Neutrosophic Sets and Systems {Special Issue: Neutrosophy and Plithogeny: Fundamentals and Applications}, Vol. 69, 2024

University of New Mexico

Impact of the development and implementation of a multiplatform mobile application in the gastronomic sector: an analysis through the neutrosophic PEST-SWOT approach

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Abstract. The dizzying technological advance has permeated all areas, including gastronomy. In this context, the development and implementation of a multiplatform mobile application has generated a significant impact in this sector. This article explores how this technological innovation has transformed the operational and commercial dynamics of gastronomy, using the neutrosophic PEST-SWOT approach. Through detailed analysis, political, economic, social and technological (PEST) factors are examined and combined with an exhaustive study of strengths, weaknesses, opportunities and threats (SWOT) from a neutrosophic perspective, revealing the complexity and dynamism inherent in this interaction. Neutrosophic analysis allows for a deep understanding of the uncertainties and ambiguities surrounding the implementation of mobile applications in gastronomy, offering a holistic and nuanced view. The findings show that while there are significant challenges, such as adapting to rapid technological changes and data management, there are also vast opportunities to improve operational efficiency and user experience. This study highlights the importance of an adaptive strategy that is aware of the multiple dimensions of the dining environment, suggesting that success lies in the ability to navigate and balance these complex forces.

Keywords: Gastronomy, SWOT Analysis, PEST Analysis, Neutrosophic Single Value Numbers, PEST-SWOT Neutrosophic Analysis, Multiplatform Mobile Application.

1 Introduction

In the current digital era, the gastronomic sector has not been immune to technological transformations . The implementation of cross-platform mobile applications has revolutionized the way restaurants and other related businesses operate and connect with their customers. These applications have not only improved operational efficiency but have also transformed the user experience, offering a range of services ranging from table reservations to home delivery. This study focuses on analyzing the impact of these technological innovations in the gastronomic sector. The development of cross-platform mobile applications has allowed gastronomic businesses to quickly adapt to changing market demands [1]. The flexibility of these applications, which can run on various operating systems such as iOS and Android, has significantly expanded the reach of dining services. Customers can now access menus, place orders and make payments from the convenience of their mobile devices, which has resulted in increased customer satisfaction and loyalty. However, the impact of these applications goes beyond mere customer convenience. In operational terms, these tools have optimized inventory management, personnel scheduling, and logistics coordination. The data collected through these applications provides valuable information that can be used to improve efficiency and reduce costs [2]. Analyzes of sales and customer preferences allow businesses to adjust their offers and marketing strategies more accurately and effectively.

The analysis of this impact is carried out using the neutrosophic PEST-SWOT approach, which combines the analysis of political, economic, social and technological factors (PEST) with a detailed study of strengths, weaknesses, opportunities and threats (SWOT). This neutrosophic approach is particularly useful in addressing the uncertainties and ambiguities surrounding the implementation of new technologies in complex environments such

as the gastronomic sector**.** It allows for a holistic evaluation that considers both the positive and negative aspects of these innovations**.** From a policy perspective, the regulation of mobile technologies and data protection are crucial aspects that affect the implementation of these applications**.** Government policies and privacy regulations must be carefully considered to ensure that applications meet legal requirements and protect user information**.** On the economic front, the cost of developing and implementing mobile applications can be significant, but the long-term benefits in terms of operational efficiency and increased revenue can justify this investment**.**

Socially, mobile applications have changed the way customers interact with food businesses**.** The ability to order online and access personalized services has increased consumer expectations**.** Applications must be intuitive and offer a fluid user experience to meet these new demands [3]. Technologically, the development of these applications requires a robust infrastructure and constant updating to keep up with the latest innovations and ensure the security and functionality of the system**.** The strengths of these applications include improving operational efficiency, reducing costs, and increasing customer satisfaction [4]**.** However, there are also weaknesses, such as dependence on technology and risks associated with cybersecurity**.** Opportunities come in the form of new markets and the ability to offer innovative services, while threats include intense competition and rapid changes in consumer technological preferences [5]**.**

