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Plithogenic Analysis of the Psychosocial Perceptions of Call Center Operators in Quito

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Abstract. This study focused on evaluating the perceptions of a group of call center operators in Quito regarding their work environment using Plithogenic statistics to address the complexity and ambiguity of the responses. The sample included 114 workers from three companies, assessed using the Battery of the Ministry of Social Protection of Colombia and a work stress questionnaire. The results revealed high job demands, perceived as stressful by employees, although satisfaction with the rewards received was shown. However, significant uncertainty was identified regarding control over work, leadership, and social relationships, suggesting critical areas for improvement. The use of Plithogenic logic allowed for an in-depth analysis of these phenomena, providing valuable information for future organizational interventions. It is recommended to implement stress management programs and improve communication and leadership to strengthen role clarity and increase job satisfaction and efficiency.

Keywords: call center operators, Plithogenic statistics, work perceptions, stress management, organizational leadership

1 Introduction

In the context of a global economy dominated by capitalist imperatives, organizations face increased pressures to comply with various essential requirements for market sustainability. These changes have profoundly modified work methodologies in recent years. Within this framework, competitiveness and productivity emerge as central axes in the formulation of corporate strategies across all economic sectors, imposing high-performance standards on employees [1].

Consequently, the intensification of work demands implies that workers must develop advanced skills and competencies to respond to global market dynamics. This requirement may increase pressure on employees to stay updated and competitive, which could potentially affect the balance between work and personal life, as well as job satisfaction. Furthermore, employees are expected to participate in multiple projects, collaborate with teams from various cultures, and take on additional tasks that were not previously common in their respective regions or countries. These demands can increase the workload and generate additional stress, particularly if adequate resources and support are not available [2].

In the telemarketing sector, competition, both nationally and internationally, drives employers or managers to exert considerable pressure on operators. This situation is exacerbated by the ability to outsource services to regions where labor is less costly and technological demands are high, putting additional pressure on Ecuadorian organizations with high operational costs [3]. Thus, the performance of operators may be intrinsically linked to the quality of leadership within the company.

Additionally, the work environment for telemarketing operators is a source of high tension, exacerbated by frequent interactions with emotionally affected clients and limited assertive communication skills. Verbal aggressions are recurrent, restricting the expression of operators and subjecting them to the pressure of meeting specific objectives, whose non-achievement can result in sanctions or dismissals, increasing their work stress [4]. Therefore, call center operators face a significant emotional burden when managing interactions with upset clients, which can deteriorate their psychosocial well-being.

The leadership style adopted by the company plays a crucial role in the work experience of call center operators, considered vital for the success of any economic, political, and organizational system [5]. Promoting leadership practices that foster virtuous and eudaimonic behaviors can be decisive in promoting both organizational and occupational well-being at individual and collective levels.

In this sense, prioritizing the management of psychosocial risk factors is critical. Exposure to psychosocial risks can induce high levels of tension in workers. According to [6], when this tension is maintained for prolonged periods with high intensity and combined with insufficient relaxation periods, it can lead to a state of chronic stress

that deteriorates the health and general well-being of employees. This phenomenon also has direct repercussions on business performance, manifested through an increase in absenteeism rates due to illness, disabilities, attitudes of indiscipline, and a decrease in work performance attributable to psychological stress [7].

Regarding the dimension of psychosocial factors, both positive and negative, these are closely linked to the work environment and the specific functions performed. An illustrative example of this is Call Centers, which emerged in the United States during the 1960s as a strategy of the Ford Company to implement telemarketing campaigns [8]. Originally, these services focused on providing information as a complementary service to the main product. Throughout the 1990s, this sector experienced significant growth both in Europe and Latin America, expanding its functions to debt management and emergency services, driven by technological advances.

The workload for call center operators is considerable, as their evaluation depends on the number of calls managed, the time invested, and the effectiveness of communication. This work configuration imposes on operators the obligation to meet call quotas and ensure their effectiveness, which often leads to pressure on customers [9]. This cycle can reverse the desired effectiveness into negativity, exacerbating stress levels among workers.

