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Research Article

Optimizing Outsourcing Decisions in the Service Sectors and Businesses: A Comprehensive DSS Model for Effective Ranking and Selection

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Abstract

Outsourcing is a key strategy in many industries and service sectors and businesses. Choosing the right outsourcing subject can boost productivity while choosing the wrong one can cause problems. Thus, a scientific model to support outsourcing decisions is needed. Especially, a specific model for the service sectors and businesses. We aim to make a comprehensive model to rank outsourcing options in the service sectors and businesses. This model covers different fields and can be used universally. We used a comprehensive library study, a questionnaire, and the CVR analysis to find and validate outsourcing decision indicators, these comprehensive indicators are one of the advantages of this article. Then, we used Kano's model to divide them into functional and basic categories for better analysis. Next, we used the fuzzy best-worst model to weigh the indicators. Finally, we used the fuzzy WASPAS model to rank the outsourcing options. We applied the model to a case study at a Hospital as a service business unit. We considered and evaluated and ranked four sectors for outsourcing: "Restaurant", "Pharmacy", "Maintenance and Repair" and "Finance and Accounting".

Keywords: Service-Outsourcing; DSS Model; WASPAS; BWM; Fuzzy logic

1. Introduction

In the modern era of intense competition, organizations and businesses strive to establish and sustain their competitive edge through diverse approaches. Currently, outsourcing is widely recognized as a prominent strategy for gaining a competitive advantage.(Ejechi & Oshodin, 2019) In order to enhance their business performance with limited internal resources, organizations must prioritize their critical and strategic activities while also giving thoughtful consideration to the aspects that can be outsourced. By doing so, they can effectively allocate their resources and concentrate on areas that will bring the most significant improvements to their overall operations.(Alrwashdeh, Adaileh, & Ali, 2022; Lu et al., 2022) The term outsourcing in world literature is defined as "providing goods or services needed by a business from sources outside the organization. ("merriam webster site-outsourcing definition,") In other literature, outsourcing is defined as the transfer of activities from the organization to a group outside the organization that can be governmental or private, to a person or a company, to the inside of the country or outside of the country, or with the subject of goods or services.(Bolumole, Frankel, & Naslund, 2007; Heeks & Arun, 2010) In other literature, outsourcing means transferring the responsibility of continuous management of a series of activities to a third party, which is generally done under the form of a contract. Due to the speed of development of issues related to outsourcing and its applicability, this issue is constantly present in research and academic fields and is investigated in various fields.(Khan, Khan, Khan, & Ilyas, 2022) like, Selecting a subject for outsourcing(Ejechi & Oshodin, 2019; Modak, Ghosh, & Pathak, 2019), service outsourcing(Skipworth, Delbufalo, & Mena, 2020), Overseas outsourcing(García-Vega & Huergo, 2019), outsourcing challenges(Abdel-Basset, Gunasekaran, Mohamed, & Chilamkurti, 2019; Hernandez & Haddud, 2018), …The topic of outsourcing is used as an effective strategy in various fields and recently it has been discussed and researched in many fields, including the fields of production(Hernandez & Haddud, 2018), service(Zhang, Deng, Liu, & Zheng, 2018), R&D(García-Vega & Huergo, 2019), and …, Also, this strategy has been used in various industries, including automobile manufacturing(Kim, Lee, & Hong, 2017), fashion(Hernandez & Haddud, 2018) and … some examples have mentioned in literature review of this article, Also, the importance of decision-making in all fields, especially the field of outsourcing, has been the focus of researchers and organizations for a long time that in different situations they tried to develop and use different methods.(Ishizaka, Bhattacharya, Gunasekaran, Dekkers, & Pereira, 2019; Williams & Durst, 2019; Zarbakhshnia, Wu, Govindan, & Soleimani, 2020) In the issue of outsourcing, we often see a decrease in performance and interruptions in processes, and this can only be solved when companies adopt the correct strategy and decision method and have a long-term point of view. (Aragão & Fontana, 2022)Therefore, presenting new models in this field will never be unnecessary because every day there will be different topics, areas, and conditions for decision-making that require appropriate models , indicators and decision-making methods.