The development and implementation of multi-platform mobile applications in the gastronomic sector has had a profound and multifaceted impact**.** This study, through the neutrosophic PEST-SWOT approach, provides a detailed understanding of these impacts and offers recommendations to maximize the benefits and mitigate the associated risks**.** The ability of gastronomic businesses to adapt to these technologies and take advantage of their advantages will be crucial to their success in the future**.**

2. Related Works.

2.1 Cross-Platform App Developers.

The digital era has brought with it countless innovations that have transformed our daily lives, and among them, multiplatform mobile applications stand out for their transversal impact in various sectors. These applications, designed to work on different operating systems such as iOS and Android, have revolutionized the way we interact with technology and the world around us. Its development has not only democratized access to tools and services, but has also generated a new paradigm in the software industry [6].

The main advantage of cross-platform mobile applications is their ability to reach a wide and diverse audience. Instead of developing and maintaining separate versions for each operating system, developers can create a single application that works efficiently across multiple platforms. This not only reduces development and maintenance costs, but also ensures a consistent and consistent user experience. Thus, users can enjoy the same functionalities and features, regardless of the device they use [7]. However, this approach also presents significant challenges. The need to adapt an application for different technical environments can result in compromises in terms of performance and functionality. Native apps, developed specifically for a particular operating system, typically offer superior performance and deeper integration with device features. On the other hand, cross-platform apps must balance these differences, which can sometimes result in a less optimized experience [8].

The mobile app market is highly competitive, and the quality of the user experience can be the deciding factor in the success or failure of an app. Users expect applications to be fast, intuitive and error-free. A failure in any of these aspects can lead to user dissatisfaction and, ultimately, uninstallation of the application. Therefore, cross-platform app developers must invest in extensive testing and constant optimization to ensure their products meet user expectations. Despite these challenges, cross-platform mobile apps have proven to be a powerful tool for innovation and digital transformation. In sectors such as education, health and commerce, these applications have facilitated access to services and resources that were previously inaccessible for many people. For example, in education, cross-platform applications allow students to access study materials, complete assignments, and participate in virtual classes from any device, democratizing access to quality education [9].

In the healthcare sector, these applications have enabled medical professionals to manage patient records, conduct virtual consultations, and monitor patients' health remotely. This not only improves the efficiency and quality of healthcare, but also facilitates access to healthcare services for people living in rural areas or with limited mobility. The ability to access these services from any device significantly increases equity in access to healthcare [10].

Commerce has also benefited greatly from cross-platform mobile applications. Consumers can shop, compare prices and access deals from their mobile devices, facilitating a more convenient and personalized shopping experience. Businesses, for their part, can reach a broader audience and manage their operations more efficiently. This has led to increased competition and the need to constantly innovate to attract and retain customers. However, the success of a cross-platform mobile app is not only measured by its reach and functionality, but also by its ability to adapt to changing user needs [11]. In a constantly evolving technological environment, developers must be

willing to continually update and improve their applications. This involves not only fixing bugs and adding new features, but also anticipating trends and adapting to new technologies.

Cross-platform mobile applications represent a significant innovation in the software industry, with the potential to transform entire sectors and improve people's lives. However, their development and maintenance present unique challenges that require constant investment in quality and optimization. By balancing these challenges with the opportunities, they offer, developers can create applications that not only meet user needs but also drive innovation and digital transformation. The future of mobile apps is undoubtedly promising, and their impact will continue to expand as technology advances.

