IT Services Weighting System for Medium-Sized Retail Sector Companies in Peru

Davila Reymundo Smith[1], Neira Callao Kevin Armando[1], Barrientos Padilla Alfredo[1,*]

[1] Facultad de Ingeniería Universidad Peruana de Ciencias Aplicadas - Lima, Perú

ARTICLE INFO	ABSTRACT
Article history: Received 8 January 2022 Received in revised form 9 April 2022 Accepted 3 May 2020 Available online 18 June 2022 *Keywords:* Multicriteria Decision; Retail; Technology selection	Several companies have promoted the use of technological tools within their processes to continue operating in the midst of the global crisis generated by COVID 19. As a result of this situation, numerous companies have emerged that provide IT services to help integrate the use of technology within the organizations that require it. However, there are many companies that are not able to optimize and estimate their multiple technological requirements and even to choose the most suitable IT service provider for their needs. For this reason, we propose a web-based IT service weighting system for retail companies using the MCDM TOPSIS method. The proposal was validated through the development of a web application and its implementation in a retail sector company, as well as the judgment of IT experts. The results show that the application significantly helps companies to choose IT service providers and increases the use of technological tools.

1. Introduction

In recent years, due to the pandemic caused by covid-19, many companies have promoted the use of technology to continue operating during the global crisis, which is due to the fact that these information technologies enable the possibility of being present in various industries and promote the continuous improvement of the processes in which they are involved [1]. According to an analysis conducted by IDC (International Data Corporation) in 2022, Latin American companies will increase their investments in the IT sector by 9.4% [1]. Also, one of the IDC predictions mentions that by 2025, companies looking to drive revenue growth will select vendors that can offer a portfolio of design strategy and technology services [1]. Although it is true that many companies opt for the implementation of different IT services in their processes, in [2] it is mentioned that many companies are not able to optimize and estimate their multiple technological requirements, which are of vital importance in the IT technology selection process.

---

* Corresponding author.
E-mail address: pcsiabar@upc.edu.pe (Barrientos Padilla, Alfredo)

On the other hand, one of the sectors with the greatest evolution related to technological advances, but which faces several challenges, is the retail sector [3]. This sector encompasses activities involving the retail sale of goods and services, ranging from cars to clothing, food, movie tickets, services and digital goods, among others. The retail sector is a channel that trades directly with the end consumer, where customer needs help drives the digital transformation of processes. In Peru, retail accounts for 70% of the market and retail that uses technology accounts for 30%. It is worth mentioning that the retail sector is very important in Peru, since in addition to generating employment, promoting consumption and investment, it also represents 10.7% of GDP [3]. However, 24% of medium-sized companies refuse to go digital due to lack of resources, lack of knowledge, high costs in the technological implementation or in many cases there is resistance to change by some members of the team. Nevertheless, despite multiple efforts, so far no application or software has been found that includes MCDM (multi-criteria decision method) that focuses on the selection of IT service providers for companies in the retail sector and the task of making the most appropriate choice of suppliers that provide such IT services is becoming more and more complicated, not only must they deal with the large number of options that exist in the current market, but they must also consider the quality of the services and reliability of their suppliers, in order to make a favorable investment for the company and satisfy its technological requirements [4]. For this reason, a web-based system for weighting IT services for companies in the retail sector using the MCDM TOPSIS is proposed. The proposal was validated through the development of a web application and its implementation in a retail sector company, as well as the judgment of experts made up of IT managers. The results show that the application significantly helps companies in the retail sector to choose IT service providers and increases the use of technological tools.

This research article details the implementation and validation of an IT service weighting system for medium-sized companies in the retail sector, using Topsis multi-criteria decision-making techniques. It has also been developed in five sections. The second section presents the literature review on TOPSIS multi-criteria decision-making methods. In the third section, our proposal for a web-based IT service weighting system for retail companies using the TOPSIS MCDM and a description of the development process is detailed. The fourth section presents the validation carried out by means of a web application and its implementation in a retail sector company. Finally, the fifth section presents the conclusions.

2. Review of the literature

A. Multicriteria Topsis weighting system

It is a methodology that establishes a weighting framework to choose the best alternative over multiple options, according to requirements and/or needs that seek to be solved. The weighting is given when the alternatives are valued based on their success in solving a need, in this sense, the best alternative will be the shortest numerical distance between the requirement and the solution alternative. The Topsis method uses a mathematical logic that finds the numerical distance and, based on these distances, the decision making on one alternative or another becomes lighter since the weighting results in order of importance to the best alternative.