Psychosocial factors are defined as elements that can be internal or external to an organization, and that encompass both working conditions and the personal characteristics of employees. These factors establish a dynamic interaction based on individual perceptions and experiences, exerting a significant influence on the health and work performance of workers [10]. In this framework, this study aims to assess the perception of a group of call center operators in the city of Quito regarding the psychosocial factors associated with their work environment.

To achieve this end, the use of contributions made by plithogenic logic is proposed, a tool that allows analyzing the evolution of variables in related groups, adapting it to investigate the correlations between working conditions and their effects on employee well-being. Plithogenic statistics, developed from traditional multivariate statistics, provide a theoretical and methodological approach to managing uncertainty and variability in perceptions [11]. By incorporating uncertainty and diversity of viewpoints into statistical analysis, this methodology facilitates a more detailed investigation of complex phenomena, such as the perception of objectivity.

This approach could reveal significant patterns that help better understand psychosocial dynamics in intensive work environments like call centers. From a scientific perspective, the use of this methodology in intensive work environments like call centers not only enriches scientific research in the area of work psychology and organizations but also provides a solid framework for improving human resource management in practical and effective terms. This approach underscores the importance of considering the diversity of experiences and perceptions within a workforce, and how these can be essential for the strategic and operational development of the company.

2 Preliminaries

2.1 Notions on Plithogenic Logic

F. Smarandache's theory of Plithogeny articulates the formation, development, progression, and enhancement of novel entities arising from the dynamic integration of pre-existing entities, which may be antagonistic, neutral, or synergistic. This concept advocates for the amalgamation and integration of theoretical constructs and insights across multiple disciplines, thereby endorsing a transdisciplinary fusion of knowledge that encompasses the soft sciences, hard sciences, arts, and theoretical aspects of literature. This approach facilitates a comprehensive understanding by bridging disparate fields of study. [12]

Within this framework, a plithogenic Set is identified as a non-trivial set P, situated within a given domain $U(P \subseteq U)$ characterized by one or more distinguishing attributes $A_1, A_2, \dots, A_m, m \geq 1$. Each attribute within this set can assume values from a wide spectrum S of potential states. This spectrum can present itself in diverse forms—it may be finite or infinite, discrete or continuous, and its range may be either open or closed. [13]

This characterization highlights the inherent versatility and dynamism of plithogenic sets, reflecting the multifaceted and intricate nature of the knowledge and phenomena they aim to represent. By integrating a diverse range of attributes and their corresponding values within a cohesive framework, the plithogenic methodology enables a more detailed and holistic examination of entities. This approach promotes an interdisciplinary discourse and investigation, facilitating the transcendence of traditional demarcations among distinct domains of study.

Each element $x \in P$, it is characterized by the entire range of potential values for the attributes contained within the set $V = \{v_1, v_2, \cdots, v_n\}$. An attribute's value has a degree of belonging $d(x, v)$ for an element x in set P based on a specific criterion. This degree of belonging can manifest as fuzzy, intuitionistic fuzzy, or neutrosophic, among other types. [14]

This signifies that for every element x in the set P, there exists a function $d: PxV \rightarrow \wp([0,1]^z)$, as shown in equation (1), where $d(x, v) \subseteq [0,1]^z$ and $\wp([0,1]^z)$ represents the power set of $[0,1]^z$. Here, z indicates the degree of appurtenance, with $z = 1$ corresponding to the fuzzy degree, $z = 2$ to the intuitionistic fuzzy degree, and $z = 3$ to the neutrosophic degree of appurtenance.

$$\forall x \in P, d: PxV \rightarrow \wp([0,1]^z) \quad (1)$$

In this advanced exposition of plithogenic sets, a nuanced mechanism is introduced for evaluating the degree

of contradiction between different attribute values within such sets. If we denote V as the value set with its cardinality being greater than or equal to 1, we define a specialized function $c: V \times V \rightarrow [0,1]^2$. This function, termed the attribute value contradiction degree function, is designed to quantify the level of contradiction between any pair of attribute values v_a, v_b. The operation of this function is guided by several key axioms: [15]

$c(v_a, v_a) = 0$, which asserts that there is no contradiction in an attribute value when compared with itself, encapsulating the principle of non-contradiction.

