addition to Covid-19, Technical Studies, Inc. (2021) argue that one of the serious long-term complications affecting the availability of talent with the necessary skills is the decline in the number of young people and the aging of the population which can have a significant impact on employment by causing a slowdown in the growth of the labor force. Consequently, these trends require participating companies to adopt

strategies and policies aimed at mitigating these changes that affect their recruitment and selection process.

In short, it can be stated that the practice of recruitment and selection cannot be limited to traditional forms. As the battle for talent increases, a changing economy and labor market, slowing workforce growth, and the intensifying use of technology, it is imperative that participating companies utilize innovative recruitment and selection channels. Static contracting is no longer sufficient in the current situation of profitability and efficiency (Hay Group Pte Ltd, 2004).

The key message here is that the area of recruitment and selection is rapidly evolving, affecting many aspects of finding, attracting, and selecting talented employees, requiring close monitoring and examination of the process by HR (Derous & Fruyt, 2016). The success of any organization depends on the quality of the workforce that the organization has recruited through the recruitment and selection process (Ekwoaba et al., 2015). Therefore, recruitment and selection practices are predictors or determinants of SME performance (Omolo Oginda & Otengah, 2013).

One of the limitations in the development of this study was the scarcity of literature and research on the recruitment and selection practices of SMEs, especially in Puerto Rico.

Another limitation of the study was the nature of the sample, which included a limited number of industries involved in recruitment and selection practices. It should be noted that one of the constraints to reaching a larger number of participants was gaining access to various resources during the Covid-19 pandemic.

It should be emphasized that the degree of similarity among the participants limits the generalizability of the study to other types of SMEs in Puerto Rico. However, the results are still significant.

The HR of each participating company was interviewed as the main responsible for the recruitment and selection process. Interviewing other members of the company involved in the recruitment and selection process would have provided a better understanding of their recruitment and selection practices. Either way, the important thing about both methods is to project the findings by providing information as close to reality as possible.

Official documents of the recruitment and selection process are valuable sources of information that support the analysis of qualitative data and the understanding of the central phenomenon of study (Hernández-Sampieri, Fernández-Collado, & Baptista-Lucio, 2014; Leedy & Ormrod, 2013). As part of the research process, participants were asked for documentation related to the recruitment and selection process; however, HR needed the company's permission to provide them. Therefore, the requested documents, which would support the analysis of the data collected, were not received.

Conducting qualitative research in an organizational setting is certainly valuable. In particular, when working a case study one hopes to capture and study the complexity and particularity that occurs in a natural setting; that is, in the real world (Leedy & Ormrod, 2013). In such an environment, challenges arise due to the nature of the environment, such as accessing organizational members, assessing and interacting with them virtually and in person (avoiding the halo), and at the same time being neutral and reliable in collecting objective data.

The results of the case study are intended to contribute to the knowledge base to be applied to the design and implementation of recruitment and selection policies and procedures aimed at

promoting innovations that benefit HR and the SME sector and, ultimately, the economy of Puerto Rico.

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INFLUENTIAL FACTORS TO IMPROVE THE PERFORMANCE OF AUTO PARTS MANUFACTURERS IN NUEVO LEÓN

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Abstract. Increasing performance towards a highly efficient operation in the manufacture of parts is one of the approaches that companies adopt in their production systems. Given the growing globalization, due to trade agreements between countries and geographical areas, the need to integrate the automotive industry into the value chain arises. The objective of this research is to determine which factors influence the improvement of the performance of auto parts manufacturers in Nuevo León. The method used to determine these factors was the collection of information, through a literature review, to form a survey as the main measurement instrument. This survey was first tested by experts in the area to validate it and later it was applied to a pilot sample to check its reliability. It is necessary to indicate that the study subjects are the managers of the productive area in auto parts companies. According to the established model, multiple linear regression was applied to evaluate the four variables that impact the Improvement of Organizational Performance. The established variables were Lean Manufacturing Tools, Process Measurement, Organizational Practices and Process Innovation. The results obtained from statistical analyzes in SPSS, indicate that Organizational Practices and Process Innovation have a significant impact on the Improvement of Organizational Performance.

Keywords: Organizational performance, lean manufacturing, innovation, process measurement, organizational practices.

FACTORES INFLUYENTES PARA MEJORAR EL DESEMPEÑO DE FABRICANTES DE AUTOPARTES DE NUEVO LEÓN

Resumen. Incrementar el desempeño hacia una operación altamente eficiente en la fabricación de piezas es uno de los enfoques que las empresas adoptan en sus sistemas de producción. Ante la creciente globalización, por acuerdos comerciales entre países y áreas geográficas, surge la necesidad de integrar la industria automotriz a la cadena de valor. La presente investigación tiene como objetivo determinar qué factores influyen en la mejora del desempeño de los fabricantes de autopartes de Nuevo León. El método usado para determinar dichos factores fue la recopilación de información, mediante revisión de literatura, para conformar una encuesta como principal instrumento de medición. Esta encuesta fue primeramente probada por expertos en el área con el objetivo de

validarla y posteriormente se aplicó a una muestra piloto para revisar su fiabilidad. Es necesario indicar que los sujetos de estudio son los gerentes del área productiva en empresas de autopartes. De acuerdo con el modelo establecido, se aplicó la regresión lineal múltiple con el objetivo de evaluar las cuatro variables que impactan en la Mejora del Desempeño Organizacional. Las variables establecidas fueron las Herramientas Lean Manufacturing, Medición de los Procesos, Prácticas Organizacionales e Innovación de los Procesos. Los resultados obtenidos, a partir de análisis estadísticos en SPSS, indican que las Prácticas Organizacionales y la Innovación de los Procesos tienen un impacto significativo en la Mejora del Desempeño Organizacional.

Palabras clave: Desempeño organizacional, lean manufacturing, innovación, medición de los procesos, prácticas organizacionales.

Introduction

The objective of this research is to analyze a proposal on the factors that influence organizational performance in the auto parts industry in Nuevo Leon performance in the auto parts industry in Nuevo Leon. The importance of studying this topic lies in the need for companies in this sector to increase their competitiveness due to the dynamic, uncertain environment and increasingly intense competition as a result of globalization, technological innovation and short product life cycles, among other factors.

Initially, the background of the problem to be studied is presented, analyzing information regarding statistics related to the subject of study, at local, national and international level, as well as the classification of the auto parts manufacturing industry according to the National Institute of Statistics and Geography (INEGI) (INEGI, 2018).

Based on the type of industry, the variables that have an impact on the problems and industrial sector presented were determined. Based on the literature, a measurement instrument was developed, which consisted of a survey with a Likert scale from 1 to 5, which was applied to a portion of the sample in order to measure the reliability of the measurement instrument.

Once the measurement instrument was validated, it was applied in its entirety to the established sample and the data collected were analyzed descriptively to establish the characteristics of the selected sample. The analysis of the impact of the independent variables on the dependent variable was carried out using inferential statistics and a model obtained by multiple linear regression.

Significant factors in Lean Manufacturing implementation

The automotive industry is one of the most important not only in Mexico but in the world. It is one of the industries that generates the largest number of jobs and improves the economy of the countries that host it, so one of the main objectives is to strengthen and develop its growth (Rugel & Pineda, 2019).

In 2012, global automotive production hovered around 84 million vehicles including pickup trucks and buses, employing approximately 9 million workers and generating 50 million jobs, including indirect jobs (OICA, 2013).

Considering the above data and coupled with the effect of the COVID-19 pandemic, it is possible to identify the relevance of this industry as a "multiplier effect" (UNESCO, 2021). This effect refers to the impact of the automotive industry on other industries and their capacity to generate employment, attract investment and technological development. The automotive sector stood out for its highest employment generation with 57% of vacancies, followed by the food industry with 11%, textile and footwear with 6%, chemicals with 5% and aerospace with

5% (MexicoIndustry, 2017). The good performance of the automotive industry benefits the rest of the sectors, such as metal-mechanics, plastics and pneumatics, as a whole. This is due to the fact that this industry requires a large number of suppliers of different parts, raw materials and/or materials, as well as services (heat treatments, coatings, welding, calibration of measuring equipment, transportation and logistics).

The automotive industry, in search of organizational development, relies on the *Lean Manufacturing* methodology, which in recent years has spread in the manufacturing industry, as well as in companies dedicated to commercial distribution, telecommunications, health, aeronautics, pharmaceuticals, among others.

According to González et al. (2012) *Lean Manufacturing* is an integrated management system, whose main objective is to achieve maximum efficiency of the company, developing operations with minimum cost and zero waste. The aim is to act on the cause of variability or losses and above all inflexibility in order to achieve improvements in costs, deadlines, times and quality, in this way the companies adopt a management philosophy based on continuous improvement.

González (2007)defines *Lean Manufacturing* as a set of tools that support the identification and elimination of waste that could improve quality, as well as production times and costs. Waste are activities that do not generate value and can be found both tangibly in materials, parts and equipment and non-tangibly in time and money (Nor, Rahman, Sharif, & Esa, 2013). Complementing *Lean Manufacturing* is *Lean Thinking*, which is a process that is characterized by identifying activities that add value for the customer with the minimum of waste (Anthony, 2011).