This model oriented to the problem that the project seeks to solve should be understood that the weighting will serve to qualify the best IT service provider that a medium-sized company may need based on the criticality of its requirements. In that sense, a medium-sized company does not have a large infrastructure for information technology, so the options to take into account for any type of IT service contracting should be mainly cloud services.

B. Proposed MCDM tools or models

In [4] a tool for TOPSIS based on Python-3 functional on Microsoft Windows and Linux platforms is designed. Such a tool is a free and open-source software, especially with extensive post-analysis extensions. Also, an easy-to-use graphical interface for solving MCDM problems using Topsis is provided.

In the case of [7] a hybrid model comprising TOPSIS and a predictive intelligence/soft computing-based technique was applied for the retail sector of the fast-moving consumer goods industry to select the best possible suppliers using the sustainability criteria.

In [6] (Halicka, 2020) a proposal for the use of MCDM during technology evaluation and selection is presented. The proposed concept combines a life cycle analysis and the Topsis method that determines the performance of a technology that examines the technological maturity.

In [8] a methodology is introduced to determine the suitable cloud service by integrating the AHP (Analytic Hierarchy Process) weighing method with the TOPSIS method. With AHP, the architecture for the cloud service selection process is defined and the criteria weights are calculated by pairwise comparison, while with the TOPSIS method, the final ranking of the cloud service is obtained based on the overall performance.

In [9] describes how to combine entropy in the TOPSIS model to reduce the bias of multicriteria evaluation. While it is true that the weights assigned to the evaluation variables are determined by expert decision makers based on their professional background, experience and knowledge, this article uses ANP (analytic network process) - entropy weights to extend the Topsis method, since these new weights replace the subjective weights provided by the experts.

The research article [10] employs the TOPSIS method and experimentally details some shortcomings of the conventional TOPSIS method by using a simulation technique, with the aim of better understanding the TOPSIS method and contributing to its improvement.

3. Proposal

The proposal used is a web application that uses the TOPSIS multi-criteria decision method (MCDM) for the selection of IT service providers that adapt to the needs requested by the client when registering their requirements in the application, which improves the search and analysis process of various providers that offer different IT services, as well as validating the quality certificates held by the various providers. The following figures show the different layers of the proposed architecture of the solution.
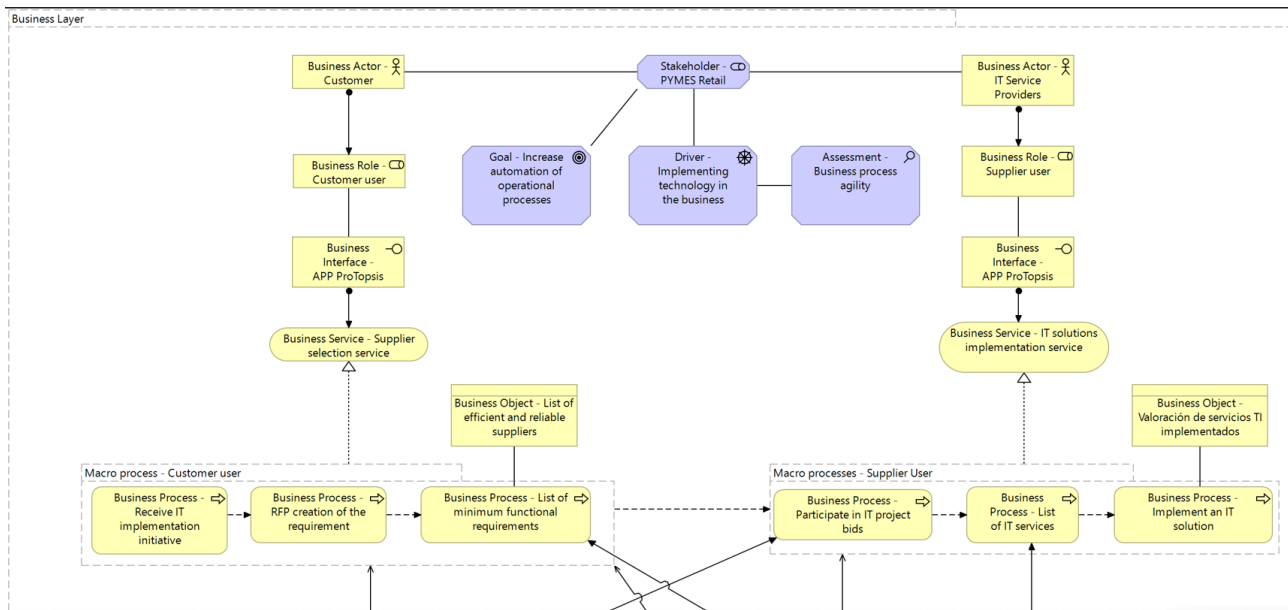
Fig. 1. Business layer of the ProTopsis web application architecture

In this layer, there are two main actors which are the client user and the supplier.