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In all the mentions, there is a need for correct decision-making, and in general, decision-making means the process of making the right decision, which is carried out in different qualitative and quantitative methods, in different areas, and with different indicators.(Dubinsky & Loken, 1989; Flannery & May, 2000; Reyna, 2008), On the other hand, if we pay close attention to the statistics and information on the gross domestic product of the world and countries, today the share of powerful countries in the service sector is increasing and according to the information of the World Bank website, the amount of this number has been quite upward in the last few years. This issue is an emphasis on the need to be careful and pay more attention to issues related to the field of services. In different literature, many definitions have been provided in about discussion of services, but one of the simplest definitions is the presentation of activities that the lower layer provides to the higher layer in the supply chain, and these activities are intangible.(Kant, Higashino, & von Bochmann, 1996) It is worth mentioning that providing a decision support model for production and non-service issues has had an audience for many years and several models have been presented for it, and in this sense, the field of services has been less addressed, and from this point of view, it is more important. In other words, service outsourcing has recently become the main driving force of service business in the world.(Lu et al., 2022)

After considering the issues mentioned above, it is evident that outsourcing is a strategy that cannot be ignored in today's organizations. By implementing outsourcing correctly, companies can focus on their competitive advantages and increase productivity. However, if outsourcing is not done correctly and without considering comprehensive indicators, it may cause interruptions and disruptions which can reduce productivity.To help decision-makers in businesses that mostly have service activities, a uniform model is necessary to assist them in making the right decision to outsource or not. This model must consider all indicators comprehensively and be flexible enough to give different weights to multiple indicators in different fields while considering the opinions and concerns of experts using scientific and modern methods.

Unfortunately, no such method was found during library and field studies. Therefore, this research addresses the issue of service outsourcing, one of the most up-to-date issues in the field of outsourcing, and presents a model that can be used in all service areas. Organizations can evaluate and weigh their issues within planned time frames and make informed decisions to outsource or not to outsource, thereby benefiting from the positive effects of correct outsourcing in their performance.

Firstly, the indicators for decision-making in service sector outsourcing are identified and summarized through library studies and expert interviews. Subsequently, the content is verified in multiple stages of screening and validation, based on their opinions and utilizing the CVR analysis tool. In the following stage, the indicators are categorized into two groups: basic and functional. This categorization aims to enhance accuracy and facilitate a more comprehensive review, employing the Kano model as a basis. These indicators are then weighted using the fuzzy BWM model and ranked according to the insights provided by experts from various hospitals. Finally, the last stage involves ranking several service activities at Ami al-Mominin Hospital using the WASPAS fuzzy model.

2. Literature Review

2.1. Outsourcing.

Outsourcing is a management strategy in which an organization assigns certain tasks or services to external companies or individuals to benefit from greater expertise and efficiency. (Akbari, 2024; Charles & Ochieng, 2023; Osagie, Emeka, & Beatrice, 2023; Sakib, Tabassum, & Uddin, 2023)This approach is often used to reduce costs, improve focus on the core business, and achieve better results in operations. (Charles & Ochieng, 2023)It is generally said that outsourcing started in the 1950s and 1960s with the transfer of production to countries with lower costs, and in the following decades, with the advancement of technology and communication, it expanded to service and information technology sectors. (Gonzales, Dorwin, Gupta, Kalyan, & Schimler, 2004)Outsourcing can be used in various fields such as production, and customer service, It is used in accounting, software development, and many other sectors. (Akhtar, 2023; Koval et al., 2023; Sternberg, Mathauer, & Hofmann, 2023)Regarding the benefits of outsourcing, it can be pointed out that since outsourced companies are usually located in countries with lower labor costs, production costs are reduced. Also, by delegating side tasks, companies can focus on their core products and services. Another advantage is that outsourcing provides access to wider knowledge and expertise.(Osagie et al., 2023; Potryvaieva & Palieiev, 2023) Also, this strategy has disadvantages, such as the quality of delivered work may not match the standards of the outsourcing company. Or the issue of language and cultural differences that can lead to communication problems. Also, the issue of transferring sensitive data and information to external companies can create security risks. Therefore, in general, it can be said that outsourcing can be a powerful tool for business growth and development, but it is important to implement it carefully and pay attention to its various aspects.

2.2. Service outsourcing

Service outsourcing means transferring part or all of a company's service activities to another company or person acting as a contractor or executor. This method is often used to reduce costs, increase efficiency, and focus on the main activities of the organization. Outsourcing in the field of services can include various services such as accounting, research and development, technical support, and marketing. This method has become one of the usual

business practices in today's world and has a growing trend.(Añón Higón, 2023; Hayashi, 2023; Mishra, Moreira, & Markus, 2023; Misra & Ravinder; Santa, Rodríguez Victoria, & Tegethoff, 2023)

Recent research in the field of outsourcing

In the field of outsourcing, especially in recent years, many articles have been presented, each of which deals with different topics of outsourcing, among which the following can be mentioned:

Enayati et al. (Enayati, Asadi-Gangraj, & Paydar, 2021) published an article titled " Scheduling on flexible flow shop with cost-related objective function considering outsourcing options", this paper examines outsourcing decision-making in a flexible manufacturing environment and aims to minimize costs of delay, internal production, and outsourcing. A MILP model is presented to solve the problem, but due to the complexity, meta-heuristic algorithms SA, GA, PSO, and PSO-SA combination are proposed for larger problems. The results show that the GA algorithm performed better than other algorithms. Mehdizadeh et al. (Mehdizadeh & Jalili, 2019)published an article titled "An algorithm based on Theory of constraints and branch and Bound for solving integrated product-mix-outsourcing Problem", The purpose of this paper is to investigate the Integrated Product Mix and Outsourcing (IPMO) problem to determine how many products should be produced within the system or purchased from external sources. The used tools include an algorithm based on the theory of constraints (TOC) and a branch and bound (B&B) algorithm. The obtained results show that the optimal result of the new algorithm is similar to the correct linear programming results. Kia et al. (KiA, Javadian, & Tavakkoli-Moghaddam, 2014) published an article titled " A Simulated Annealing Algorithm to Determine a Group Layout and production plan in a dynamic cellular manufacturing system" this paper aims to present a mixed integer linear programming (MINLP) model for group layout (GL) design in a cellular manufacturing system (CMS) in dynamic environment considering production planning (PP) decisions. The tools used include GAMS software to solve the numerical examples and the simulated refrigeration algorithm (SA) to solve the presented model. The obtained results show that the quality of the solutions obtained by SA is quite satisfactory and especially for large-sized problems, in terms of the objective value and computational time, it is favorable compared to the GAMS software.´ Arif et al. (Arif, Azzouz, & Benboubker, 2023)published an article titled "Towards mathematical modeling for selecting logistics service providers: case of Moroccan LSP", The purpose of this paper is to select the logistics service development (LSP) modeling and outsourcing specific services to the most appropriate LSP in Morocco. The tool used for coding the linear program is CPLEX and the problem-solving method is the branch-and-bound method. The result of the research is the development of a linear model that optimizes the cost of each appropriate LSP by considering quantitative and qualitative criteria. Alawadi et al. (Alawadi, Abbasi, & Al-Refaie, 2023), published an article titled "Prioritization of factors influencing outsourcing maintenance decisions in thermal power plants", The purpose of this article is to investigate the influencing factors on outsourcing decision-making using a systematic literature review (SLR) method and focusing on maintenance activities in industrial companies. The tool used is the Analytical Hierarchy Process (AHP) method for prioritizing important factors based on experts' judgments. The result of the research showed that improving service quality, acquiring new skills or technical knowledge and the difficulty of performance management are the first priorities before deciding to outsource maintenance activities in power plants. Ngoc et al.(Ngoc, Tien, Long, & Vu, 2023) published an article titled "Total factor productivity and outsourcing: the case of Vietnamese small and medium-sized enterprises " The purpose of this paper is to examine the difference in total factor productivity (TFP) between companies with and without outsourcing activities in a developing country such as Vietnam. The instruments used included panel data of SMEs obtained from biannual surveys conducted in collaboration between educational and government institutions. The results show that companies that outsource have higher total factor productivity than companies that do not outsource, and the more they spend on outsourcing, the more productivity they get. Wang et al. (Wang, Lee, Park, & Lee, 2024) published an article titled "The strategic role of R&D outsourcing practices and Partners in the Relationship between product modularization and new product development efficiency " The purpose of this paper is to examine the conditional relationships between product modularization and new product development (NPD) efficiency, assuming that research and development (R&D) outsourcing plays an important mediating role. In the design and methodology, the theory of transaction cost economics was used and the moderated mediation model was tested using hierarchical regression and macro PROCESS on survey data from 273 manufacturing companies in China. The results show that product modularization increases NPD efficiency directly and indirectly through external collaboration in R&D outsourcing, and this role is more effective when competence trust in R&D outsourcing partners is high. Tannoe et al.(Tannor, Dordaa, & Akparep, 2023) published an article titled " Agency problems in facility management (FM) outsourcing in the Ghanaian retail sector" The purpose of this paper is to examine agency problems that arise between commercial property owners and vendors of facilities management (FM) services in Ghana. This research was conducted using telephone and face-to-face interviews, and the answers were analyzed by content analysis. The results showed that agency problems in FM outsourcing in Ghana's retail sector are related to disagreements about maintenance and repair costs and sharing and misuse of tenants' information. Hailu et al.(Hailu & Chebo, 2023) published an article titled "Mapping business process outsourcing and innovation towards future research" The purpose of this article was to investigate the relationship between business process outsourcing (BPO) and innovation using bibliometric