According to León (2017)who analyzed the factors that determine the success of *Lean Manufacturing* implementation in organizations, indicated that there are four key factors, among which top management commitment, continuous monitoring, leadership and the training program stand out.

Möldner (2020)in his research determined that *Lean Manufacturing* application techniques (Just in Time, Total Productive Maintenance, *Jidoka, Value Stream Mapping* and continuous improvement) have a direct relationship with the development of the organization's operations.

On the other hand, Arango (2015) indicated the use of *Kanban* as a methodology that has an impact on organizational performance due to the decrease of inventories and synchronization of the stages for the assortment of materials, Figure 1.

Figure 1

Kanban Hypothesis Model and Organizational Performance

Peralta (2020)reported as an independent variable the application of the Kanban tool in cedis, depending on cost reduction, that is, to obtain improvements that allow the success of the tool. The author concludes that the human factor is key for the tool to work in the best way; however, it was proven that the implementation of the tool brings improvements and leads to a successful application.

Santos (2013)santos, states that the 5's technique provides solutions to make processes more agile, since this technique is defined as a work philosophy that allows the development of a systematic behavior to continuously maintain classification, order and cleanliness, resulting in higher productivity, improved safety, work environment, personal motivation, quality, efficiency and consequently the performance of the organization. The name of the 5's tool is derived from the techniques in Japanese: Seiri, Seiton, Seiso, Seiketsu and Shitsuke.

Author Lefcovich (2012)mentions some of the benefits of Kaizen: reduced accidents, reduced inventories, process-oriented thinking, emphasis on the planning stage, reduced equipment and tool failures, reduced machine setup times, customer satisfaction, increased inventory turnover levels, significant drop in failure and error levels, improved staff self-esteem and motivation, increased productivity, cost reduction, improved product design, reduced waste and spoilage, reduced design and operating cycles, improved cash flow, reduced customer and employee turnover, economic and financial balance, improved attitude and aptitude of management and staff for continuous change implementation, ability to compete in globalized markets and finally a better adaptation to abrupt changes in the market.

Monge (2013)monge, establishes that the independent variables lean manufacturing, sustainable processes and continuous improvement have a direct, relevant, positive and statistically significant impact on the dependent construct of operational efficiency and environmental responsibility, with lean manufacturing having the greatest impact.

Wilches (2013)indicates that there is a strong relationship to increase the performance of organizations through *Lean Manufacturing* tools, highlighting that important factors for this increase are the commitment of employees and the continuity of management in the planning, follow-up and action-taking stages.

In the research conducted by Prasanta (2019)presented the analysis of the independent variables, development of lean and sustainable practices, process innovation in small and medium-sized companies, on the dependent variable organizational performance, concluding that *Lean* practices are more effective for SMEs compared to process innovation.

Greenan (2003)states that there is a relationship between process innovation and improved organizational performance. Achanga (2006)indicates that globalization and

emerging technologies have had an impact on manufacturing industries around the world. He identified that 50% corresponds to leadership, 30% financial investments, 10% organizational culture and 10% skill.

Process innovation is the implementation of a new or significantly improved production or delivery method, including significant changes in techniques, equipment and/or software (Klewitz & Hansen, 2014). Innovation is a process of change, currently the industry 4.0 revolutionized production processes by creating smart factories through the use of robotics, the internet of things, advanced interface and virtual reality (Ivanov, Dolgui, & Sokolov, 2019).

Indicators and organizational practices

Alvarado (2001) describes indicators as numerical values that allow measuring the behavior and evolution of a process, activity, area or department. They should be simple or direct, and should consist of a direct measure of the characteristics to be measured, and their purpose is to evaluate specific activities or tasks of a process in order to improve the performance of the organization. Ray (2007) indicates that a business metric should quantify, monitor and evaluate the success or failure of the organization's performance.

Related to the indicators are organizational practices, which are mechanisms used in an organization to communicate its values, norms and goals to its employees; they are instrumental and shape perceptions about the emphasis that the organization places on its principles. They also serve the function of pointing out, communicating and reinforcing those aspects that the organization expects from its employees. In the context of quality, the practices emphasize attitudes and behaviors within the organization (Riordan C, Gatewood, & Bill, 1997).

Mudhafar (2017), states that leadership impacts the implementation of lean manufacturing and determined that it has been highlighted as a key success factor especially in SMEs. In addition to the above, it indicates that through the use of lean tools and methods it is possible to implement lean manufacturing; the reality is that they do not ensure success unless top management and leadership adapt to the needs of *Lean Manufacturing*.

Sarhan (2013) analyzes the success of *Lean Manufacturing* implementation in the construction industry by analyzing the organizational practices that serve as determinants for its implementation. The author concluded that *outsourcing,* social responsibility, financial problems, lack of management commitment, lack of Lean education, lack of customer focus and lack of establishing performance metrics can all affect the success of *Lean Manufacturing*.

Among the main practices is management's commitment to quality. There is a consensus in accepting management leadership or commitment as a necessary condition for a quality culture. Deming includes it in his fourteen principles of application, Crosby refers to it as the first step to quality and Juran holds top management accountable for operational compliance. There is positive evidence between leadership and organizational performance (Tejada & Arias, 2005).

Gopalakrisghnan (2000)considers that organizational performance has several synonyms, among which are efficiency, effectiveness, financial results and employee satisfaction. Empirical studies related to organizational performance have been carried out in which the innovation process stands out (Yamakawa & Ostos, 2011).

In accordance with the literature reviewed, the improvement in the performance of organizations and the relationships found between variables in different research studies, Figure 2 is presented.

Figure 2

Graphical model of the hypotheses
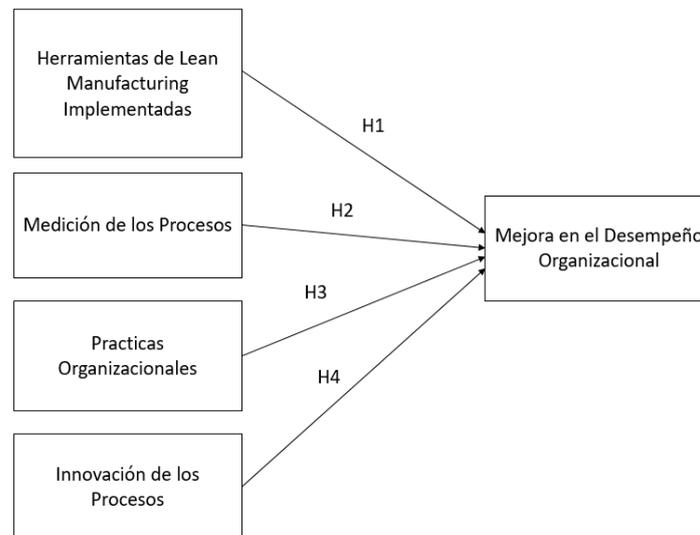
The hypotheses presented for the research are described below:

H1: *Lean Manufacturing* tools have an impact on improving organizational performance.

H2: Process Measurement has an impact on improving organizational performance.

H3: Organizational Best Practices have an impact on improving organizational performance.

H4: Process innovation has an impact on improving organizational performance.

The research approach is quantitative in nature because it measures phenomena and uses statistics to test hypotheses and theory (Hernandez S. , 2014).

Method

The present study is of the cross-sectional type because the data collection was carried out at a single time point. It is quantitative in nature since it considers the measurement of variables related to the dependent variable. In addition, it is correlational and explanatory since it evaluates the impact of the independent variables on the dependent variable, through the application of the survey and subsequent analysis by means of multiple linear regression with the use of SPSS software. On the other hand, this research is non-experimental since the phenomenon was observed without any type of manipulation of the model variables (Hernandez R. , 2018).

The sample was determined using the non-probabilistic sampling technique with an unknown finite inventory, at a 90% confidence level and an error of 10%, obtaining a sample of 28 large auto parts manufacturing companies for motor vehicles distributed in the state of

Nuevo Leon (Hernandez R. , 2018). It is important to note that the measurement instrument was sent to selected companies with their prior authorization.

In order to collect the information, a survey with a Likert scale evaluation was applied: 1) Strongly disagree, 2) Disagree, 3) Neither agree nor disagree, 4) Agree, 5) Strongly agree. In order to carry out the content validity, the measurement instrument was reviewed with a group of experts in the field, resulting in the restructuring of the wording of some items (IP1, IP2, HLM19, and HLM20), and the recommendation to use the 5-point Likert scale (Soriano, 2014).

On the other hand, in order to test the reliability of the measurement instrument, a pilot test was carried out with 15 surveys addressed to companies dedicated to the manufacture of auto parts. To test reliability, Cronbach's Alpha index was applied per variable. Table 1 shows the results for the variables Process Measurement, Organizational Practices and Organizational Performance, which indicate that there is a correlation and it is not necessary to eliminate any item. For the variables Innovation in the Organization and Lean Tools, it is necessary to eliminate three and one item, respectively, in order to achieve internal consistency of the instrument. Consequently, the survey consists of 41 questions for the next stage.