A. Customer user
- Addresses the need for an IT solution implementation
- Creates the RFP document, which details the requirements and functions of the IT service to be implemented
- Generates business cases of the project to be implemented

B. Supplier user
- Register and participate in tenders that an IT services implementation requires attention
- Attach quality and/or best practice certifications
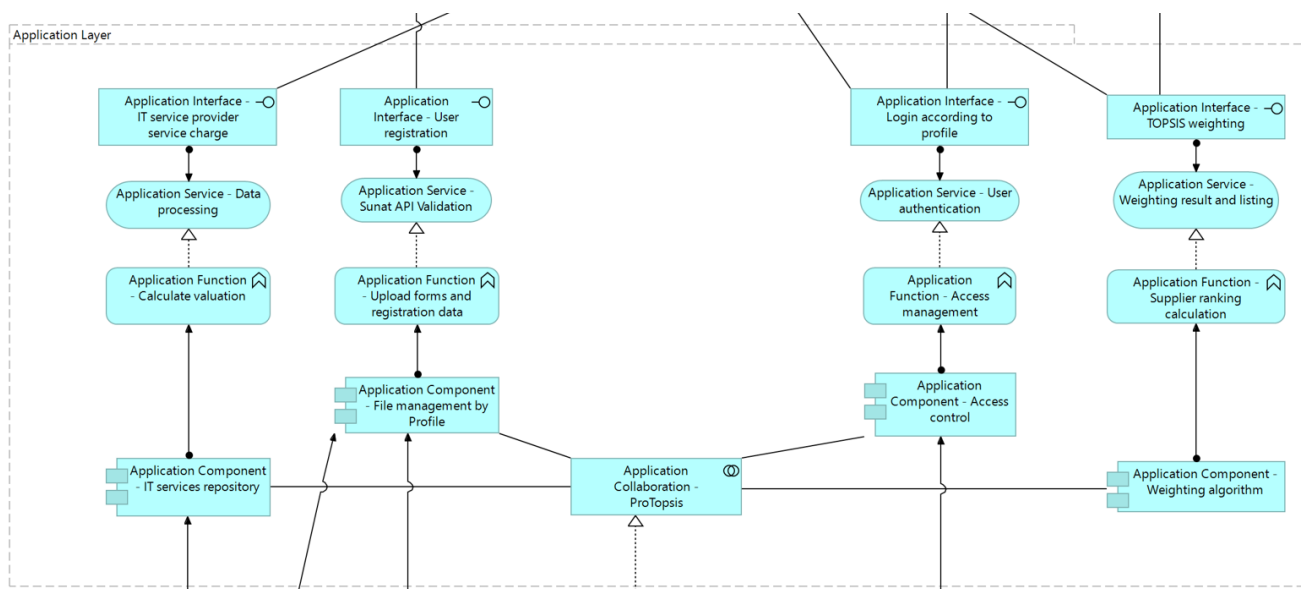
Fig. 2. Application layer of the ProTopsis web application architecture

In the application layer you will find:

A. IT service repository
* The valuation of the services provided by the IT service provider is calculated
B. File management by profile
* Records the registration data of users/suppliers and validates their company authenticity through a validation with SUNAT.
C. Access control
* Manages and moderates the authentication of the users registered in the application, according to the profile to which they belong (customer or supplier)
D. Weighting algorithm
* It calculates the ranking of suppliers based on the Topsis multi-criteria weighting model, since this is the basis for the choice that the customer-user will consider for the implementation of the IT solution.
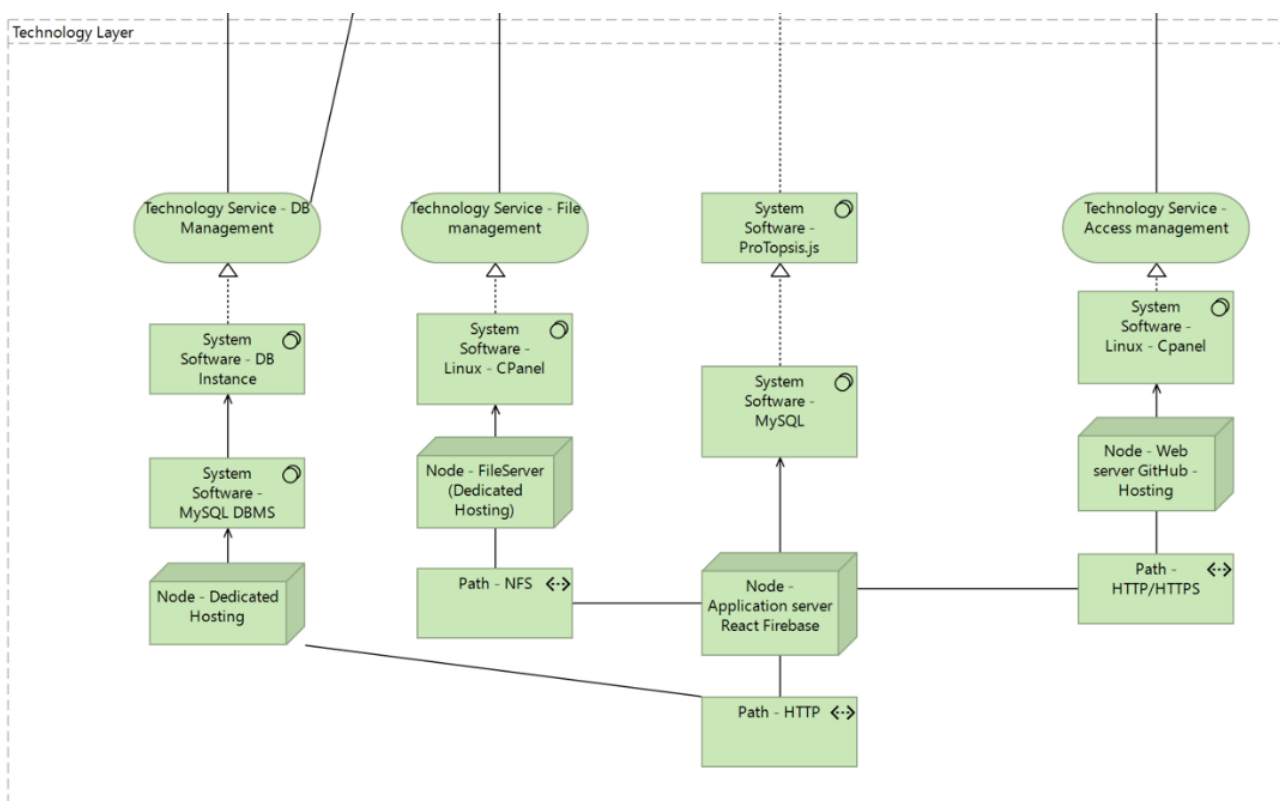
Fig. 3. Technology layer of the ProTopsis web application architecture

And in the technology layer, the application will have the following elements:

A. The application will be developed in a localhost environment.
* 1 test server – React Firebase
B. The productive environment of the application shall consist of:
* 1 web server backed by GitHub - Dedicated Hosting
* 1 shared server with one MySQL instance - Dedicated Hosting
* 1 shared server of Fileserver – Dedicated Hosting
C. The visual interface for the server where the integration and configuration of the dedicated hosting will be managed is:
* WHM CPANEL – Linux based

Figure 4 shows the web application. To access the tool, go to the https://protopsis.xyz/sistema/ page and log in with the client or supplier user profile.
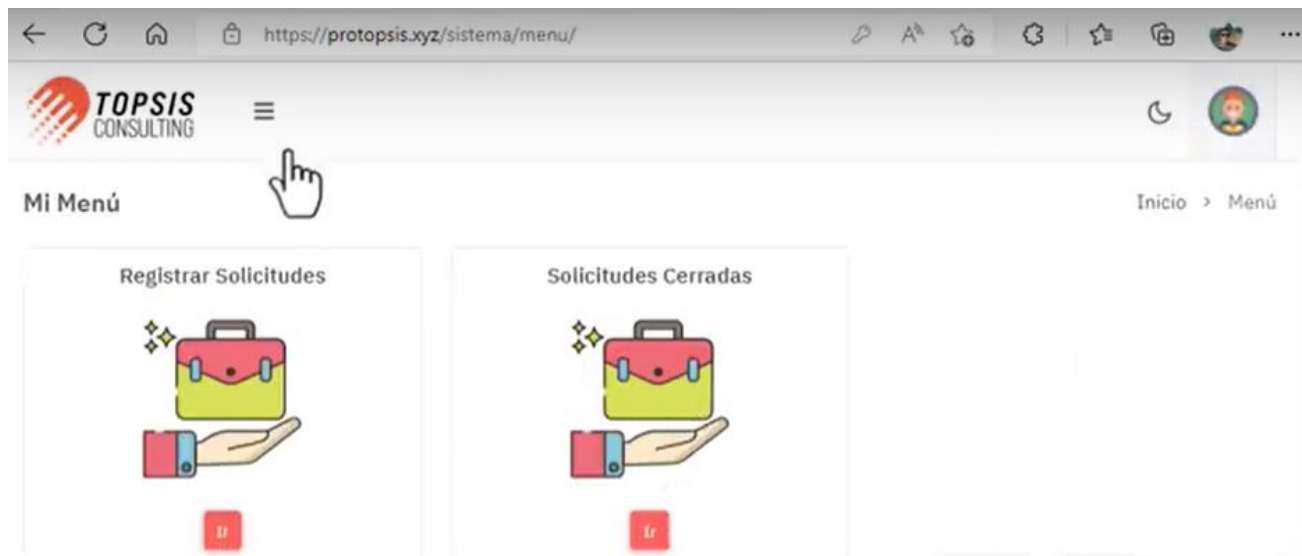