$c(v_a, v_b) = c(v_b, v_a)$, which underscores the symmetry in the degree of contradiction between any two distinct attribute values, suggesting that the contradiction is mutual and unaffected by the order of comparison.

The notation c is specifically chosen to highlight that this function operates within the realm of fuzzy logic, implying a continuum of contradiction degrees rather than binary or discrete states. Additionally, variations of this function, such as $c_{IF}: V \times V \rightarrow [0,1]^2$, are conceptualized to accommodate the framework of neutrosophic logic, thereby acknowledging and quantifying varying levels of certainty or contradiction inherent in the attribute values.

Definition 1. In the context of a plithogenic set defined as (P, A, V, d, c), a Plithogenic Neutrosophic Aggregation Operator is described by Equation 2:

$$(a_1, a_2, a_3)AND_p(b_1, b_2, b_3) = ((1-c)(a_1 \wedge_F b_1) + c(a_1 \vee_F b_1), \frac{1}{2}(a_2 \wedge_F b_2 + a_2 \vee_F b_2), (1-c)(a_3 \vee_F b_3) + c(a_3 \wedge_F b_3)) \quad (2)$$

Here, $c \in [0,1]$, where $\wedge_F$ denotes a t-norm and $\vee_F$ denotes a t-conorm, as discussed in [16]. The operation acts as a Plithogenic Neutrosophic Intersection when c=0 and transforms into a Plithogenic Neutrosophic Union when c =1. This aggregation approach is noted for its superior accuracy compared to standard n-norms and n-conorms used between neutrosophic sets.

Additionally, a plithogenic neutrosophic set can be simplified into a crisp value using the formula outlined in Equation 3.

$$S(T, I, F) = \frac{1}{3}(2 + T - I - F) \quad (3)$$

In the framework of a plithogenic set, defined as (P, a, V, d, c), the structure consists of the principal set P, the attribute set A, the value set V, a membership function m, and the contradiction degree function d, which is conceptually aligned with the harmony coefficient c. This contradiction function is instrumental in assessing and quantifying the level of contradiction among the attributes, especially in regard to a primary attribute, should such an attribute be deemed critical in comparison to others. This framework thus serves as a potent instrument for analyzing and elucidating the intricate interactions among attributes within a plithogenic set. It provides valuable insights into the dynamics of contradiction and coherence, enhancing our understanding of the complex relationships within the set. [17]

In contrast, (U, a, V, d, c) is designated as Plithogenic Probability, wherein E represents the event space. Plithogenic probability is conceptualized as the probability of an event's occurrence considering the influence of all associated random variables, where each variable may conform to various probabilistic models including classical, T, I, F-neutrosophic, I-neutrosophic, T, F-intuitionistic fuzzy, T, N, F-picture fuzzy, T, N, F-spherical fuzzy, or other fuzzy extensions in their distribution functions. This approach significantly broadens the classical framework of multivariate probability by incorporating a diverse array of distribution functions that accommodate uncertainty and imprecision inherent in the data, providing a more comprehensive understanding of probabilistic events across different contexts and scenarios. [18]

Plithogenic statistics expands upon traditional multivariate statistics by integrating the principles of plithogenic probability. This integration not only broadens the conventional analytical framework but also enhances its descriptive power by allowing for a more nuanced decomposition of probabilities into distinct components: truth, indeterminacy, and falsehood. Such a multifaceted approach provides a deeper, more comprehensive analysis of probabilistic data, acknowledging and addressing the complexities often inherent in real-world scenarios. This methodology enables researchers and practitioners to capture and quantify the various degrees of uncertainty and vagueness that traditional statistical methods might overlook, offering a richer, more detailed understanding of the underlying dynamics of the data. Specifically, it breaks down probabilities into detailed segments represented as $T_1, T_2, \ldots, T_p$ for truths; $I_1, I_2, \ldots, I_q$ for indeterminacies; and $F_1, F_2, \ldots, F_r$ for falsehoods. This granular approach ensures that at least one set among the truths, indeterminacies, or falsehoods is comprised of more than one element, indicating the multifaceted nature of probabilities within the plithogenic framework.