Table 1

Cronbach's Alpha values pilot test

Variable	Variable Name	Final Cronbach's Alpha	Items eliminated from the total	Items considered
X1	Lean Manufacturing Tools	0.824	HL16	HL17, HL18, HL19, HL20, HL21, HL22, HL23, HL24, HL25
X2	Process Measurement	0.910	-	MP9, MP10, MP11, MP11, MP12, MP13, MP14, MP15
X3	Organizational Practices	0.805	-	PO30, PO31, PO32, PO33, PO34, PO35, PO36
X4	Innovation in the Organization	0.799	IP5, IP6, IP8	IP1, IP2, IP3, IP4, IP7
Y1	Organizational Performance	0.909	-	DO37, DO38, DO39, DO40, DO41, DO42, DO43

Results

Results of descriptive statistics

The results of the respondents' gender and the descriptive statistics to obtain the values of the measure of each of the variables are presented below. Regarding the gender of the respondents, it is important to note that 55% are men and 45% are women. The number of surveys applied was 45, however, there were *outliers*, which resulted in 33 surveys being considered valid. This information can be seen in Figure 3.

Figure 3

Gender of Respondents
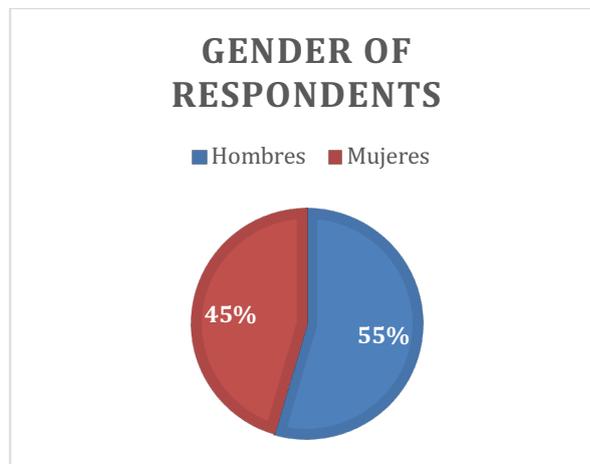
From the data collected during the application of the 33 surveys, the mean and standard deviation of each of the variables were calculated. The results of the descriptive statistical observation on the behavior of each variable item are shown in the following tables.

The descriptive statistics of the items that make up the variable X1, *Lean Manufacturing* Tools, are shown in Table 2. The mean of the responses tends to a value of 5, which being the maximum value indicates that the respondents fully agree with the question asked. On the other hand, the standard deviation for item HL17 is 0.36411 which indicates that the data are stable, similar and close to each other. Data for items HL16, HL19, HL20 indicate variability, but not significant. The items that show this variability correspond to the use of *Value Stream Mapping*, SMED and JIDOKA, which are *Lean Manufacturing* tools that take more time to develop and companies choose to select "other" tools for the improvement of their processes, such as the 5's. Furthermore, considering that the question is focused on the frequency of tool use, it is possible to conclude that these are second-level tools, which are not applied on a daily basis.

Table 2

Descriptive Statistics Variable Lean Manufacturing Tools Implemented.

	N	Minimum	Maximum	Media	Standard Deviation
HL16	33	1	5	4.3030	1.35750
HL17	33	4	5	4.8485	0.36411
HL18	33	3	5	4.7879	0.48461
HL19	33	1	5	4.3636	1.02525
HL20	33	1	5	4.0303	1.15879
HL21	33	1	5	4.2121	0.99240
HL22	33	3	5	4.2424	0.70844
HL23	33	4	5	4.7879	0.41515
HL24	33	2	5	4.7576	0.66287
HL25	33	3	5	4.7576	0.56071

For variable X2, Process Measurement, the information is presented in Table 3. The mean value shows an inclination to strongly agree. The standard deviation of item MP12 is 0.39167, indicating that the variability is low. In the case of item MP8 the variability is 0.90558, which corresponds to the analysis of the productivity of human resources in the different processes of the organization. It is considered that this deviation was generated due to the fact that not only productive processes but also other areas of the organization were asked about.

Table 3

Descriptive Statistics Variable Process Measurement

	N	Minimum	Maximum	Media	Standard Deviation
MP8	33	2	5	4.4848	0.90558
MP9	33	2	5	4.6061	0.78817
MP10	33	2	5	4.5455	0.79415
MP11	33	3	5	4.5152	0.75503
MP12	33	4	5	4.8182	0.39167
MP13	33	3	5	4.3636	0.74239
MP14	33	3	5	4.8182	0.46466
MP15	33	2	5	4.5758	0.75126

In the case of the Organizational Practices variable, the information is presented in Table 4, which shows that the mean of each of the items is oriented towards the highest score. On the other hand, the standard deviation indicates that item PO30 has a low variability of 0.17408, the opposite is true for item PO34 with 0.96236. The latter corresponds to the empowerment of workers. Mexico, being a country undergoing change, still has organizations that consider excluding the empowerment of its workers, concentrating the power of decision only in the managers (Blanco & Moros , 2020).

Table 4

Descriptive Statistics Variable Organizational Practices

	N	Minimum	Maximum	Media	Standard Deviation
PO30	33	4	5	4.9697	0.17408
PO31	33	4	5	4.8788	0.33143
PO32	33	3	5	4.6061	0.55562
PO33	33	3	5	4.5455	0.61699
PO34	33	1	5	4.3636	0.96236
PO35	33	3	5	4.8485	0.44167
PO36	33	2	5	4.9788	0.54530

For the last independent variable, Process Innovation, the results are shown in Table 5 whose mean is above a value of 4.

Table 5

Descriptive Statistics Variable Process Innovation

	N	Minimum	Maximum	Media	Standard Deviation
IP1	33	3	5	4.4848	0.79535
IP2	33	3	5	4.4545	0.79415
IP3	33	2	5	4.0909	0.91391
IP4	33	2	5	4.3030	0.91804
IP5	33	2	5	4.2727	1.09752
IP6	33	2	5	4.6061	0.82687
IP7	33	3	5	4.8182	0.52764

The statistical data associated with the dependent variable, Organizational Performance, show that the means of the items tend to a value close to 5, which represents the highest score in the measurement instrument. On the other hand, the standard deviation for this construct is minimal as shown in Table 6.

Table 6

Descriptive Statistics Variable Organizational Performance

	N	Minimum	Maximum	Media	Standard Deviation
DO37	33	4	5	4.8182	0.39167
DO38	33	4	5	4.7273	0.45227
DO39	33	4	5	4.6364	0.48850
DO40	33	3	5	4.4848	0.66714
DO41	33	4	5	4.7273	0.45227
DO42	33	4	5	4.5455	0.50565
DO43	33	3	5	4.5454	0.61169

Final results obtained using multiple linear regression

In this research, multiple linear regression was used to test the significance of the hypotheses, according to the model described above (Hair , Black , Babin , & Anderson , 2014). The principles of linear regression for data analysis are presented below.

Normality

Considering that the information collected is ordinal and the responses were coded with a Likert scale applied to a sample, a Kolmogorov-Smirnov test was performed to verify the fit of the data to a normal distribution. To check the significance level, if it is less than 0.05, the distribution is not normal; if it is greater than 0.05, the distribution is normal. Table 7 shows that the significance level obtained was 0.608, so the hypothesis of normality of the residuals is not rejected.

Table 7

Kolmogorov-Smirnov test

One-Sample Kolmogorov-Smirnov Test		Standardized Residual
N		33
Normal Parameters a,b	Mean	0
	Std. Deviation	0.96824584
Most Extreme Differences	Absolute	0.133
	Positive	0.087
	Negative	-0.133
Kolmogorov-Smirnov Z		0.761
Asymp. Sig. (2-tailed)		0.608

Note. a Test distribution is Normal. b Calculated from data.

Linearity

Linearity is another quality statistic of a linear regression. The "Pearson" correlation coefficient was used, which has a series of parameters mentioned below: coefficient of 1 indicates that the correlation is perfect and positive, between $0.90 < r < 1$ is very high, $0.70 < r < 0.90$ is high, $0.40 < r < 0.70$ is moderate, $0.20 < r < 0.40$ is low, $r = 0$ is null, $r = -1$ is perfect and negative. Table 8 shows that the Innovation variable is highly correlated, Process Measurement is low, Lean Tools and Organizational Practices are moderately correlated; however, the method used "by successive steps" did not consider the Lean Tools variable in the proposed model.

Table 8

Pearson correlation

Type of Variable	Variable Name	Correlation
V.I	Innovation	0.701
V.I	Process Measurement	0.125
V.I	Lean Tools	0.564
V.I	Organizational Practices	0.580

Multicollinearity

Multicollinearity describes the relationship between variables when we create an econometric model. It is usually considered a problem of degree because its relationship can be of greater or lesser degree. To test this statistic we used the variance inflation factor which indicates the degree to which the variance of the least squares estimator is raised by collinearity between variables.

In practice, multicollinearity is considered to exist as from 5. Multicollinearity is calculated using variance inflation factors (VIF) as shown in Equation 1:

Equation 1. Multicollinearity calculation

$$VIF = \frac{1}{1 - R^2}$$

Source: Lopez, 1998

Table 9 shows the statistical results of collinearity and confirms that they are in the range mentioned in the literature.