methods and quantitative analysis. The tools used were the Web of Science database and VOS viewer software for data visualization. The results have shown that in the last 30 years, the number of articles published in this field has been constantly fluctuating and the three main areas of research have been innovation, outsourcing, and performance. Navarro et al. (Navarro-Paule, Romerosa-Martínez, & Lloréns-Montes, 2023) published an article titled "IT vendor integration as a catalyst of IT outsourcing success" This paper examines how small and medium-sized enterprises (SMEs) create business value through the use of a hybrid model of information technology outsourcing (ITO) services. This model allows SMEs to build IT capabilities (such as economic, strategic and technological capabilities) to achieve ITO success through the choice of an ITO strategy facilitated by an information technology (IT) supplier. The results show that process integration and information sharing by skilled IT supplier facilitate success in ITO. This study focuses on SMEs, which are typically neglected in ITO studies. Matytsin et al. (Matytsin, Dzedik, Markeeva, & Boldyreva, 2023) published an article titled " mart" outsourcing in support of the humanization of entrepreneurship in the artificial intelligence economy" The article examines the role of intelligent outsourcing in humanizing entrepreneurship in the artificial intelligence economy. The tools used include econometric modeling and regression analysis on "Global-500" companies in 2022. The result shows that smart outsourcing is preferred due to its flexibility, rationality, and efficiency, and helps to improve the efficiency of entrepreneurial activities and resistance to economic crises. Ali et al. (Ali et al., 2023) published an article titled " Investigation of the drivers of logistics outsourcing in the United Kingdom's pharmaceutical manufacturing industry" The purpose of this paper is to investigate the reasons behind the decision to outsource logistics in the UK pharmaceutical industry. The tools used included web-based questionnaires, logistic regression, exploratory factor analysis, and t-tests. The results showed that improving quality and reliability and reducing logistics costs are the most important reasons for outsourcing logistics services by British pharmaceutical manufacturers. Charles et al. (Charles & Ochieng, 2023) published an article titled "Strategic Outsourcing and firm performance: A Review of literature" The purpose of this paper is to examine the strategic impact of outsourcing on firm performance in developing countries and to identify knowledge gaps for future research. The tools used include resource-based theories, transaction cost economics, and social exchange theory. The result of the research shows that strategic outsourcing through service integration, external and multi-source outsourcing affects productivity, profitability, competitive advantage, customer satisfaction and employee productivity, and this relationship is moderated by core capabilities and competitive intensity. Deng et al. (Deng & Xu, 2023) published an article titled " Manufacturing and procurement outsourcing strategies of competing original equipment manufacturers" The purpose of this article is to investigate the strategic interaction between production outsourcing and logistics outsourcing in a three-level supply chain. The tool used is a two-stage game model in which two OEMs simultaneously choose their outsourcing strategies. The result of the research shows that the outsourcing strategies of OEMs depend on the discount rate of the part price and the fixed investment cost of production, and there is a strategic relationship between the outsourcing of production and logistics. Khan et al. (Khan et al., 2022) published an article titled " Challenges and practices identification in complex outsourcing relationships: A systematic literature review" The purpose of this article is to identify the challenges and methods in complex IT outsourcing relationships. For this purpose, a systematic literature review method was used and 11 main challenges were identified along with 67 methods from a total of 85 articles. The results of this research will lay the foundation for building a comprehensive framework in the future using methods such as AHP and fuzzy logic. Khosravizadeh et al. (Khosravizadeh et al., 2022), published an article titled " Developing decision model for the outsourcing of medical Service delivery in public hospitals" The purpose of this article was to develop a decision-making model for outsourcing medical services in public hospitals. The tools used include a cross-sectional study, questionnaires, and a structural equation model on AMOS22. The results showed that control and monitoring are the most important factors in outsourcing decision-making and it is suggested that continuous monitoring be done as a guide and prevent errors. Aragao et al. (Aragão & Fontana, 2022), published an article titled " Outsourcing Strategies in Public Services under Budgetary Constraints: Analyzing Perceptions of Public Managers" The purpose of this article was to investigate outsourcing strategies in public services and their relationship with business sustainability and flexibility in times of budget constraints. Semi-structured interviews were used as a qualitative analysis tool with 51 public administrators in the state of Pernambuco, Brazil. The results showed that during periods of budget cuts, outsourced services are often the first sectors to experience cuts or interruptions, which directly affects the continuity of public services. Alrwashdeh et al. published an article titled " THE IMPACT OF OUTSOURCING ON OPERATIONAL PERFORMANCE: A FIELD STUDY IN INDUSTRIAL COMPANIES IN JORDAN" The purpose of this article was to investigate the impact of outsourcing on operational performance in Jordanian industrial companies. For this purpose, a questionnaire was developed based on previous literature, and confirmatory factor analysis was performed using AMOS 24 software. The results of structural equation modeling showed that organizational structure and culture fully mediate the effect of outsourcing on operational performance. Lu et al. (Lu et al., 2022), published an article titled "A bilevel whale optimization algorithm for risk management scheduling of information technology projects considering outsourcing" The purpose of this article is to improve competitiveness and reduce costs in companies through planning risk management in the IT