2.2. SWOT Analysis.

SWOT analysis is an essential technique for evaluating the status of a company or project, examining both its internal characteristics (Weaknesses and Strengths) and its external environment (Threats and Opportunities) in a structured matrix. This process is broken down into four phases: analysis external, internal analysis, creation of the SWOT matrix and determination of the strategy to follow. The survival and prosperity of the organization are deeply linked to the environment that surrounds it, which presents both opportunities and threats. These are the key components of the external analysis. Simultaneously, the internal factors of the organization, such as its weaknesses and strengths, depend directly on its internal management [12].

Each of these four aspects can be classified as positive, driving the development of the organization, or negative, representing obstacles that impede said development - Opportunities are positive factors in the environment that, once identified, can be used to promote the growth of the organization The organization or project. On the contrary, threats are negative external influences that must be addressed with tactics and strategies to overcome them Internally, weaknesses are negative elements that need to be overcome through proper management, while strengths are positive aspects that must be exploited and enhanced. The SWOT analysis identifies strengths and weaknesses in areas such as the availability of capital resources, personnel, assets, product quality, internal and market structure, and consumer perception. The results of this analysis are placed in a matrix and are evaluated by experts, whose combined assessment offers a clear vision of the most promising strategies and tactics for the organization or project [13].

2.3. PEST Analysis.

The PEST analysis examines the external factors that influence a company, covering Political, Economic, Social and Technological components. This analysis allows us to understand how legislative regulations, economic conditions, sociocultural trends and technological advances impact the organization. For example, political factors include environmental protection laws, antitrust regulations and government stability, while economic factors encompass all variables that affect the market Sociocultural aspects refer to the configuration and behavior of consumers, and technological factors consider the development and adoption of new technologies [14]. The PEST-SWOT methodology is developed in two main stages. First, an exhaustive analysis of external factors is carried out from political, economic, social and technological perspectives In the second stage, the principles of SWOT analysis are applied to evaluate the internal characteristics of the company - Combining both approaches, a comprehensive and detailed vision of the business situation is obtained, identifying external opportunities and threats, as well as internal strengths and weaknesses, which facilitates the formulation of more effective and holistic strategies for the development and sustainability of the company [15].

2.4. PEST Analysis.

Unlike traditional PEST-SWOT methods, in this work the evaluations are carried out based on Triangular Neutrosophic Numbers of Single Value. Below are the fundamental explanations on this topic.

Definition 1 ([17]) : The neutrosophic set NS is characterized by three membership functions, which are the truth membership function T_A, the indeterminacy membership functionI_A and membership function to falsehood F_A, where Uis the Universe of Discourse and $\forall x \in U$, $T_A(x), I_A(x), F_A(x) \subseteq]^{-}_{a}0, 1^{+}[$, and $^{-}_{a}0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^{+}$.

See that by definition, $T_A(x), I_A(x)$ and $F_A(x)$ are standard or non-standard real subsets of $]^{-}_{a}0, 1^{+}[$ and, therefore, $T_A(x), I_A(x)$and $F_A(x)$can be subintervals of $[0, 1]$. $^{-}_{t}0$and1^{+} They belong to the set of hyperreal numbers.

Definition 2 ([17]): The single-valued neutrosophic set $F_A: U \to [0, 1]$(SVN N) Ais U, $T_A: U \to [0, 1]$ where $A = \{< x, T_A(x), I_A(x), F_A(x) > : x \in U\}$and $I_A: U \to [0, 1]$. $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

The single-valued neutrosophic number (SVN N) is symbolized by

$N = (t, i, f)$, such that $0 \leq t, i, f \leq 1$and $0 \leq t + i + f \leq 3$.