Table 9

Collinearity table

Model	Tolerance	Collinearity	VIF
1	Constant		
	Innovation	0.784	1.276
	Organizational Practices	0.784	1.276
	A. Dependent Variable		

Measure of goodness of fit: Linear correlation coefficient

In this research the R^2 was used, this statistical measure indicates numerically how close the data are to the fitted regression line. The R^2 is the percentage of variation in the response variable. According to the authors, a correlation coefficient with a value of 0 means that there is no linear correlation, therefore, it can be said that it shows linear independence, if it is between 0 and 0.2 there is a very weak linear correlation, between 0.2 and 0.5 is a weak linear correlation, between 0.5 and 0.7 is a medium linear correlation, between 0.7 and 0.9 is a strong linear correlation and between 0.9 and 1 is a very strong correlation (López & Fachelli, 2015).

IBM SPSS software was used in this research to test this assumption. The system generated two models, which are shown in Table 10. The model that best represents the research problem is presented, in this case model 2, which obtained an R^2 of 0.532.

Table 10

Models developed by the method of successive steps

Model	R	R square	R-square adjustment	Standard error of the estimate	*Durbin Watson*
1	0.701	0.491	0.475	0.38606364	
2	0.749	0.561	0.532	0.36453846	*1.511*

Model 1	Independent Variables: Innovation
Model 2	Independent Variables: Innovation, Organizational Practices
	Dependent variable: Organizational Performance

According to the results obtained, the result of the second model 0.532 is valid for the research, since, according to the authors, a coefficient between 0.5 and 0.7 shows a medium linear correlation. The variables included in the model were Innovation and Organizational Practices; those excluded in this case were Process Measurement and *Lean Manufacturing* Tools. The latter two were the ones that presented items with significant standard deviations, which were described above.

Analysis of VARIANCE

The analysis of variance "ANOVA" tests the hypothesis where the means of two or more populations are equal. ANOVAs assess the significance of one or more factors by comparing the means of the response variable at different factor levels (Minitab , 2021).

According to the analysis of variance (ANOVA), presented in Table 11, the null hypothesis, which indicates that there are no effects or interactions between the dependent and independent variables, is rejected. Therefore, the alternative hypothesis is accepted, which mentions that there is an interaction between the independent and dependent variables, confirming that the model is significant.

Table 11

ANOVA

Model		Sum of Squares	DF	Quadratic Mean	F	Sig.
2	Regression	5.091	2	2.545	19.155	0.000
	Waste	3.987	30	0.133		
Model 2	Independent Variables: Innovation, Organizational Practices					
	Dependent variable: Organizational Performance					

Significance of t-Student variables

Table 12 shows the results of the *t*-Student statistic, a test that aims to show which variables have an impact on the study conducted. In this case, the stepwise method considered that of the 4 variables that were entered into the system, only 2 were significant. These variables are Process Innovation and Organizational Practices, both with a positive impact and lower standard deviations.

Table 12

t-Student and Standardized Coefficients

Model Variable	Coefficients not Standardized		Standardized coefficients t	Coefficients	
	Beta	Standard error	Beta	t	Sig
Constant	0.325	0.065		4.969	0
Innovation	3.180	0.077	0.5562	4.110	0
Organizational Practices	0.169	0.077	0.298	2.184	0

Durbin Watson

The next test of quality is the independence of the residues. The Durbin Watson (DW) statistic is a test used to detect the presence of autocorrelation. The value of this statistic ranges from 0 to 4. A value close to 2 indicates that there is independence of the residuals (so values between 1.5 and 2 are acceptable). In this study the DW value is 1.511, shown in Table 13.

Table 13

Value of Durbin Watson

Model	R	R square	R-square adjustment	Standard error of the estimate	Durbin Watson
1	0.701	0.491	0.475	0.38606364	
2	0.701	0.561	0.532	0.36453846	1.511
Model 1			Independent Variables: Innovation		
Model 2			Independent Variables: Innovation, Organizational Practices		
			Dependent variable: Organizational Performance		

Testing of Hypotheses

Table 14 shows the consolidated acceptance or rejection of the hypotheses for the dependent variable Organizational Development. With the results presented, the hypothesis of the variables Innovation and Organizational Practices is accepted, while for the variables *Lean Manufacturing* Tools and Process Measurement the hypothesis is rejected.

Table 14

Consolidated Information of the Independent Variables

Variable	Hypothesis	Beta	P value	Accept or Reject
Lean Manufacturing Tools	Lean Manufacturing Tools have an impact on improving organizational performance.	-	-	Rejects
Process Measurement	Process Measurement has an impact on organizational improvement.	-	-	Rejects
Organizational Practices	Organizational Practices have an impact on improving organizational performance.	0.298	0.00	Accept
Process Innovation	Process Innovation has an impact on improving organizational performance	0.562	0.00	Accept

With the above, it is possible to obtain Equation 2, which indicates that the coefficients of the betas represent 86% of the phenomenon studied.

Equation 2. Proposed linear regression model.

$$\hat{y} = 0.325 + 0.298\,X3 + 0.562\,X4 + \in$$

Where:

$\hat{y}$: Improved performance

X3: Organizational Practices

X4: Process Innovation.

$\in$: Error

Discussion and conclusions

This research contributes to knowledge, as it establishes that Organizational Practices are necessary to achieve process improvement and Process Innovation will allow to be competitive. In accordance with the above, Figure 4 shows the final graphic model, where it is indicated that the statistically significant independent variables are Organizational Practices and Process Innovation, as well as the Beta coefficients, β for each of them.

Figure 4

Graphical model of final variables
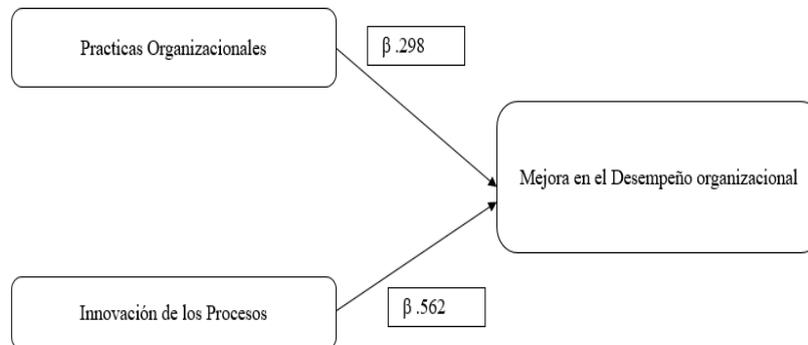
The results of this research indicate that the organizations in the study do not consider *Lean Manufacturing* tools and Process Measurement as variables that impact the improvement of their process performance.

Despite this, it is recommended to analyze the *Lean Manufacturing* tools variable separately, as it contains several tools that may bias the opinion of the study subject, and harm the result generated by the item in the construct (Nor, Rahman, Sharif, & Esa, 2013). Next, authors are cited who analyzed some tools as the dependent variable and focused on narrowing down which variables have an impact on that tool only.

Authors such as Balram (2003), Arango (2015)Peralta (2020)analyzed the variables that directly influence Kanban, this being its dependent variable.

Santos (2013) also analyzed the 5's methodology. Lefcovich (2012)independently analyzed the Kaizen methodology. The aforementioned authors concluded that these variables have an impact on the improvement of the processes individually; however, in this research it is concluded that there is no impact on the improvement of the grouped processes.

On the other hand, when taking the results of the surveys applied to this construct, at least three items were identified as having a higher standard deviation than the rest, which affects the final result. The study subject's response is due to the fact that the question asks about the frequency of use of the tool, and since the tools are not easy to apply or do not require prior knowledge, this generates the affectation. In this case, it is recommended for future research to change the question "How often do you use...?" to "Do you consider that the tool _____ contributes to the improvement of the organization's performance?", in this way, the fact that the tool is not used in your current job does not affect the result, since the subject of the study can determine if it really has an impact based on his or her experience.

The Process Measurement variable was not statistically significant. This result was affected by item MP8, which was left "open" when it is known beforehand that human resources are generally measured in organizations in a very particular way in production departments and not in office departments. In the question, marketing was mentioned as an example, when the latter could be said to have an indicator to review the products obtained from human resources, not their productivity.

The Likert scale measurement instrument encourages the subject of the study to indicate what he/she considers to be happening in his/her organization. It should be mentioned that the measurement instrument for this independent variable was based on questions that had been considered in other research studies (Monge C. , 2015) (Ray, Zuo, & Wiedenbeck, 2007), (Mulugeta, 2021). In addition to the above (change in the item) it is recommended to assign a numerical scale in each Likert level so that the study subject can really locate the results obtained in the organization and not leave a totally disagree or agree.

In the case of Organizational Practices, this study is supported by the results obtained by Mudhafar (2017) who talks about the impact of leadership on process improvement through lean manufacturing implementation. Similarly, Sarham (2013) indicates that the values of the organization's employees affect the improvement of processes through the use of lean manufacturing. The main practices considered were training, employee competencies, idea generation, motivation (Padilla, 2019), worker empowerment (Saumyaranjan, 2017), supplier development, as well as contracting a quality management system. According to the aforementioned, it can be indicated that in order to improve processes, a fundamental part is the practices adopted by the organization mentioned above.