This sophisticated subdivision allows plithogenic statistics to capture the complexity of real-world phenomena more accurately than classical methods. By acknowledging and quantifying the degrees of truth, the potential for indeterminacy, and the possibility of falsehood in any given situation, plithogenic statistics provide a richer, more dimensional view of statistical analysis. This methodological advancement enables researchers and analysts to account for the inherent uncertainties and ambiguities in data, offering a more refined and nuanced understanding of statistical outcomes. [19]

2.2 Method

This study adopts a descriptive cross-sectional quantitative approach to assess the perception of psychosocial factors in the work environment of a group of call center operators in Quito. The research focuses on the application of plithogenic statistics to analyze the perceptions and responses of workers to various work conditions. This approach allows for a detailed interpretation of the collected data, covering the complexity and heterogeneity of individual perceptions through a robust and adaptive statistical model.

The selection of the target population was meticulously planned to include call center operators who work under indefinite and full-time contract conditions, in three pre-selected companies located in Quito. This specific criterion was chosen to ensure homogeneity in employment conditions, providing a stable base for assessing psychosocial impacts without the confounding variables that might be introduced by variable duration contracts or different work schedules.

For participant selection, simple random sampling was implemented. This method was used to choose 114 workers from the payrolls of the selected companies, thus ensuring representativeness and randomness in the sample selection. This approach ensures that each member of the population has the same probability of being chosen, which is fundamental for the statistical validity and generalization of the study results.

The main instrument used in the research was the Psychosocial Risk Battery from the Ministry of Social Protection of Colombia, a validated and widely recognized tool for its effectiveness in measuring levels of stress and other psychosocial factors in work environments. This tool classifies work conditions into three main domains: intra-labor, extra-labor, and individual. Each of these domains is broken down into various dimensions that address specific aspects of the work environment:

1. Labor Demands: This domain evaluates the inherent demands of the job, including aspects such as quantitative demands, mental load, emotional load, responsibilities, physical and environmental effort, duration of the workday, and role consistency.
2. Control over Work: This domain investigates the extent to which the worker can influence or make decisions about their work, covering role clarity, training received, participation and management of change, development opportunities, and the use of skills and knowledge.
3. Leadership and Social Relations: Focuses on the quality of social and leadership interactions at work, considering leadership characteristics, social relationships, feedback on performance, and relations with colleagues.
4. Rewards: Assesses the perception of the rewards received, both in terms of recognition and compensation, as well as rewards derived from a sense of belonging to the organization.

Additionally, a stress assessment questionnaire was administered to identify symptoms of stress, classified into physiological, social behavioral, intellectual, work, and psychoemotional categories. This questionnaire complements the Battery by providing a direct analysis of stress reactions, allowing for a more comprehensive assessment of the psychosocial well-being of workers.

The combination of these instruments offers a comprehensive and detailed analysis of work conditions and their impact on the well-being of call center operators, thereby allowing the identification of critical factors that could be targeted for future interventions aimed at improving the quality of work life and organizational productivity.

Data collection was conducted using linguistic scales. These scales are associated with plithogenic numbers for their analysis, as represented in Table 1. This step facilitates a more precise and nuanced evaluation of the responses, using plithogenic numbers that represent degrees of affirmation and negation within a neutrosophic framework.

Table 1: Linguistic scale associated with plithogenic numbers for the evaluation of respondents

Linguistic scale	(T, I, F)
Strongly disagree	(0.1; 0.75; 0.85)
Disagree	(0.4; 0.7; 0.5)
Undefined	(0.5; 0.4; 0.6)
Agree	(0.65; 0.3; 0.45)
Strongly Agree	(0.95; 0.05; 0.05)

The analysis was conducted using plithogenic statistical techniques, which allow for the aggregation and complex analysis of neutrosophic data. This method is particularly useful for decomposing and understanding the variabilities and contradictions in employees' perceptions. Correlations and emerging patterns among the different domains and dimensions were evaluated to identify the main psychosocial factors affecting the well-being and job satisfaction of call center operators.