Definition 3 ([17]): The single- $\tilde{a} = \langle (a_1, a_2, a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$valued triangular neutrosophic number, is a neutrosophic set in $\mathbb{R}$, whose membership functions of truth, indeterminacy and falsity are defined as follows:

$$T_{\tilde{a}}(x) = \begin{cases} \alpha_{\tilde{a}}\left(\frac{x-a_1}{a_2-a_1}\right), a_1 \leq x \leq a_2 \\ \alpha_{\tilde{a}, x=a_2} \\ \alpha_{\tilde{a}}\left(\frac{a_3-x}{a_3-a_2}\right), a_2 < x \leq a_3 \\ 0, \text{otherwise} \end{cases} \quad (1)$$

$$I_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\beta_{\tilde{a}}(x-a_1))}{a_2-a_1}, a_1 \leq x \leq a_2 \\ \beta_{\tilde{a},}\, x = a_2 \\ \frac{(x-a_2+\beta_{\tilde{a}}(a_3-x))}{a_3-a_2},\ a_2 < x \leq a_3 \\ 1, \text{otherwise} \end{cases} \quad (2)$$

$$F_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\gamma_{\tilde{a}}(x-a_1))}{a_2-a_1}, a_1 \leq x \leq a_2 \\ \gamma_{\tilde{a},} x = a_2 \\ \frac{(x-a_2+\gamma_{\tilde{a}}(a_3-x))}{a_3-a_2},\ a_2 < x \leq a_3 \\ 1, \text{otherwise} \end{cases} \quad (3)$$

Where $\alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \in [0, 1]$,$a_1,\ a_2, a_3 \in \mathbb{R}$ and $a_1 \leq a_2 \leq a_3$.

Definition 4 ([17]) : Given$\tilde{a} = \langle (a_1, a_2, a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$ and$\tilde{b} = \langle (b_1, b_2, b_3); \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}} \rangle$ two triangular neutrosophic numbers of a single value andλ any non-zero number on the real line . Then, the following operations are defined:

1. Addition: $\tilde{a} + \tilde{b} = \langle (a_1 + b_1, a_2 + b_2, a_3 + b_3); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$,

2. Subtraction: $\tilde{a} - \tilde{b} = \langle (a_1 - b_3, a_2 - b_2, a_3 - b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$,

3. Investment: $\tilde{a}^{-1} = \langle ({a_3}^{-1}, {a_2}^{-1}, {a_1}^{-1}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, where $a_1, a_2, a_3 \neq 0$.

4. Multiplication by a scalar number:

$$\lambda\tilde{a} = \begin{cases} \langle (\lambda a_1, \lambda a_2, \lambda a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, \lambda > 0 \\ \langle (\lambda a_3, \lambda a_2, \lambda a_1); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, \lambda < 0 \end{cases}$$

5. Division of two triangular neutrosophic numbers:

$$\frac{\tilde{a}}{\tilde{b}} = \begin{cases} \langle \left(\frac{a_1}{b_3}, \frac{a_2}{b_2}, \frac{a_3}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_3 > 0 \text{ and } b_3 > 0 \\ \langle \left(\frac{a_3}{b_3}, \frac{a_2}{b_2}, \frac{a_1}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_3 < 0 \text{ and } b_3 > 0 \\ \langle \left(\frac{a_3}{b_1}, \frac{a_2}{b_2}, \frac{a_1}{b_3}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_3 < 0 \text{ and } b_3 < 0 \end{cases}$$

6. Multiplication of two triangular neutrosophic numbers:

$$\tilde{a}\tilde{b} = \begin{cases} \langle (a_1 b_1, a_2 b_2, a_3 b_3); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle,\ a_3 > 0 \text{ and } b_3 > 0 \\ \langle (a_1 b_3, a_2 b_2, a_3 b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_3 < 0 \text{ and } b_3 > 0 \\ \langle (a_3 b_3, a_2 b_2, a_1 b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_3 < 0 \text{ and } b_3 < 0 \end{cases}$$

Where,$\wedge$ It's a norm$\vee$ It is a conorm t .