Finally, the independent variable Innovation was statistically significant. This variable obtained a β of 0.562, which indicates that it has a greater impact than the Organizational Practices variable 0.298. Klewitz (2014), supports the results of this research by mentioning in his definition that innovation is the implementation of a new or significantly improved production or delivery method. Prasanta (2019), posed as independent variable the development of lean and sustainable practices, as well as process innovation and as dependent variable organizational performance, having as a result that the latter has a noticeable impact on organizational performance. Therefore, innovation implemented with a specific objective will guarantee better results in the organization.

Recommendations

In order to obtain a broader vision of the improvement of the organizations' performance, it is recommended to apply the measurement instrument at the different levels of

the supply chain, as well as to expand its application in the states of the Mexican Republic where the automotive area is developed.

As future lines of research, it is mainly recommended to change the question of the variable *Lean Manufacturing* Tools from How often do you use...? to Do you consider that the tool _____ contributes to the improvement of the organization's performance?, with the objective of including the previous knowledge that the subject of the study has and not to bias it by limitation of resources or considerations of superiors that lead to declaring it as an independent variable. In the case of Innovation and Organizational Practices they can remain the same in the current model as independent variables and in the case of Process Measurement it is recommended that it be a mediating variable, since it is in charge of the organization's indicators.

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MOTIVATION AND ITS RELATIONSHIP WITH THE WORK ENVIRONMENT IN THE POLICE COMMAND OF THE REPUBLIC OF MOZAMBIQUE IN MANICA IN THE PERIOD FROM 2016 TO 2019

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Abstract. Nowadays there is dynamism in organizations, providing changes in the organizational context of companies that contribute to the valorization of their staff, through motivation. In order to analyze the factors that inhibit motivation in the Police officers of the Republic of Mozambique, a description of the types of motivation present in the officers was studied at the Provincial Command of Manica, Chimoio City, through the identification of the strategies implemented by the motivation and examining the factors that contribute to that motivation. To achieve these objectives, bibliographic research was used to collect information relevant to the study and field with the aid of observation and questionnaire inquiry to agents from different provincial command departments, departments and sectors and the data were selected and coded in the spreadsheet. Excel 2016 and processed in the SPSS version 13.0 statistical package in the Analyze Descriptive - Statistics frequencies extension for the creation of graphs and tables. The results point to the existence of intrinsic and extrinsic motivations in the agents, driven by the disclosure of their rights and duties, the existence and dissemination of the promotion and progression plan, as well as the promotion of meetings and fraternization parties, although they have a cost to participants. Having concluded that the factor of poorly paid police work is crucial for the motivation of the agents since the value of variance after the Turkey test was greater than 5.9. And, the study recommends verifying the influence of material resources and physical means in meeting the established goals.

Keywords: Motivation, motivation theories, satisfaction strategies.

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A MOTIVAÇÃO E SUA RELAÇÃO COM O AMBIENTE DE TRABALHO NO COMANDO DA POLÍCIA DA REPÚBLICA DE MOÇAMBIQUE EM MANICA NO PERÍODO DE 2016 A 2019

Resumo. Os dias actuais vive-se um dinamismo nas organizações, propiciando mudanças no contexto organizacional das empresas que contribui na valorização do seu pessoal, através da motivação. Com o propósito de analisar os factores inibidores da motivação nos agentes da Polícia da República de Moçambique, foi estudada no Comando Provincial de Manica, Cidade de Chimoio, através da identificação do tipo de motivação presente nos agentes, a descrição das estratégias implementadas pela direcção na motivação dos mesmos e o exame dos factores que contribuem nessa motivação. Para o alcance desses objectivos foi usada a pesquisa bibliográfica para o levantamento de informações relevantes ao estudo e de campo com auxílio de observação e inquérito por questionário aos agentes das diferentes direcções, departamentos e sectores do Comando Provincial e os dados foram seleccionados e codificados na planilha Excel 2016 e processados no pacote estatístico SPSS versão 13.0 na extensão Analyse Descriptive – Statistics frequencies para a criação de gráficos e tabelas. Os resultados apontam para a existência nos agentes as motivações intrínseca e extrínseca, movidas pela divulgação dos seus direitos e deveres, a existência e divulgação do plano de promoção e progressão, bem como a promoção de encontros e festas de confraternização, apesar das mesmas terem um custo aos participantes. Tendo concluído que o factor trabalho policial mal remunerado é crucial para a motivação nos agentes uma vez que o valor de variância após o teste Turkey ter sido maior que 5.9. E, o estudo recomenda para a verificação da influência dos recursos materiais e meios físicos no cumprimento das metas estabelecidas.

Palavras-chave: Motivação, teorias da motivação, estratégias de satisfação.

LA MOTIVACIÓN Y SU RELACIÓN CON EL AMBIENTE LABORAL EN EL COMANDO DE POLICÍA DE LA REPÚBLICA DE MOZAMBIQUE EN MANICA EN EL PERÍODO 2016 A 2019

Resumen. Hoy en día, las organizaciones están experimentando un dinamismo, lo que lleva a cambios en el contexto organizacional de las empresas que contribuyen al mejoramiento de su personal, a través de la motivación. Con el propósito de analizar los factores inhibidores de la motivación en los agentes de la Policía de la República de Mozambique, se estudió en la Comandancia Provincial de Manica, Ciudad de Chimoio, a través de la identificación del tipo de motivación presente en los agentes, la descripción de las estrategias implementadas por la dirección en su motivación y el examen de los factores que contribuyen a esa motivación. Para lograr estos objetivos se utilizó una investigación bibliográfica para recolectar información relevante para el estudio y de campo con la ayuda de la observación y encuesta a los agentes de las diferentes direcciones, departamentos y sectores de la Comandancia Provincial, y se seleccionaron los datos y codificados en la hoja de cálculo Excel 2016 y procesados en el paquete estadístico SPSS versión 13.0 en la extensión Analyse Descriptive – Estadísticas de frecuencias para la creación de gráficos y tablas. Los resultados apuntan a la existencia de motivaciones intrínsecas y extrínsecas en los agentes, impulsadas por la difusión de sus derechos y deberes, la existencia y difusión del plan de promoción y progresión, así como la promoción de encuentros y fiestas de confraternización, a pesar de que tienen un costo para los participantes. Habiendo concluido que el factor trabajo policial mal pagado es crucial para la motivación de los agentes ya que el valor de la varianza después de la prueba de Turquía fue mayor a 5.9. Y, el estudio recomienda verificar la influencia de los recursos materiales y medios físicos en el cumplimiento de las metas establecidas.

Palabras clave: Motivación; teorías de la motivación; estrategias de satisfacción.

Introduction

The complexity of work in organizations, their multiple and varied demands, the new production environments and the growing competitiveness in the business world have as a corollary the need to value employees and create favorable conditions to maximize their performance and job satisfaction (Tamayo & Paschoal, 2003). This motivation at work is manifested by the employee's drive to perform their tasks with dynamism and precision, persisting in their execution until they achieve the expected or anticipated result.

A good working environment, training, knowledge, the qualities required to perform a particular task and the availability of the necessary tools do not guarantee that the employee will be able to carry out their task productively (Fraga, 2011). The same author (2011), quoting Glasser (1994), states that the failure of most companies is not due to a lack of technical knowledge, but to the way they deal with people.

According to Perez and Marques (2014), employee satisfaction in the workplace is an indispensable factor in organizations, but they have great difficulty in meeting their needs. For Tamayo and Paschoal (2003), motivation is considered to be the area of human resources research and management, permanently oriented by a positive and humanizing approach to the work environment, seeking to find ways to help workers satisfy their needs at work and achieve professional fulfillment in it.

The subject of employee motivation and satisfaction is currently being discussed with great relevance. According to Júnior (2016), this issue is discussed in order to find better ways to improve productivity at work, by managers of companies, organizations and even social groups, and yet various positions are taken on this situation, with regard to the factors that stimulate motivation at work and, to a certain extent, contrasting positions.

In line with Chiavenato's (2009) thoughts, we are currently living in a dynamic world, where organizations and companies are experiencing constant and complex changes in their organizational context, in order to acquire innovative, flexible and agile ways of working that value human relationships. On this path of change, the issue of motivation comes to the fore, and motivation is a major challenge for any personnel management organization. According to Baptista *et al*. (2005), motivation has been considered an important factor, and here specifically at work.

The same authors (2005) add that, since ancient times, literature has shown a certain concern with the reasons why people act or why they decide what to do (Baptista *et al*. 2005).