outsourcing process. The tool used is a two-level risk management model with respect to project planning risk and risk management cost, as well as a Wall Optimization Algorithm (BiWOA) to solve the problem. The research result shows that the BiWOA algorithm can effectively control the planning risks of IT projects and has higher accuracy than other algorithms. Karagoz et al. (Karagöz, Deveci, Simic, & Aydin, 2021) published an article titled " Interval type-2 Fuzzy ARAS method for recycling facility location problems" The purpose of this paper is to present a novel approach to support the location process of end-of-life vehicle (ELV) recycling facilities in Istanbul. The tool used was the expansion of the Additive Ratio Assessment (ARAS) method in the intermittent type-2 phase environment. The result of the research was to verify the validity and stability of the intermittent ARAS type-2 fuzzy method through a real case study in Istanbul and comparing it with MCDM methods based on existing type-2 fuzzy sets. Lu et al. (Luo, Yang, Zhang, & Pan, 2021), published an article titled " Service outsourcing strategy decision for value creation in manufacturing firms" The purpose of this article is to solve the problem of outsourcing decision making strategy of manufacturers. The tool used is a value creation model for the manufacturer, service contractor and customer. The results show that incentive services should be done by the manufacturer and healthcare services should be outsourced to create more value. Jaukovic Jocic et al. (Jaukovic Jocic et al., 2020) published an article titled "A novel integrated piprecia–interval-valued triangular fuzzy aras model: E-learning course selection" The purpose of this paper is to present an integrated approach based on multi-criteria decision-making methods (MCDM) and symmetry principles for the selection of e-learning courses. The tools used include PIPRECIA to determine the weights of the criteria and Triangular Fuzzy Additive Ratio with Distance Value (ARAS) method to rank options, i.e. e-learning courses. The research result showed that the proposed integrated model is suitable through a numerical case study. Skipworth et al. (Skipworth et al., 2020) published and article titled "Logistics and procurement outsourcing in the Healthcare Sector: A Comparative Analysis" The purpose of this article is to investigate the effects of outsourcing in healthcare supply chains by comparing two outsourcing methods from public to private and public to public. The tool used is a conceptual framework adapted from previous literature, which is used to provide a comprehensive view of the phenomenon and examine the effects of logistics and procurement outsourcing on the structure and performance of the health supply chain. The result of the research is a European cross-country comparison that analyzes the experiences of NHS outsourcing in the UK and RHS in the Tuscany region of Italy provides suggestions for managers and policymakers and increases the current knowledge about outsourcing in the public health sector. Conclusion: An examination of various research conducted in the domain of outsourcing and decision-making highlights the growing significance of this field. According to the investigations, numerous studies and multiple approaches have been employed in this context. Nevertheless, no study was discovered that made a comprehensive effort to furnish a model for facilitating outsourcing decision-making specifically in the service sector, indicating the necessity for further endeavors in this area.

3. Methodology

This research has a developmental and applied focus in terms of its objective. Regarding the research methodology, it is categorized as descriptive survey research. As for the type of data collected, it falls under the qualitative category. the objective of this research is to gather information by conducting an extensive examination of existing research literature and utilizing library studies. Additionally, gathering expert opinions will be accomplished through the distribution of questionnaires and conducting interviews pertaining to the field of service outsourcing.

The steps of the research have been carried out in the following three phases, which are:

3.1. The first phase: Identification of indicators

The primary objective of the initial stage of the study is to acquire reliable factors that influence decisions regarding service outsourcing. These factors are anticipated to be applicable across various service domains. To achieve this goal, we have utilized a combination of literature reviews, field studies, and expert analysis. The experts involved in this research include university professors and professionals who possess extensive knowledge and experience in service-related industries and outsourcing. Therefore, the action steps were planned as follows.

3.1.1 Aggregation of indicators and library and field study

In the initial phase, we will consolidate the decision-making factors for service outsourcing by examining literature, conducting field studies, and conducting interviews with experts. The aim is to gather comprehensive information from all relevant indicators in this domain and compile it into a coherent set of insights.

3.1.2 Removal of duplicate indicators by the researcher.

In this stage, which serves as the initial screening phase for the indicators, the researcher will eliminate any redundant items after carefully reviewing the compiled set of indicators. The objective is to remove any duplicate or overlapping elements from the aggregated list.

3.1.3 Obtaining final indicators.

The objective of this stage is to present a condensed set of indicators that can be used for decision-making in service outsourcing. To achieve this, the indicators selected from the previous stage are evaluated, and experts' opinions are obtained through the distribution of questionnaires. The collected information is then analyzed using techniques

such as Lawche and CVR analysis to validate their content.

3.1.4 Classification of indicators.

In this phase, it is essential to categorize the final set of indicators in order to facilitate a comprehensive and precise evaluation during the weighting and ranking process. To accomplish this, the Kano model will be utilized as the basis for categorization. This step aims to enhance the organization and structure of the indicators for more effective analysis and decision-making.