3. Results and discussion

The study is carried out on the factors that impact the development and implementation of a multiplatform mobile application in the gastronomic sector. For this purpose, experts on the subject and specialized literature were consulted. In this way the following factors were identified:

1. **Technological Compatibility:** Ensure that the application works smoothly on different mobile operating systems such as iOS and Android.
2. **User Experience (UX):** Design an intuitive and easy-to-use interface that improves the user experience when interacting with the application.
3. **Data Security:** Implement robust security and privacy measures to protect users' personal and financial information.
4. **Development Cost:** Evaluate the budget necessary to develop and maintain the application, considering the costs associated with different platforms and updates.
5. **Integration with Existing Systems:** Ensure that the application can be effectively integrated with existing management and operational systems in restaurants and gastronomic establishments.
6. **Speed and Performance:** Optimize application performance to ensure fast loading times and smooth response to user interactions.
7. **Marketing and Promotion:** Plan effective strategies to promote the application and attract potential users, using digital marketing and public relations techniques.
8. **Feedback and Continuous Improvement:** Establish mechanisms to receive feedback from users and use this data to continually improve the application and its functionalities.
9. **Regulatory Compliance:** Comply with local and international regulations and standards related to data protection, electronic commerce and computer security.

Considering these factors during the development and implementation of a multiplatform mobile application in the gastronomic sector can help maximize its effectiveness and ensure its acceptance by the users and establishments involved.

The construction of a comprehensive model on the impact of the development and implementation of a multiplatform mobile application in the gastronomic sector may face several obstacles that require attention and consideration – The main obstacles to include are:

1. **Technological Differences:** Adapting the application to work optimally on different mobile operating systems, such as iOS and Android, can be complex due to variations in development technologies and standards.
2. **High Costs:** Cross-platform application development can be more expensive initially due to the need for compatibility with multiple operating systems and devices.
3. **Performance Optimization:** Achieving optimal performance on all platforms can be a challenge, as native applications often offer better performance than cross-platform ones in certain cases.
4. **Uneven User Experience:** Maintaining a consistent and satisfying user experience across different de-vices and operating systems may require additional design and development effort.
5. **Security and Privacy:** Ensuring the security of user data across platforms can be complicated due to differences in security policies across operating systems and mobile devices.
6. **Complex Integration:** Integrating the application with existing management systems in restaurants and gastronomic establishments can be challenging due to differences in technological infrastructure and operational processes.
7. **Updates and Maintenance:** Keeping the application updated and compatible with new versions of operating systems and mobile devices can require significant resources and constant attention.
8. **Market Adoption:** Convincing users and dining establishments to adopt and use the application can be difficult due to competition in the application market and established consumer preferences.

Overcoming these obstacles requires a multidisciplinary approach that includes diverse perspectives, fosters collaboration among multiple actors, and employs comprehensive data collection along with meticulous analysis of the complexity and uncertainty inherent in socioeconomic impact assessment. Based on the PEST analysis, we can categorize the mentioned factors as threats and opportunities in relation to the four components of this analysis.

Threats

1.1. Political

- T 1: Changes in data protection and privacy regulations.
- T 2: Political instability and legislative changes in technological regulations.

1.2. Economic.
- T 3: Fluctuations in application development and maintenance costs.
- T 4: Increase in digital marketing and app promotion costs.

1.3. Social
- T 5: Resistance of some users to adopt new technologies in gastronomy.
- T 6: Impact on local culinary culture and the acceptance of new digital platforms.

1.4. Technological
- T 7: Limitations in interoperability between mobile operating systems.
- T 8: Shortage of experts in mobile application development for multiple platforms.

Opportunities

2.1. Political
- O 1: Government support for digitalization initiatives in the gastronomic sector.

2.2. Economic
- O 2: Creation of new business models and markets through the mobile application.
- O 3: Increase in the competitiveness of the gastronomic sector through technological innovations.

2.3. Social
- O 4: Generation of local employment in urban and rural areas through the digital economy.
- O 5: Contribution to accessibility and culinary diversity for local and international consumers.

2.4. Technological
- O 6: Advances in geolocation technologies and personalization of gastronomic experiences.
- O 7: Opportunities for research and development of new functionalities and continuous improvements.