Fig. 4. Topsis Consulting web application - client user

For the customer user profile the system displays 2 sections, in which you can register requests for an IT service implementation and complete the requirements fields so that the selected provider meets all customer needs as shown in Figure 5 and the closed requests section, in which the customer will see the requests that have been created and processed by the system for the choice of the IT service provider that suits their needs. Also, it will be possible to visualize the detail of all its history of executions by project and the detail of the step by step executed by the system for its interpretation as shown in Figure 6 and 7.
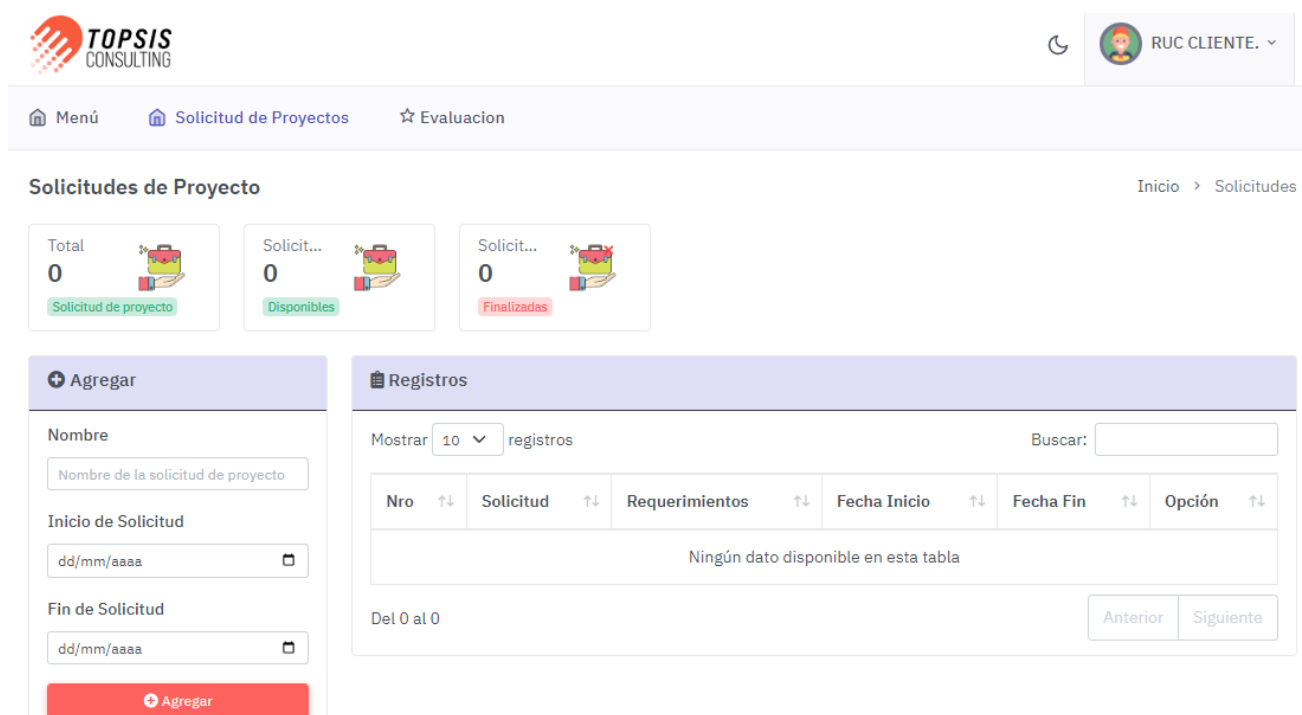
Fig. 5. Registration of requests for requirements - Protopsis web site