At the level of the General Command, the entity that manages the PRM's personnel, there is no qualifier for the positions of Command, Direction, Leadership, Trust, Professional Careers of the PRM and the Personnel Framework set out in article 51 of Decree 58/2019 of July 1, which approves the Organic Statute of the Police of the Republic of Mozambique. Allied to this, there is a lack of progression and promotion, low salaries, social benefits, inappropriate working conditions (lack of meals during the shift, lack of a place to rest and medical assistance), working hours above those recommended by the WTO (World Labor Organization) in Article 427 of the Treaty of Versailles, precarious communication between subordinates and superiors, relations between employees, which creates demotivation among PRM agents. For this reason, this research was concerned with studying the factors behind motivation in relation to the working environment of the officers of the Police of the Republic of Mozambique in the Manica Provincial Command from 2016 to 2019.

Based on the guiding question, the research seeks to bring an approach to motivation in relation to the work environment based on identifying the type of motivation, the strategies implemented by management in motivating agents and the analysis of motivation factors, since

it constitutes one of the major processes that account for the efforts expended by the employee and their persistence in carrying out their tasks in order to achieve the objectives previously set.

From concepts to theories of motivation

According to Pina *et al.* (2014), motivation is the set of energetic forces that originate both within and outside the individual and that give rise to work behavior, determining its form, direction, intensity and duration.

According to Júnior (2016), four essential elements are added to the concept proposed by Pina *et al.* (2014), to make a difference between the various other definitions: (i) stimulation - the energetic forces responsible for triggering the behavior; (ii) action and effort - the observed behavior; (iii) movement and persistence - the prolongation over time of the motivated behavior; and (iv) reward - the reinforcement of previous actions.

But Montserrat (2004) conceptualizes motivation in three different areas of study, namely: 1. In the area of consumption, it concerns the psychological factors that explain the purchase of a product, its order or refusal; 2. In economics, it translates the set of factors that determine the behavior of an economic agent; 3. In psychology, it corresponds to the physiological and psychological process responsible for the beginning, continuation or end of a behavior.

For Madureira (1990), motivation is a force that resides in the person and stimulates them to direct their behavior towards achieving certain goals. The same author (1990) adds that motivation for work is a positive state of mind, which allows the individual to carry out tasks and give their full potential.

According to Vries (1993), there are many theories of motivation, including the needs theories of Maslow, McClelland, Alderfer, the Two Factor Theory of Herzberg, Mausner, Snyderman, the Expectations or Instrumentality Theory of Vroom[1], the Reinforcement Theory of Skinner, Connellan, the Goals Theory of Locke, Bryan, the Equity Theory of Homans and Adams, Theory X and Y - Douglas McGregor.

According to Teixeira (1998), McClelland's theory of needs, motivation, which the author called the motivational cycle, begins with a stimulus to satisfy a certain need that manifests itself, generating tension that translates into a state of imbalance in the organism. Thus, the imbalance will be reached as soon as this need is met.

Maslow, quoted by Teixeira (1998), with his theory, called Maslow's Theory of Needs, bases it on three assumptions, namely: a) unsatisfied needs motivate people or influence their behavior. As long as one basic need is not satisfied, the others generally have no influence on the individual's behavior. The author called this the "dominance principle"; b) needs are grouped according to a hierarchy; and c) the needs of any one level of the hierarchy emerge as significant motivators only when the needs of the levels below them in the hierarchy have already been reasonably satisfied, the emergence principle.

In Maslow's 1954 hierarchy of needs theory, human behavior is motivated by basic needs, which are reflected in terms of deficiency, and in terms of growth. The hierarchy of needs ranges in priority from physiological and safety needs to social, esteem and self-fulfillment needs, aimed at exploiting their potential.

Despite Frederick Herzberg's 1966 two-factor theory, which advocates intrinsic motivation, emphasizing the limitations of extrinsic rewards and punishments, his proposition is motivation by the work itself, to be achieved by enriching the job. According to Vieira (2003),

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[1] See Vroom (1964). *Work and Motivation*. John Wiley and Sons.

promotion or job enrichment is the way to increase employee satisfaction, as it offers the opportunity for psychological growth. It's a proposition that shouldn't be implemented all at once, but on an ongoing basis, with the initial changes having to last for a fairly long period of time and, as a result, drive the job upwards, right to the top. As you rise through the ranks, you gain skills that will enable you to be promoted to higher positions.

On the other hand, the expectations theory first proposed by Vroom (1964) goes beyond the assumptions of the theories listed above. It recognizes individual differences and argues that motivation is the product of the expected value attributed to a goal and the probability of achieving that goal.

According to Pina *et al*. (2014), in a cognitive approach, which considers that "behavior and performance are the result of a conscious choice. The behavior chosen is, as a rule, the one that leads to the greatest gains for the person." This theory is essentially based around the concepts of expectation, valence and instrumentalization.

Finally, Adams' Equity Theory (1960) is based on the idea that employees compare their contributions to the organization or company with what they receive as a reward. As you can see, the term equity refers to justice, righteousness. In other words, fairness only manifests itself when a worker, for example, is rewarded with values that justify his or her commitment to the job. There is fairness when two workers are rewarded according to their efforts, merit, commitment and skills (Pina *et al.* 2014). In summary, we can see from this point of view that, for example, it would not be fair if two workers earning the same salary received an equal pay rise if one of them was more committed to the job than the other.

Types and strategies of motivation

According to Universia (2017), there are several types of motivation (intrinsic or extrinsic), each of which influences behavior in different ways. None of them works for everyone. People's personalities can vary according to the type of motivation that is most effective in inspiring their behavior. These are incentives (involving rewards, monetary or otherwise. Many people are driven by the certainty that they will be rewarded for achieving a certain goal or target. Promotions and raises are a good example of the type of incentive used for motivation), fear, achievement, growth, power and social.

Fear involves consequences. This type of motivation is usually used when incentives fail. In a model of motivation called "carrot and stick", incentive is the carrot and fear is the stick. Punishment or negative consequences is a form of fear motivation. This type of motivation is commonly used to motivate students in the education system and also in professional environments. If you break the rules or don't achieve your goals, you'll be penalized in some way.

Achievement is commonly thought of as a drive for competence. You move to achieve goals and get what you want. This kind of motivation comes from the desire to improve your skills and prove your competence to yourself and others. However, in certain circumstances achievement motivations can involve a desire for external recognition. It's normal to want positive feedback from your colleagues and friends. This can include anything from an award to a small compliment.

Growth, this type of motivation involves the need to improve oneself, it's really an internal motivation. A burning desire to increase your knowledge of yourself and the world around you can be a strong source of motivation. Everyone wants to learn and grow as an individual. Growth motivation can be seen as a desire for change. Many of us are conditioned by our personality or upbringing to constantly seek change. This makes you see stagnation as negative and undesirable.

Power can be as much about the desire for autonomy as it is about controlling the people around you. You want to have options and control over your own life. It's a way of trying to direct the way you live now and in the future. This can also translate into a desire to control those around us. The desire for control is stronger in some people than in others. In some cases, this desire for power can translate into wrong attitudes. But in others, it's just a desire to affect the behavior of others.

Social motivation is seen in most people as a result of social factors. This may be a desire to be part of something and to be accepted by a specific group or a larger sphere in the world. Everyone has an innate desire to feel connected to others, as well as a desire for affiliation and acceptance. Another form of social motivation is the desire to contribute and make a difference to other people's lives. Those who are motivated to contribute to the world are usually motivated by social factors.

According to Chiavenato (2009b) on motivation, the essential motivational strategies for organizations are: a good job and salary plan; professional recognition; social gatherings, thus improving relationships between employees; in decision-making, the opinions of all employees are heard; the work environment is comfortable and ideal for the best convenience of its employees; the existence of openness for employees to expose their dissatisfactions in relation to their work, and these are reflected and improved.

According to Gil (2001), the challenges for motivational strategies are becoming ever greater, because in order to match the desires of organizations with the needs, at least the basic ones, of their employees, it is worth highlighting two fundamental strategies: a good job and salary plan and a comfortable environment that is conducive to employee well-being, because even if the company is small and going through times of economic crisis, it needs to adapt to all the inconstant changes in the market and the different personalities and objectives of each employee.

However, Sousa and Anjos (2015) point out that satisfying people in the corporate sphere goes much further than just salary issues, but rather good relationships with colleagues, a harmonious work environment, with harmony and professional recognition, valuing areas of training and good team performance.

The same authors point out that organizing activities or moments for integration between employees is essential for them to feel at home in their work environment: "Because I'm pushed to hit targets every day"; and, "Compared to other companies I've worked for, this is where people work, people are respected, employees respect and help each other and God is above all" (Sousa and Anjos, 2015).

Method

The methodology comprises the presentation of the methods used to carry out the research, in which the research design is presented, starting by defining the nature of the research, its approach, objective, procedures and methods for collecting and presenting data.

The Police of the Republic of Mozambique (PRM) is headed by a General Commander, subordinate to the Minister of the Interior. Since its creation, it has chosen to be organized militarily[2], even though the police organization that existed in Mozambique at the time as a

colony of Portugal was the civilian Public Security Police. In hierarchical terms, it is organized at all levels of its structure, respecting the differentiation between police and non-police functions, with the former obeying the hierarchy of command and the latter the rules of public administration hierarchy.