In Kano's model, indicators are divided into three basic, functional, and motivational categories. (Kano, 1984), In this research, all the identified indicators are from the first two categories and no index has an unknown aspect or the failure to reach it has no effect on the organization's favorability, So the classification is based on the first two categories and according to the following definitions:

A: basic indicators

B: performance indicators

• Basic indicators: There are those indicators that go back to the readiness of activities to be outsourced, in other words, activities are expected to have a level of preparation for successful outsourcing.

• Performance indicators: They are those indicators that check whether the outsourcing of the outsourcing volunteer activity creates better conditions for the organization from different points of view or not.

It is worth mentioning that the classification of indicators into these two categories was obtained with the help of a questionnaire and its analysis based on the binomial method.

3.2. The second phase: Weighting of indicators in a case study.

The aim of this research phase is to assign weights to the indicators identified in the initial phase within the specific case under study. To accomplish this, questionnaires will be distributed among experts in hospital settings, including doctors and decision-making managers from relevant groups. By utilizing the fuzzy model, the weighting and ranking of indicators for service outsourcing decisions will be conducted.
For this purpose, the BWM (Best-Worst Method) is used. In this method, the decision maker determines the best and worst indicators, and a pairwise comparison is made between each of these two indicators and the other indicators. Then, a maximum-minimum problem is formulated and solved to determine the weights of different indicators. Additionally, in this method, a formula is used to calculate the inconsistency rate, which helps to check the validity of the comparisons.(Rezaei, 2015)
Also, the best-worst fuzzy method has an algorithm similar to the deterministic best-worst method, and the use of fuzzy numbers due to the verbal ambiguity of the respondents causes more accuracy and better results in calculations.(S. Guo & Zhao, 2017)
In this article, the best-worst fuzzy method is employed to examine questionnaires. The table of verbal expressions and the corresponding fuzzy numbers of Joe and Zhao are utilized as follows: (S. Guo & Zhao, 2017)

Table 1
Verbal expressions and corresponding fuzzy numbers of Joe and Zhao

Verbal phrases	**fuzzy number**
Equal importance	(1,1,1)
little importance	(0.67,1,1.5)
Relatively important	(1.5,2,2.5)
Very important	(2.5,3,3.5)
absolutely important	(3.5,4,5)

Also, the compatibility index of the fuzzy best-worst method is based on the following table:

Table 2
The consistency index of the best-worst fuzzy method

subject	**absolutely important**	**Very important**	**Relatively important**	**little importance**	**Equal importance**
the amount	(3.5,4,4.5)	(2.5,3,3.5)	(1.5,2,2.5)	(0.68,1,1.5)	(1,1,1)
compatibility index	8.04	6.69	5.29	3.8	3

It is worth mentioning that, during the implementation of the model, for other cases and fields under study, it is necessary to update the weighting process based on the opinions of experts in that field, because the weight of the indicators in different fields is not the same.

The third phase: prioritizing outsourcing options.

In this phase of the research, considering that in the previous phase, the weight of the decision-making indicators has been determined, first, some options of outsourcing candidates in the field of hospital services were selected based on consultation with the experts of the case under study, then the options were prioritized

using the fuzzy method. The outsourcing candidate is paid based on the opinion of the experts of the studied hospital.
The WASPAS fuzzy method, derived from the phrase "Weighted Aggregated Sum Product Assessment," is a combination of WSM and WPM. It is one of the new methods of multi-criteria decision-making that prioritizes options. (Turskis, Zavadskas, Antucheviciene, & Kosareva, 2015)
In this article, for the fuzzy analysis of Waspas method, in the questionnaires, the tables of verbal expressions and the corresponding fuzzy numbers of Patil and Kant are used as follows (Patil & Kant, 2014)

Table 2
Table of fuzzy verbal expressions

Fuzzy equivalent of priorities			priorities	lines
Up limit	**Average Limit**	**low limit**		
3	1	1	Very weak	1
5	3	1	weak	2
7	5	3	moderate	3
9	7	5	good	4
11	9	7	Very good	5

In addition, the experts at the investigated hospital include doctors and decision-making managers. It is worth mentioning that during the implementation of the model for other cases and areas under study, it is necessary to prioritize the options of outsourcing candidates based on the updated opinions of experts in that field. This is because the options with outsourcing priority may vary in different cases.

Model and Implementation algorithm.