Fig. 6. Execution history by project - Protopsis web site

Fig. 7. Detail of the execution of a Topsis evaluation - Protopsis website

Figure 8 shows the supplier user view, where you can add or edit services provided, add or delete quality certificates, good practices, among others, and apply for offers from client users.
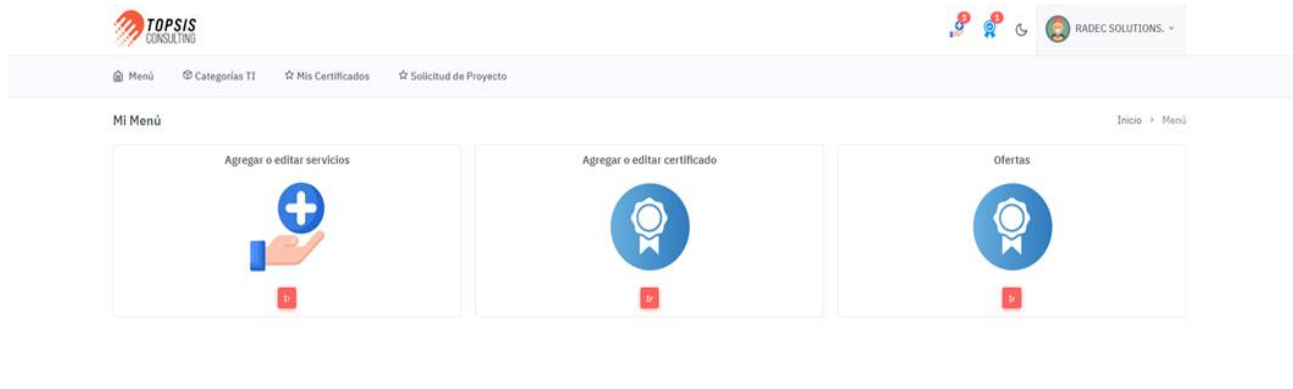
Fig. 8. Topsis Consulting web application - user provider

4. Validation

To validate the proposed solution, interviews were conducted with client users and IT experts. The objective is to receive comments and feedback from the use of the tool applied in a real environment. The users interviewed are people with work experience and who at different times have had the need for an IT automation system, either by the nature of their functions or technological improvements in the area to which they belong.

Two sets of questionnaires were developed for each profile, which were based on the research article [11] and [12] in which some questions were adapted to provide more focus to the proposed solution and that each of them responds to the identified main causes of the project. It is worth mentioning that the survey questions that have the greatest impact on the validation of the project have been carried out and evaluated on a Likert scale, since obtaining a quantitative result helps to evaluate the value and impact of the proposed solution. For the group of IT experts, the questions that have generated the greatest impact were the following: On a scale of 1 to 5 where 1 is helped very little, 2 is helped a little, 3 is more or less, 4 is helped, 5 is helped quite a lot. How much do you consider that the web application helps to compare different IT service providers that exist in the market (see Figure 9 for the detail of the answers).
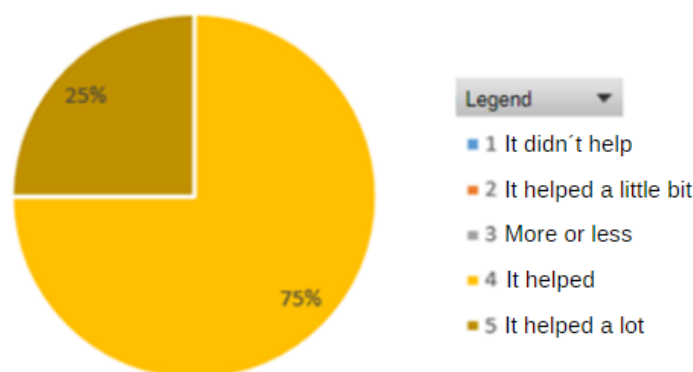

Fig. 9. IT expert survey response

Please indicate, on a scale of 1 to 5, where 1 is not optimized, 2 is slightly optimized, 3 is more or less optimized, 4 is optimized and 5 is optimized a lot. How much did you optimize your supplier search and analysis process (see Figure 10 to visualize the result of the survey).
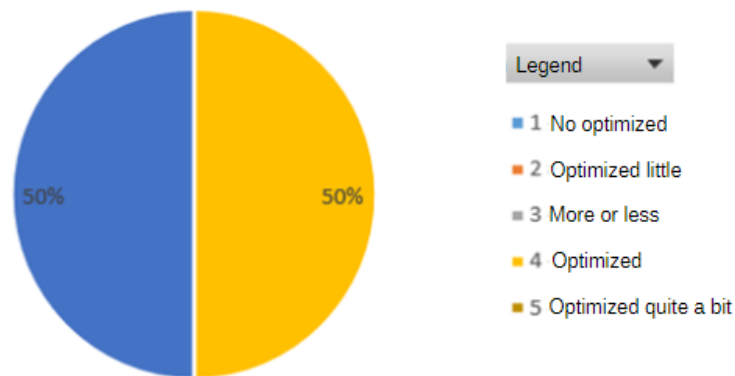
Fig. 10. IT expert survey responses