Weaknesses
- W 1: Shortage of UX/UI specialists to design intuitive and attractive interfaces.
- W 2: Complexity in integration with existing management systems in restaurants and gastronomic establishments.

Strengths
- S 1: Taking advantage of the growing popularity of food delivery and gastronomic tourism.
- S 2: Potential to improve operational efficiency and order management in gastronomic establishments.
- S 3: Improvement in customer experience and loyalty through loyalty programs and personalized recommendations.

A team made up of eleven experts was in charge of analyzing various combinations between an external and an internal factor . Each of them were asked to carry out evaluations using the linguistic terms detailed in Table 1.

Table 1. Linguistic terms for evaluations and their associated SVTNNs . See [14-17] .

Linguistic Terms	SVTNN
Very low (VL)	$\langle(0,0,1);0\ .00,1\ .00,1\ .00\rangle$
Low (L)	$\langle(0,1,3);0\ .17,0\ .85,0\ .83\rangle$
Medium Low (MDL)	$\langle(1,3,5);0\ .33,0\ .75,0\ .67\rangle$
Medium (M)	$\langle(3,5,7);0\ .50,0\ .50,0\ .50\rangle$
Medium High (MDH)	$\langle(5,7,9);0\ .67,0\ .25,0\ .33\rangle$
Height (H)	$\langle(7,9,10);0\ .83,0\ .15,0\ .17\rangle$
Very high (VH)	$\langle(9,10,10);0\ .00,1\ .00,1\ .00\rangle$

Specifically, there are the following sets:

$W = \{W_1, W_2\}$ denotes the set of Weaknesses,

$S = \{S_1, S_2, S_3\}$denotes the set of Strengths,

$T = \{T_1, T_2, T_3, T_4, T_5, T_6, T_7\}$denotes the set of Threats,

$O = \{O_1, O_2, O_3, O_4, O_5\}$denotes the set of Opportunities .

The steps are the following:

1. Each expert was asked to evaluate the possible combinations between the elements of SO, ST, WO and WT. This evaluation is carried out in terms of how the development and implementation of a multi-platform mobile application in the gastronomic sector would have a socioeconomic impact.
2. Linguistic terms are replaced by the equivalent single-valued triangular neutrosophic numbers (SVTNN) in Table 4.
3. A single SVTNN is obtained by calculating the median of the SVTNNs of all experts for each pair of items.
4. The arithmetic mean of the SVTNN is calculated for each quadrant SO, ST, WO and WT.
5. The final result of each quadrant is converted to a crisp value using precision Equation 4. This converts them into values on a numerical scale out of 10 that allows the results to be compared.

$$A(\tilde{a}) = \frac{\cdot}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} + \gamma_{\tilde{a}}) \quad (4)$$

Tables 1, 2, 3 and 5 summarize the results obtained after applying the previous steps .

Table 2. Calculation results for the SW quadrant. The medians of all experts are shown.

		Opportunities				
		O_1	O_2	O_3	O_4	O_5
Strengths	S_1	H	V . H .	H	H	V . H .
	S_2	V . H .	H	V . H .	V . H .	H
	S_3	H	MDH	H	H	V . H .

Table 3. Calculation results for the ST quadrant . The medians of all experts are shown.

		Threats						
		T_1	T_2	T_3	T_4	T_5	T_6	T_7
Strengths	S_1	MDH	H	MDH	MDH	H	H	V . H .
	S_2	H	VVH	H	H	V . H .	V . H .	H
	S_3	V . H .	MDH	H	V . H .	V . H .	MDH	V . H .

Table 4. Calculation results for the WO quadrant. The medians of all experts are shown.

		Opportunities				
		O_1	O_2	O_3	O_4	O_5
Weaknesses	w_1	MDH	MDH	MDH	MDH	MDH
	w_2	MDH	MDH	MDH	MDH	MDH

Table 5. Calculation results for the WT quadrant. The medians of all experts are shown.