The study was conducted respecting the ethical principles of confidentiality, voluntariness, and informed consent. All participants were informed about the objectives of the research and gave their consent before participating. It was ensured that all information collected was treated confidentially and used exclusively for research purposes.

The adoption of plithogenic statistics in this study provides a valuable tool for exploring and understanding the complexity of psychosocial perceptions in the work environment of call center operators in Quito, opening new avenues for future research and for the development of evidence-based interventions that improve working conditions in this sector.

This methodology not only highlights the richness of the data obtained but also allows for handling uncertainty and the diversity of opinions in a structured manner, facilitating the interpretation of the complex psychosocial factors that influence the work environment of call center operators. The plithogenic approach, therefore, presents itself as a valuable tool in the context of data analysis where responses can be intrinsically nebulous or where individual perceptions may significantly diverge.

3 Results

The use of selected instruments facilitated data collection, capturing both individual and collective perceptions related to job demands, control over work, leadership, social relations, and rewards, as well as symptoms related to stress. Each response was meticulously recorded and organized to ensure the integrity and coherence of the information gathered. Data processing was carried out using statistical techniques utilizing the facilities provided by plithogenic numbers. This technique allowed for the decomposition of responses into neutrosophic components of truth, falsity, and indeterminacy, offering a deeper and more nuanced view of the perceptions of the work environment.

Figure 1 shows a summary of the responses obtained regarding each of the domains analyzed, as well as the level of perception expressed by the respondents.

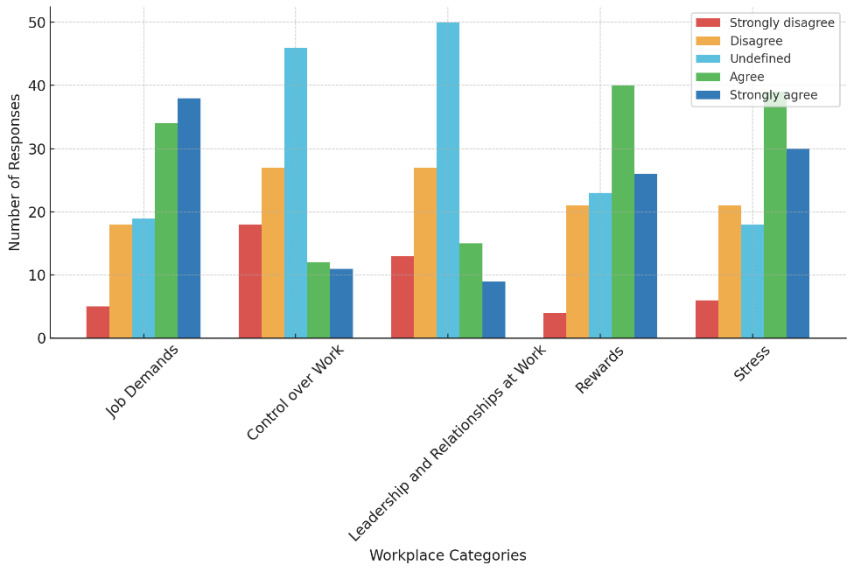

Figure1: Summary of questionnaire responses by domain analyzed

The evaluation of the "Labor Demands" dimension shows a pattern, particularly manifested in the responses grouped under the "Agree" and "Strongly Agree" categories. This phenomenon indicates that most call center operators perceive a significant level of job demands, including aspects such as mental and emotional load, assigned responsibilities, and the physical and environmental effort required in their daily work.

These results suggest that call center operators perceive the influence of an intensive work environment with high psychosocial demands. These results may indicate work stress that is not fully recognized or articulated by the workers. This is particularly relevant in the case of mental and emotional loads, which are known for their cumulative effects and, if not properly managed, can lead to long-term negative consequences for mental and physical health.