According to Article 1(1) of Law No. 16/2013, of August 12, which partially repeals Law No. 5/88, of August 27 and Law No. 19/92, of December 31, the Police of the Republic of Mozambique (PRM) is a non-partisan public service, paramilitary in nature, integrated into the Ministry of the Interior, which oversees the area of public order and security. And paragraph 2 of the same article states that the existence of the PRM does not exclude the creation of other specialized bodies integrated into other public institutions.

The Provincial Command of the Police of the Republic of Mozambique in Manica is located in the City of Chimoio 601, in the streets of Barué and Mossurize.

Figure 1

Front view of the Manica PRM Provincial Command Building.

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[2] The organization of the PRM follows the principle of deconcentration, with the aim of decongesting the central office and bringing the security services closer to the population. The PRM organization level comprises:

a) Central, provincial, district, administrative post, town and village.

b) At central level, it is organized into a General Command and at local level into provincial and district commands.

c) In cities and towns, the PRM is organized into police stations, police posts and police sectors.

d) At the level of administrative posts, towns and villages, the PRM is organized into police posts.

In order to carry out this research, a mixed research approach (qualitative and quantitative) was adopted. According to Dalfovo (2008), quantitative research is a method characterized by the use of quantification, both in the way information is collected and in the way it is processed using statistical techniques, from the simplest to the most complex.

The same author (2008) considers qualitative research to be research that works predominantly with qualitative data, i.e. the information collected by the researcher is not expressed in numbers, or the numbers and the conclusions based on them play a minor role in the analysis. And qualitative research was used to help interpret and attribute basic meanings to phenomena, where it was necessary to use statistical methods and techniques, (Dalfovo, 2008).

For data collection, which took place between May and October 2019, various combinations of techniques were used in order to obtain credible information, namely bibliographic research (used to gather information in various works, such as scientific articles, monographs, theses and dissertations that address the topic in question), a questionnaire survey (in which a form of questions was drawn up with closed questions and put to PRM members, with the aim of analyzing their motivation in carrying out their activities in relation to the work environment) and direct observation, in order to understand the members' state of mind, using materials such as an observation script, notepad and camera to store the information.

Results

In order to analyze the factors that influence the motivation of the Republic of Mozambique Police (PRM) officers in Manica Province in relation to the work environment, a survey was carried out at the Manica Provincial Command using a questionnaire that was issued to 67 officers who were carrying out their activities there.

This section presents the analysis and discussion of the results of the survey through the answers collected by the questionnaire. Firstly, the general data of the respondents is presented. Secondly, the responses on the factors that affect the motivation of the staff of the Police of the Republic of Mozambique in Manica Province in relation to the working environment, according to the respondents, are presented and analyzed.

Characteristics of respondents

A total of 75 PRM agents were contacted and 67 filled in the questionnaires, which represented around 90%, of which 38 were male and the remaining 29 female, corresponding to 57% and 43% respectively, as can be seen in the graph in Figure 2 below.

Figure 2

Graph of the distribution of PRM agents surveyed by gender

Distribution of respondents by gender
- 43%
- 57%
- ■ Homem
- ■ Mulher
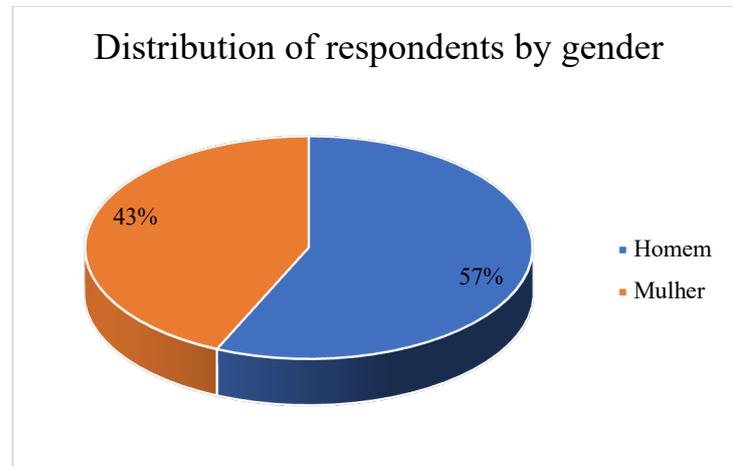
Of the 67 agents surveyed, the majority have been working as PRM agents for 7 years with 12, followed by agents with more than 10 years' service, with 10 years' service, with 4 years, 5 years, 9 years, 3 years, 8 years, and 6 years, with 10 agents, 9 agents, 7 agents, 6 agents, 5 agents and 3 agents each, respectively, as can be seen in Table 1 below.

Table 1

Distribution of respondents by length of service

Length of service	Sex		Total	%
	Male	**Female**		
3 years	4	2	06	8,96
4 years	3	4	07	10,45
5 years	4	3	07	10,45
6 years	2	1	03	4,48
7 years	5	7	12	17,91
8 years	4	1	05	7,46
9 years	5	3	07	11,94
10 years	5	4	09	13,43
10+ years	6	4	10	14,93
Total	38	29		
	57 %	43 %	67	**100 %**

With regard to level of education, of the 67 respondents, 21 have a basic level of education, which corresponds to 31.34% and the remaining 46 agents are subdivided into 27 with a secondary level of education and 19 with a 1st cycle degree, corresponding to 40.30% and 28.36% each, respectively, as can be seen in the graph in Figure 3.

Figure 3

Graph of the distribution of PRM agents surveyed by Academic Level

Distribution of respondents by Academic Level

|	Nivel Basico	Nivel Medio	Nivel Sup. Licenciado
■ Series1	21	27	19
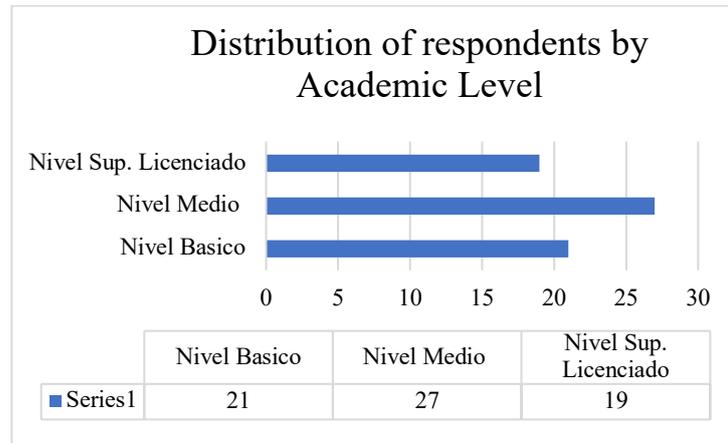
Type of motivation present in officers of the Police of the Republic of Mozambique of the Manica Provincial Command

In order to answer this objective, regarding the type of motivation in the PRM officers of the Provincial Command, three questions were asked: whether the officers, since joining the Police, continue to occupy the same job; whether the work they do, they have carried out with pleasure and whether of all the work they do, they need to be rewarded, where the results indicate that the majority of respondents (37 officers), answered that they carry out their activities with pleasure and the remaining 30 officers, divided into 17 answered that the work they do needs reward and the 13 continue to occupy the same job since they were admitted to the Police, as can be seen in the graph in Figure 4.

Figure 4

Graph of the distribution of the type of motivation in the PRM agents surveyed.
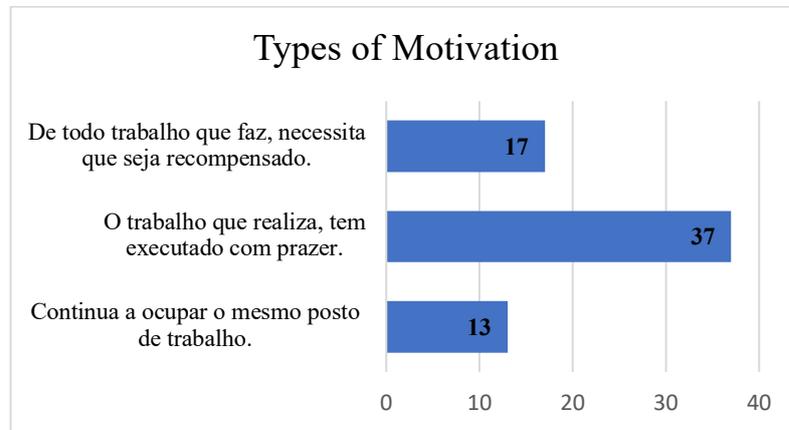
In percentage terms, 55% of respondents answered positively to the question that the work they do is a pleasure, and the remaining 25% and 20% each. This type of motivation is considered intrinsic, as mentioned by Texeira (1998), Amabile (1999) and Vromm (2000), whose motivation is based on the satisfaction of needs, i.e. motivation that has to do with self-realization.
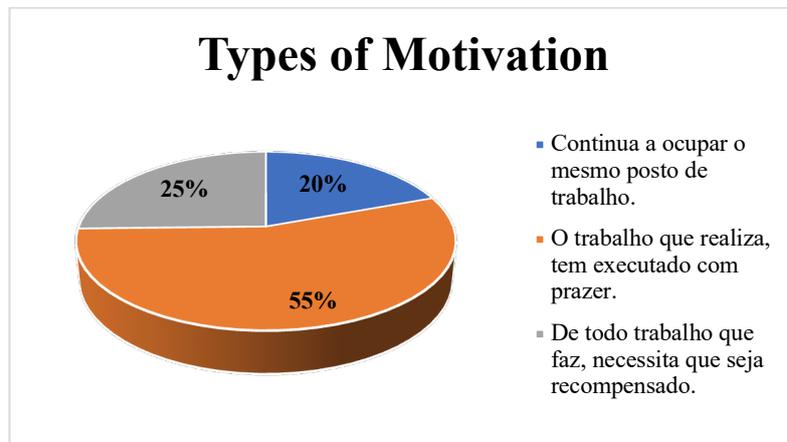
The members of the PRM assigned to the Manica Provincial Command are intrinsically motivated, due to the gratification they feel from carrying out their tasks effectively, regardless of the rewards they receive, getting involved in the work for the challenge or the pleasure itself, in other words, they are motivated by interest in the satisfaction it provides.