On a scale of 1 to 5 where 1 means not at all, 2 means not very much, 3 means more or less, 4 is quite a lot and 5 is too much. After using the tool, you felt that all your requirements are considered, and your need is taken into account. Figure 11 below will graphically show the survey result for this question.
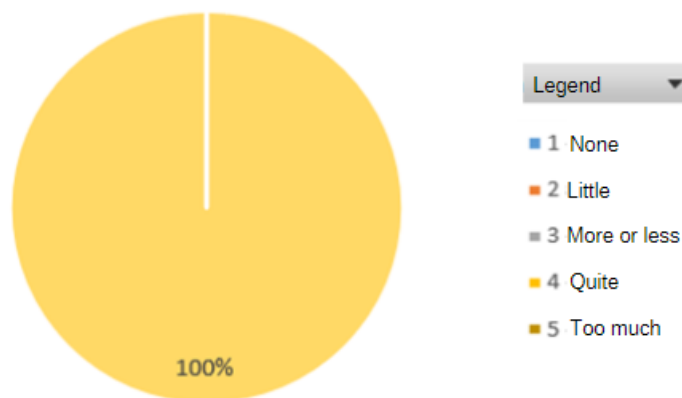
Fig. 11. Survey response to IT experts

On the other hand, for the group of client users, a total of 20 questions were asked, but the questions that generated the greatest impact were the following: On a scale of 1 to 5, where 1 is not optimized, 2 is slightly optimized, 3 is more or less optimized, 4 is optimized and 5 is quite optimized. After using the tool, he felt that he optimized his search process for companies that provide IT services. On a scale of 1 to 5 where 1 is no coverage, 2 is little coverage, 3 is more or less coverage, 4 is coverage and 5 is total coverage. The supplier, within the proposal sent through the web application, covered the implementation of all its requirements.

Mention yourself, on a scale of 1 to 5 where 1 is not optimized, 2 is slightly optimized, 3 is more or less optimized, 4 is optimized and 5 is fairly optimized.

After using the tool, did you feel that you optimized your search process for companies that provide IT services?

Fig.12. Client user survey responses

On a scale of 1 to 5 where 1 is no coverage, 2 is little coverage, 3 is more or less coverage, 4 is coverage and 5 is total coverage.

The supplier within the proposal sent through the web application, covered the implementation of all its requirements.

Fig. 13. Client user survey responses

From the total of 20 questions in the questionnaire for client users and 15 for IT experts, it was possible to solve the main causes identified in the project, which are the following: High growth of IT service offers that provide similar functionalities during the last years, lack of verifiable evidence of IT service quality by suppliers, clients without the capacity to optimize and estimate their functional requirements for the choice of an IT service, conventional multi-criteria decision methods that do not adapt to the new needs or requirements of their clients.

From the interviews conducted with client users and IT experts, 3 important points stand out:

The PROTOPSIS tool speeds up the time it usually takes to carry out an IT implementation/automation, as users explain to us, before an implementation can be carried out, it must go through many phases, from an initiative to an approval. In some cases, this delay triggers a company to get involved with "Shadow IT", as they are forced to take this option given the need to hire an IT solution or tool.

As indicated by a group of users, the algorithm that manages the PROTOPSIS tool, can be extrapolated to more sectors or business areas, since as an input of this algorithm, requirements are recorded and then evaluated by an expert, thus giving rise to the possibility of receiving proposals/quotations from suppliers of various kinds. In this way, our tool could centralize the general request of an entire company, for the management of the choice of the best suppliers, as the case may be [13].

We can affirm that, by depending on an expert evaluator, the tool runs the risk of producing subjective results [14]. In this context, a second phase proposed is the integration with an RPA, in the sense that this RPA processes a greater amount of information when extracting evaluation criteria from a proposal and at the same time, evaluates a greater number of suppliers at the same time, with a lower margin of error [15]. This completely rules out the possibility of a conflict of interest between the suppliers to be evaluated and the expert evaluator.

5. Conclusions

This paper proposes a web application for companies in the retail sector that uses the Topsis multi-criteria decision method to select the ideal IT service provider based on customer requirements. Likewise, through the solution, the retail sector in Peru, whose technological growth is increasing and represents an important part of the GDP in Peru, is being served [16]. This is why the need to provide a new approach to the multi-criteria method is evident, given that the literature reviewed so far most of the applications of the TOPSIS algorithm are for the logistics world and in companies that generate a greater economic impact than SMEs.