On the other hand, regarding the "Control over Work" domain, the majority of responses categorized as "Undefined" illustrate a lack of clarity and consensus among respondents about their ability to influence and make decisions in their job roles. This ambiguity in responses suggests a diffuse and possibly incoherent perception of autonomy and individual management capacity in the workplace, as well as the clarity of roles and responsibilities

assigned. High variability in responses indicating uncertainty or negative answers could reflect significant differences in individual employee experiences.

Similarly, the "Leadership and Social Relations" domain reveals an interesting pattern with a significant amount of responses classified as "Undefined". This trend suggests notable uncertainty or diversity of opinions among employees about the quality of social interactions and leadership within their work environment. The presence of such indeterminate responses reflects the existence of varied and possibly contradictory perceptions about these critical aspects of organizational climate. Differences in perception can arise from variations in employees' direct experiences with their superiors, as well as from the effectiveness with which interpersonal relations are managed and conflicts are resolved within teams.

Meanwhile, the results show positive responses and general satisfaction with the rewards received, encompassing both recognition and compensation. This pattern of responses suggests a positive feeling of appreciation and belonging within the organization, crucial elements for employee motivation and engagement. Despite this, samples were collected that indicate a significant inclination towards "Strongly Agree" in the perception of work stress. This result is particularly relevant, as it indicates that a considerable segment of the workforce experiences high levels of stress, a factor that can have profound implications for both the individual well-being of employees and the overall productivity of the organization. The marked tendency to strongly agree on perceiving stress highlights the presence of significant stressors in the work environment. Work stress not only affects the physical and mental health of employees but can also lead to a decrease in efficiency, increased absenteeism, and high turnover rates, which in turn negatively impacts the operability and costs for the company.

In the analysis of the collected data, the plithogenic AND_p aggregation operator formula was implemented, specifically designed to handle and synthesize information from contexts where variables may present inherent ambiguities or potential contradictions between analyzed elements. The formulation used incorporates minimum (min) and maximum (max) operations to perform conjunction $\wedge_F$ and disjunction $\vee_F$ operations, respectively, with a value of c=0.5. This value was chosen to balance the importance between conjunction and disjunction, reflecting a neutral position where neither operation is prioritized over the other, as there is no clear justification to favor one at the expense of the other. Moreover, by using equations (2) and (3), it was possible to determine the behavior of the parameters of interest for each particular dimension and in general.

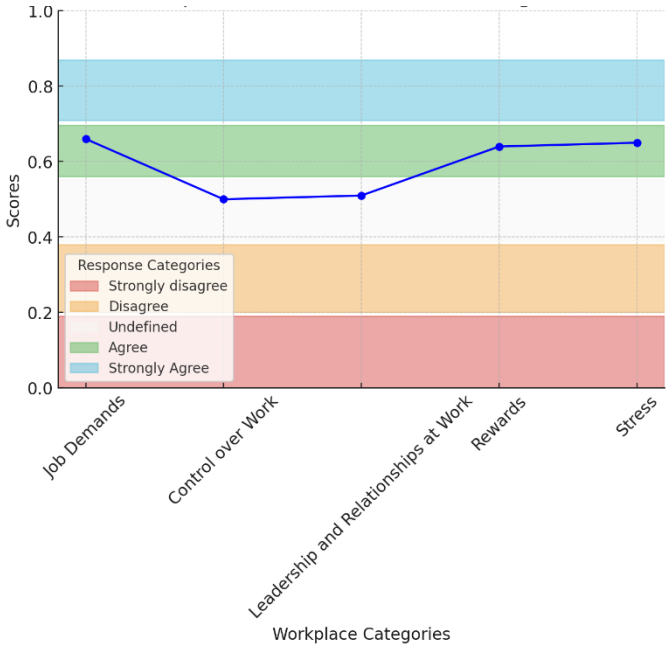

Figure 2: Overall plithogenic scores for each dimension evaluated

As observed in Figure 2, in general, employees indicate that high job demands, both physical and mental, are a prominent feature of their work environment. These demands are significantly associated with the perception of stress among workers. In this regard, it can be inferred that the intensity and volume of work, along with the required emotional and mental load, contribute to elevated levels of stress. This finding is consistent with existing literature that links high job demands with occupational stress, which can have adverse effects on the physical and mental health of employees.