With regard to the question of whether the respondents do the work, need the reward and continue to occupy the same job, this is extrinsic motivation, which is defended by Steiner (1964), who understands it as being the stimuli or incentives that the environment offers in a given institution, or objectives that the person pursues because they satisfy a need, in a way arousing a feeling of interest because they represent the reward to be achieved.

Extrinsic motivation requires an instrumentality between the activity and some separable consequences, such as tangible or verbal rewards. Satisfaction comes not from the activity itself, but from the extrinsic consequences produced by the activity.

Figure 5

Graph of the percentage distribution of the type of motivation in the PRM agents surveyed

Types of Motivation

- Continua a ocupar o mesmo posto de trabalho.
- O trabalho que realiza, tem executado com prazer.
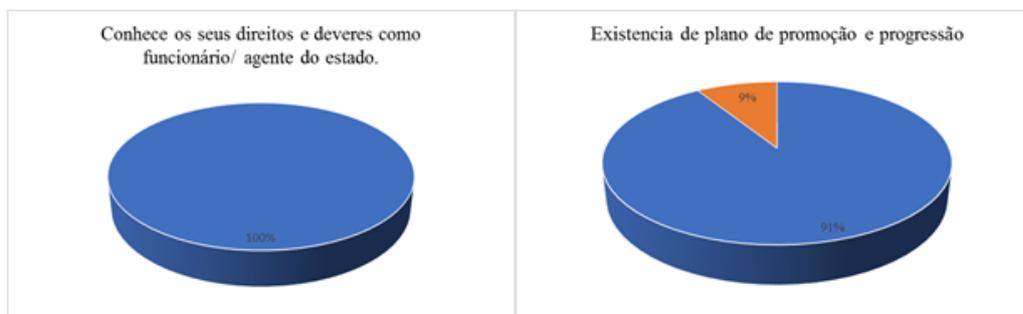- De todo trabalho que faz, necessita que seja recompensado.

Strategies implemented by the management of the Manica Provincial Command to motivate agents

In terms of strategies for motivating officers, we tried to find out whether officers know their rights and duties as a state employee, whether there is a promotion and progression plan in the sector where they work (if there is, it would be known to all staff) and whether there have been any meetings or get-togethers between colleagues and the sector at Command level, and whether they have taken part.

The results show that of the 67 respondents, corresponding to 100%, answered that the Provincial Command's management has publicized the rights and duties of its members, as for the existence of a promotion and progression plan, 91% said that it exists and has been publicized and the remaining 9% are unaware of the existence of this plan.

Figure 6

Graph of the percentage distribution of the motivational strategy (disclosure of the rights and duties of PRM agents) and motivational strategy (existence of a promotion and progression plan for PRM agents).

Conhece os seus direitos e deveres como funcionário/ agente do estado.

Existencia de plano de promoção e progressão

With regard to the promotion of get-togethers and get-together parties, everyone was unanimous in saying that the management of the Command has promoted get-togethers and get-together parties as a way of motivating the officers, but on the other hand only 21% of them

have taken part, clearly demonstrating that the get-togethers do not bring any value to the officers, since these meetings are not compulsory and are subject to a contribution, taken from their salaries to make them happen, and this plan is known to all staff and management has promoted meetings and parties for colleagues to get together, as can be seen in the graph in Figure 7.

Figure 7
Graph of the percentage distribution of participation in meetings and get-togethers
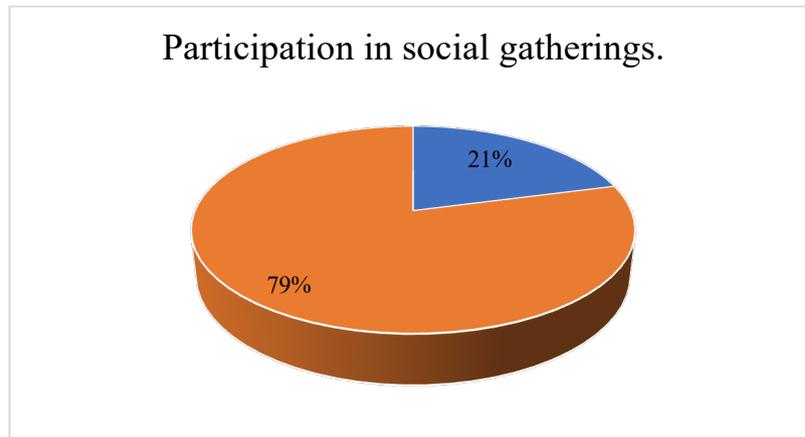
Motivational factors for the number of Mozambique Republic Police officers assigned to the Manica Provincial Command

In order to understand and assess what factors influence the motivation of the police officers assigned to the Manica Provincial Command, a range of factors were listed, such as: whether police work is heavy or light, whether they have all the material they need to carry out their activities, whether there is no incentive at work, whether the working environment is not the best, whether there is a lack of relationships between colleagues, whether police work is poorly rewarded, whether they don't feel famous and whether they can't achieve their individual plans. Thus, the reward factor was seen as the crucial factor, with 67 respondents saying that this factor greatly affects motivation.

This is also supported by Chiavenato (2009), who argues that no one works for free, expecting to receive adequate and fair compensation in return for their work, dedication and personal effort. In turn, employers or organizations are interested in rewarding these people as their goals are achieved. However, Zimpeck (1999) points out that determining salary and using it as an instrument to stimulate the individual's well-being is not simple, as it depends on certain external elements, such as those related to the financial policy adopted by the government, which are beyond the control of the organizational context.

In contrast, Taylor's scientific management theories and Henry Fayol's Classical Management tended to consider remuneration to be, at least at the time, an important motivational factor or strongly linked to the motivation process. This way of thinking extends to the present day, where concern for workers' well-being is fundamental due to their psychophysical needs.

The statistical analysis of variance with a *p-value* (0.05) showed that there were differences between the means of the factors studied, although these were statistically significant, as the *p-value* was greater than the 5% significance level (see table below).

Table 2

Analysis of statistical significance for motivational factors in PRM agents of the Manica Provincial Command

Source of variation	SQ	gl	MQ	F	p-value	Critical F
Between groups	41.6875	23	13.8958333	1.889518414	0.185198	3.490295
Within groups	88.25	44	7.35416667			
Total	**129.9375**	**67**				

The statistical significance test showed that although there were no statistically significant differences between the factors, the means and variance differed, with only one value with a larger variance of 5.9 for the variable Poorly paid/rewarded police work compared to the factors Lack of fulfillment of dreams and goals, Lack of complete material and Heavy police work with 2.9, 2.9 and 0.6 respectively, as can be seen in table 3.

Table 3

Significance test of motivational factors in PRM agents of the Manica Provincial Command

Groups	Counting	Sum	Average	Variance
Heavy police work	1	2	2	0.66666667
Lack of complete material	1	3	3	2.91666667
Lack of fulfillment of dreams and goals	1	3	3	2.91666667
Poorly paid/rewarded police work	1	4	4	5.91666667

Discussion and conclusions

The aim of this research was to analyze the factors influencing the motivation of the staff of the Republic of Mozambique Police in the Manica Provincial Command in relation to the work environment, by identifying the type of motivation present in the officers, the strategy implemented by management to motivate them and examining the factors that motivate the staff in the performance of their duties, it was possible to see that intrinsic and extrinsic motivations are evident, driven by the dissemination of their rights and duties, the existence and dissemination of the promotion and advancement plan, as well as the promotion of meetings and fraternization parties, despite the fact that they cost the participants.

The study shows that the reward factor is the main motivational cause for PRM agents assigned to the Manica Provincial Command. In addition to this primary cause, the heavy police workload, the lack of complete equipment to fully perform their duties and the lack of personal fulfillment of their dreams and objectives were other factors that influence motivation, which statistically did not differ significantly.

A major limitation in this study was the fear on the part of the PRM agents of filling in the questionnaires in detail and getting an effective picture of their motivational condition in the performance of their duties.

In line with the above limitations and recognizing that not everything was perfect in this research, for future studies we recommend analyzing the causes of dissatisfaction in the workplace; studying motivation as a determining factor in achieving individual goals and its importance in the workplace; and understanding how material resources and the physical environment can influence the achievement of goals.

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