The application has client and supplier user profiles, in which each one has different navigation interfaces according to their main purposes. In addition, the application executes the Topsis method considering the client's requirements and shows a recommended list of a ranking of ideal suppliers for the solution, being the first option the most ideal supplier. However, the customer can modify the weights, run the algorithm again or contact the various suppliers showing the final recommended list.

This application was validated through interviews with expert users and client users and tested in a real retail environment. The results of the validation of the proposed solution are favorable, since most of the respondents mentioned that the tool helps them to optimize their supplier search and analysis process considering their needs from the point of view of a medium-sized company in the retail sector. While it is true that the tool is subjective to the evaluation of an IT expert to consider the weights assigned to each supplier, this can be improved by integrating technologies such as artificial intelligence and neural networks in order to eliminate such subjectivity of the expert evaluator.

References

[1] Retail, P. P. (El reto que tienen las Pymes frente a la tecnología. Perú Retail. 2021, 18 agosto).

[2] Eduardo G., E. (IDC estima crecimiento de 9,4% en las inversiones de TI para 2022. CIOAL The Standard IT. 2022a, enero 12).

[3] AméricaEconomía.com. Inversiones en TI: empresas latinoamericanas aumentarán en más de 9% su apuesta en este rubro en 2022. AméricaEconomía. (2022, 18 febrero).

[4] Yadav, Vinay, Subhankar Karmakar, Pradip P. Kalbar, and Anil Kumar Dikshit. "PyTOPS: A Python based tool for TOPSIS." *SoftwareX* 9 (2019): 217-222. https://doi.org/10.1016/j.softx.2019.02.004

[5] Editor Prensa Peru Retail. Negocio de retail representa el 10.7% del PBI del Perú. Perú Retail. (2019, 9 septiembre).

[6] Halicka, Katarzyna. "Technology selection using the TOPSIS method." *Форсайт* 14, no. 1 (eng) (2020): 85-96. https://doi.org/10.17323/2500-2597.2020.1.85.96

[7] Okwu, Modestus O., and Lagouge K. Tartibu. "Sustainable supplier selection in the retail industry: A TOPSIS-and ANFIS-based evaluating methodology." *International journal of engineering business management* 12 (2020): 1847979019899542. https://doi.org/10.1177/1847979019899542

[8] Kumar, Rakesh Ranjan, and Chiranjeev Kumar. "A multi criteria decision making method for cloud service selection and ranking." *International Journal of Ambient Computing and Intelligence (IJACI)* 9, no. 3 (2018): 1-14. https://doi.org/10.4018/IJACI.2018070101

[9] Chen, Chun-Ho. "A hybrid multi-criteria decision-making approach based on ANP-entropy TOPSIS for building materials supplier selection." *Entropy* 23, no. 12 (2021): 1597. https://doi.org/10.3390/e23121597

[10] Çelikbilek, Yakup, and Fatih Tüysüz. "An in-depth review of theory of the TOPSIS method: An experimental analysis." *Journal of Management Analytics* 7, no. 2 (2020): 281-300. https://doi.org/10.1080/23270012.2020.1748528

[11] Khachan, Ahmad M., and Ahmet Özmen. "IMSSAP: After-school interactive mobile learning student support application." *Computer Applications in Engineering Education* 27, no. 3 (2019): 543-552. https://doi.org/10.1002/CAE.22096

[12] Chaipunyathat, Ajchareeya, and Nalinpat Bhumpenpein. "Communication, culture, competency, and stakeholder that contribute to requirement elicitation effectiveness." *International Journal of Electrical & Computer Engineering (2088-8708)* 12, no. 6 (2022). https://doi.org/10.11591/ijece.v12i6.pp6472-6485

[13] Kurt, Mahmut Mahir, and Osman Yazıcıoğlu. "Competitive strategy selection in retail E-Commerce using IF AHP & TOPSIS methodology." *Journal of Intelligent & Fuzzy Systems* 41, no. 2 (2021): 2617-2637. https://doi.org/10.3233/JIFS-202010

[14] Pätäri, E., Karell, V., Luukka, P., & Yeomans, J. S. (2018). Comparison of the multicriteria decision-making methods for equity portfolio selection: The U.S. evidence. European Journal of Operational Research, 265(2), 655–672. https://doi.org/10.1016/j.ejor.2017.08.001

[15] Pätäri, Eero, Ville Karell, Pasi Luukka, and Julian S. Yeomans. "Comparison of the multicriteria decision-making methods for equity portfolio selection: The US evidence." *European Journal of Operational Research* 265, no. 2 (2018): 655-672. https://doi.org/10.1109/ACCESS.2020.2987111

[16] Becker, L. IDC's Top 10 Worldwide Services 2021 Predictions. IDC Blog. (2021, 8 junio).