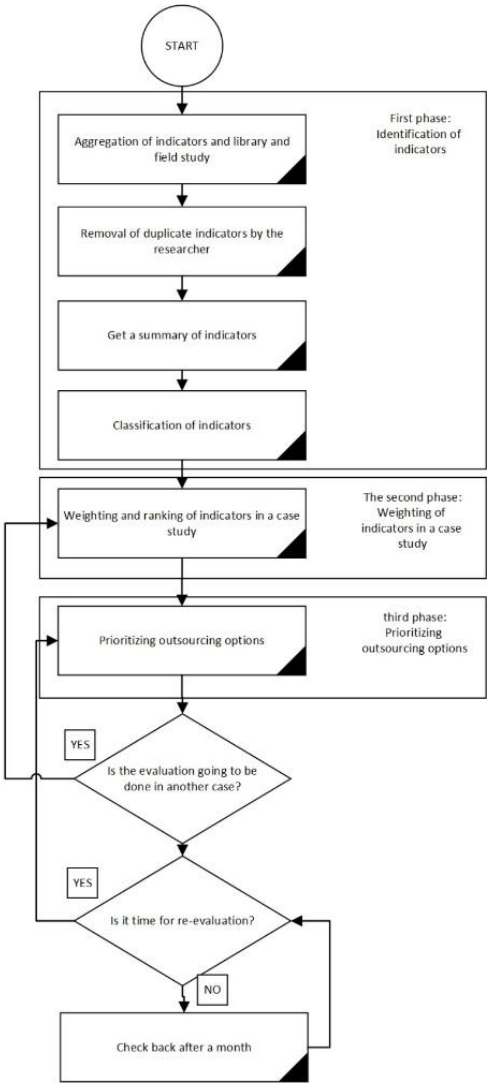


Fig. 1. Model and Implementation algorithm.

4. Results.

4.1. Identification of indicators.

Aggregated indicators from library and field study.

Following a thorough examination of approximately 40 articles pertaining to the subject of outsourcing decision-making, as well as conducting interviews with specialists in this domain, a total of 285 indicators were gathered. These indicators included instances of repetitive titles and concepts.

Removal of duplicate indicators by the researcher.

At this particular phase, the researcher carefully analyzed and reviewed the pool of 285 aggregated indicators. During this process, the indicators that exhibited clear repetition were eliminated, leading to a final list of 60 indicators presented as attachment of this article.

Final indicators.

After administering the questionnaire to experts and gathering feedback from 12 of them, the content's validity was assessed using the Lavache method and CVR analysis. Consequently, out of the 60 indicators evaluated in the previous phase, 25 indicators achieved a score higher than 0.62, indicating their satisfactory content quality. The group of experts involved in this process consisted of university professors and professionals engaged in service-oriented industries, possessing knowledge and experience in the field of services and outsourcing. It is anticipated that the indicators obtained at this stage will encompass a comprehensive set of decision-making criteria for service outsourcing.

Classification of indicators.

During this stage, apart from presenting the final set of 25 indicators, an arrangement of these indicators is also provided. The objective behind this classification is to enhance the comprehensiveness of the evaluation process and improve the accuracy of the weighting procedure.

The participants in this phase consisted of 11 university professors and industry experts specialized in service-related fields who possessed extensive knowledge about services and outsourcing. Consequently, each of these indicators was evaluated based on their position within the scale of desired indicators outlined in the distributed questionnaire. A binomial test was employed to conduct the research assessment. Through this test, indicators that received above-average scores were validated, leading to the categorization of the existing indicators into the two aforementioned categories.

Therefore, the classification of indicators is based on the information obtained from the following table:

Table 3
Final indicators and classification based on the Kano model

Line	Index name	category	Reference	Line	Index name	category	Reference
1	More focus of the organization on its competitive advantage activities	Performance index	(Adler, 2003; Assaf, Hassanain, Al- Hammad, & Al- Nehmi, 2011)	14	The degree of non-dependence of this activity with other activities of the organization	Basic index	(Kivijärvi & Toikkanen, 2015)
2	Increasing flexibility against environmental changes	Performance index	(Assaf et al., 2011; Lamminmaki, 2011; Muchai & Acosta, 2012; Rhodes, Lok, Loh, & Cheng, 2014)	15	Non-specialization and non-strategic activity	Basic index	(Assaf et al., 2011; TOUFIGH, RAJABI, & QAZIZADEH, 2015)
3	Reduce the cost of the activity	Performance index	(Dorasamy, Marimuthu, Jayabalan, Raman, & Kaliannan, 2010; Y. Guo & Liang, 2016; Oduk, 2013; Rhodes et al., 2014)	16	Avoiding big investments	Performance index	(Assaf et al., 2011; Y. Guo & Liang, 2016)
4	Improving the quality of work	Performance index	(Assaf et al., 2011; Low & Hsueh Chen, 2012)	17	Increasing the quality of using the organization's internal resources	Performance index	(Assaf et al., 2011; Y. Guo & Liang, 2016)
5	Increasing the amount of work output	Performance index	(Assaf et al., 2011; Y. Guo & Liang, 2016)	18	Ability to standardize activity	Basic index	(Assaf et al., 2011)
6	Improve work time	Performance index	(Assaf et al., 2011; Y. Guo & Liang, 2016)	19	There is no risk of dependence on suppliers and the possibility of their abuse	Basic index	(Hanafizadeh & Zareravasan, 2020)
7	Using the supplier's financial strength	Performance index	(Diana, 2009; Dibbern, Chin, & Heinzl, 2012)	20	Alignment with the rules and regulations and strategies of the organization	Basic index	(Muchai & Acosta, 2012; Westphal & Sohal, 2013)
8	Solving the problem of shortage or surplus of human resources in the organization	Performance index	(Assaf et al., 2011; Messerschmidt & Hinz, 2013)	21	Government laws and regulations regarding outsourcing	Basic index	(Assaf et al., 2011; Lian, Yen, & Wang, 2014)