		Threats						
		T_1	T_2	T_3	T_4	T_5	T_6	T_7
Weaknesses	w_1	V . H .	H	H	V . H .	H	V . H .	H
	w_2	MDH	MDH	MDH	MDH	MDH	MDH	MDH

From Tables 1 to 5, we have the following results:

- Potentials (Opportunities+Strengths): $\langle((7\ .6667, 9\ .2667, 9\ .9333); 0\ .67, 0\ \ .25, 0\ .33\rangle$,
- Risks (Strengths+Threats): $\langle(5\ .5190, 6\ .5714, 9\ .7519); 0\ .57, 0\ .25, 0\ .33\rangle$,
- Challenges (Weaknesses+Opportunities) $\langle(6, 7, 9); 0\ .57, 0\ .35, 0\ \ .23\rangle$:
- Limitations (Weaknesses+Threats): $\langle(6\ \ .0, 7\ \ .0, 6\ \ .5); 0\ \ .60, 0\ .40, 0\ .50\rangle$.

As a last step, these values are converted into a crisp scale with a maximum of 10 using Equation 4 . From here we have the following results:

1. Potentials (Opportunities+Strengths): 9. 6563 .
2. Risks (Strengths + Threats): 6. 4657 .
3. Challenges (Weaknesses + Opportunities): 7 .8241 .
4. Limitations (Weaknesses + Threats): 6 .7652 .

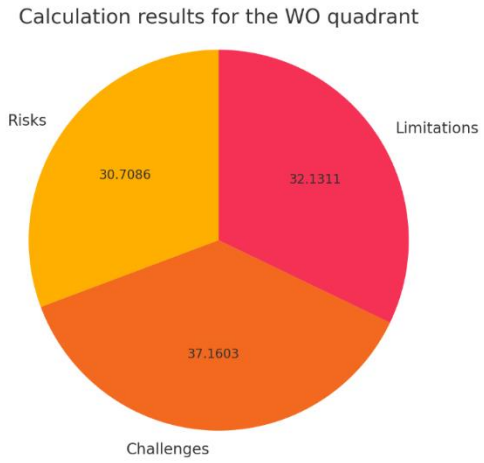

Figure 1. Calculation results for the WO quadrant.

After analyzing the SWOT analysis and the neutrosophic values associated with the development and implementation of a multiplatform mobile application in the gastronomic sector, several significant conclusions can be drawn that impact both the opportunities and challenges faced by this technological initiative. The political, economic, social and technological threats identified reveal a complex panorama for the integration of a mobile application in gastronomy. Regulatory changes in data protection (T1) and political instability (T2) suggest potential risks in terms of legal certainty and adaptability to future regulations. Economically, fluctuations in development costs (T3) and increased digital marketing (T4) can affect the long-term financial viability of the project.

Socially, the resistance of some users (T5) to the adoption of new technologies and the impact on local culinary culture (T6) pose challenges in the acceptance and integration of the application in the market. Technologically, limitations in interoperability (T7) and a shortage of specialized talent (T8) are critical obstacles that could compromise the efficiency and operational effectiveness of the system. On the other hand, the opportunities and strengths identified indicate significant potential for the development and expansion of the gastronomic sector through technological innovations. Government support (O1) and the creation of new business models (O2) represent strategic advantages that can drive mobile application adoption and scalability. Socially, the generation of local employment (O4) and the improvement in culinary accessibility (O5) promote inclusion and diversification of the market.

Technologically, advances in geolocation and personalization (O6) offer opportunities to improve the user experience and differentiate the gastronomic offer in a competitive market. Strengths such as leveraging growth in food delivery and gastronomic tourism (S1), improving operational efficiency (S2), and building customer loyalty through loyalty programs (S3) reinforce the project's strategic position.