Despite the challenges mentioned, there is general satisfaction with the rewards obtained. This aspect of the

study reflects a positive perception of the compensation and recognition policies implemented by the participating companies. Satisfaction with rewards can be a mitigating factor of the negative impact of work stress, as it provides employees with a sense of appreciation and fairness, essential for maintaining motivation and organizational commitment.

However, there is a generalized indeterminacy or uncertainty regarding control over work and in positions of leadership and labor relations. This result suggests that there is a lack of clarity or consistency in how employees perceive their ability to influence decisions and work processes, as well as the quality of interactions and leadership in the workplace. The ambiguity in these domains is problematic, as the perception of lack of control and poor labor relations are known factors that contribute to job dissatisfaction and a decrease in well-being at work.

4 Discussion

The implementation of plithogenic logic and the use of plithogenic numbers in the conducted study constitutes a methodological approach of great relevance, providing an analytical framework capable of addressing the complexity and multifaceted nature of human data, especially in the field of social and behavioral sciences. On one hand, the use of plithogenic logic allows for the manipulation and analysis of information that is inherently uncertain, imprecise, and/or contradictory. This capability is particularly relevant in studies where variables, such as human perceptions and emotional responses, do not lend themselves to strict or binary categorizations. Plithogenic numbers, which express degrees of truth, falsity, and indeterminacy, facilitate a more faithful representation of the subjective reality of respondents, allowing for a deeper understanding of their experiences and opinions.

The use of this methodology in the study provided several key advantages. First, it enabled capturing the complexity of employees' perceptions in a way that traditional statistical methods might have overly simplified. Additionally, the ability to break down responses into neutrosophic components helped to identify specific areas of consensus and dissent among employees, thereby facilitating more targeted and effective interventions.

From a decision-making perspective, the information generated through plithogenic logic allowed managers and policymakers to have a rich and detailed database on which they could base their strategies for improving the work climate. The identification of areas with high indeterminacy points to the need for greater clarity in company policies or in communicating expectations to employees.

Finally, the adoption of plithogenic numbers and plithogenic logic in this study not only enriches the analysis within the current project but also contributes to the methodological literature, proposing a path for future research facing similar challenges in measuring complex and subjective phenomena. This approach offers a valuable alternative to conventional methods, suggesting new possibilities for exploring and understanding the depths of human experience in various organizational and social contexts.

5 Conclusion

This study comprehensively explored the perceptions of relevant psychosocial factors among a group of call center operators in the city of Quito. Using advanced statistical methods and tools, such as plithogenic logic and plithogenic numbers, it was possible to capture and analyze the complexity and ambiguity inherent in human perceptions, providing valuable information for organizational management and the development of labor policies. Validated instruments were used to assess psychosocial factors and the perception of work-related stress. The use of elements of plithogenic logic and plithogenic numbers allowed for a detailed representation and analysis of employee responses, addressing the uncertainty and contradictions in their perceptions.

The results of the study revealed that call center operators face high job demands that significantly contribute to the perception of stress. This underscores the importance of developing strategies to manage the workload and improve employee well-being. Despite the demands and stress, employees expressed high satisfaction with the rewards received, indicating that compensation and recognition policies are effective and valued by workers. The indeterminacy in perceptions about control over work and the quality of leadership and social relationships suggests that these are areas that require additional attention and improvements to ensure a clearer and more cohesive work environment. The use of plithogenic statistics in the study was crucial for unraveling the complexity and ambiguity of employees' perceptions of their work environment, allowing for a detailed and nuanced analysis that goes beyond conventional statistical techniques. It is suggested to implement comprehensive stress management programs and review leadership policies to improve clarity in responsibilities and increase employee control and satisfaction at work.

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