The neutrosophic analysis provides a balanced perspective by considering both the risks and opportunities inherent in mobile application development in the gastronomic sector. The potentials (9.6563) indicate a favorable balance between opportunities and strengths, suggesting an environment conducive to innovation and growth . However, risks (6.4657) and challenges (7.8241), which combine strengths and threats with weaknesses and opportunities respectively, highlight the need to mitigate risks and make the most of the identified opportunities. Limitations (6.7652), which group weaknesses and threats, highlight critical areas where attention and specific strategies are required to overcome obstacles. It is essential to adopt a strategic approach that capitalizes on identified strengths and opportunities, while proactively managing risks and overcoming technological and operational challenges. The success of the development and implementation of a multiplatform mobile application in the gastronomic sector depends on a careful evaluation and management of the factors identified in the SWOT analysis. Effective technology integration, agile response to regulatory changes and creating tangible value for users and

gastronomic businesses will be crucial to achieving and maintaining a sustainable competitive advantage in today's digital market.

Machine learning has been increasingly recognized as a powerful tool for enhancing SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis, facilitating more accurate and data-driven decision-making processes. For instance, Abdel-Basset et al. [17] introduced a novel group decision-making model utilizing triangular neutrosophic numbers, showcasing the integration of advanced computational techniques in strategic analysis. Furthermore, recent advancements in sustainable machine intelligence, as demonstrated by Abd El-Khalik [18, 19], highlight the potential of machine learning in improving predictive models for various applications, including thermal comfort prediction in built environments). These studies underscore the transformative impact of machine learning on traditional analytical frameworks, suggesting its viability for enhancing SWOT analysis methodologies.

4. Conclusion

After a careful analysis of the SWOT analysis and the neutrosophic values associated with the development and implementation of a multi-platform mobile application in the gastronomic sector, fundamental conclu-sions emerge that outline both the promising opportunities and the significant challenges that this technological project faces. The threats identified in the political, economic, social and technological spheres reveal a complex panorama that could hinder the effective integration of the application in the gastronomic industry. Aspects such as regulatory changes in data protection and political instability pose considerable risks in terms of legal certainty and adaptability to future regulations, thus affecting the long-term operational stability of the project. On the economic front, fluctuations in development costs and the rise of digital marketing present additional challenges that could compromise the financial viability of the project. Socially, the resistance of some users to adopting new technologies and the potential impact on local culinary culture underscore the importance of marketing and educational strategies to overcome these barriers to acceptance. Technologically, limitations in interoperability between systems and a shortage of specialized talent represent critical obstacles that require innovative and collaborative solutions.

On the other hand, the identified opportunities and strengths indicate significant potential to positively transform the gastronomic sector through technological innovations. Government support and the creation of new business models represent strategic advantages that can catalyze the adoption and scalability of the mobile application in the market. Socially, the generation of local employment and the improvement in culinary accessibility promote the inclusion and diversification of the market, while technologically, advances in geolocation and personalization offer new ways to improve the user experience and differentiate the gastronomic offer in a competitive environment.

The neutrosophic analysis sheds light on the delicate balance between risks and opportunities inherent in mobile application development in the gastronomic sector. Although the potentials indicate a positive balance between opportunities and strengths, it is crucial to proactively address the identified risks and challenges. Risks combined with strengths and threats with opportunities outline critical areas where meticulous and strategic management is required. Overcoming technological and operational limitations, as well as capitalizing on identified strengths, will be crucial to ensure the sustainable success of the project. In summary, the success of the development and implementation of a multiplatform mobile application in the gastronomic sector will depend on the ability to effectively evaluate and manage the factors identified in the SWOT analysis. Effective integration of technology, adaptive response to regulatory changes, and creating tangible value for both users and food businesses are imperative to maintaining a competitive advantage in today's dynamic digital marketplace.

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Received: February 25, 2024. **Accepted:** June 16, 2024