9	Use of required equipment, from the supplier network	Perform ance index	(Hanafizadeh & Zareravasan, 2020; Muchai & Acosta, 2012)	22	Reducing the administrative burden and improving the management of internal processes	Performan ce index	(Ikediashi Dubem, Ogunlana Stephen, Boateng, & Okwuashi, 2012)
10	Technology readiness level	Basic index	(Graf & Mudambi, 2005; Walterbusch, Martens, & Teuteberg, 2013)	23	Developing cooperation with other similar companies	Performan ce index	(Assaf et al., 2011; Y. Guo & Liang, 2016)
11	Risk sharing between the organization and the supplier	Perform ance index	(Assaf et al., 2011; Ratten, 2014)	24	No risk of disclosure of confidential information and loss of intellectual property rights	Basic index	(Dorasamy et al., 2010; Kivijärvi & Toikkanen, 2015)
12	Diversity in providing services to customers	Perform ance index	(Assaf et al., 2011; Y. Guo & Liang, 2016; Lacity, Khan, & Yan, 2017)	25	Not losing control over the work process	Basic index	(Alvarez-Suescun, 2010; Y. Guo & Liang, 2016; Wu, Cegielski, Hazen, & Hall, 2013)
13	Freeing the time and working complexity of employees in internal activities	Perform ance index	(Assaf et al., 2011; Gerbl, McIvor, Loane, & Humphreys, 2015; Y. Guo & Liang, 2016)				

4.2. Weighting of indicators in a case study.

In order to determine the importance of indicators in making outsourcing decisions, it is necessary to follow a specific approach based on the case being studied. In this particular research, the focus is on service-related matters in hospitals. Therefore, experts from hospitals affiliated with "Tamin Ejtemaei" and "bonyad shahid" organizations in Isfahan, namely Dr. Shariati, Dr. Gharazi, and Amir-Almomenin hospitals, were surveyed. The questionnaire was distributed among experts consisting of doctors and managers who are involved in decision-making regarding hospital outsourcing. It is important to note that these three hospitals are highly regarded in Isfahan and offer a wide range of general and specialized services. Hence, their experiences in different areas of service outsourcing can be thoroughly examined.

Considering that the operational issues of the hospitals are of the same type, it is expected that the fuzzy weights obtained at this stage can be used for subsequent calculations in other hospitals as well.

In this research, the weighting analysis is based on the fuzzy BWM method, in which the best and worst indicators are determined by the decision maker, and a pairwise comparison is made between each of these two indicators and other indicators; Then a maximum-minimum problem is formulated and solved to determine the weight of different indicators.

In the first step of the best-worst method, the most important and least important indicators should be determined. In this research, based on the consensus opinion of experts, the best and worst indicators were determined among the sub-criteria, which are given in the table below.

Table 4
The best and worst indicators

The best indicator	**The worst indicator**	**subject**
Improving the quality of work	Reducing the administrative burden and improving the management of internal processes	Functional subcriteria
Alignment with the rules and regulations and strategies of the organization	There is no risk of dependence on suppliers and the possibility of their abuse	Basic subcriteria

In this part, pairwise comparisons of the best criteria compared to other criteria (BO) and other criteria compared to the worst criteria (OW) are performed. Determine the preference in pairwise comparisons. After responding, pairwise comparisons were merged with the geometric mean method, The table details of this part are given in the attached file of the article.

After that we will form the optimization model of the problem, in models with three or more criteria, it is better to convert the model into a linear one. Therefore, the linear model of the fuzzy BWM method was formed and solved by Lingo 18 software, and the weights of the criteria were obtained. The results are given in the table below. Fuzzy weight is obtained directly from solving the model in Lingo software, then these fuzzy weights are converted into deterministic weight by relation $R(\tilde{a}_i) = \frac{l_i+4m_i+u_i}{6}$. In this regard, the fuzzy weight is the measure of increasing the amount of work done in the form of (0.076, 0.0767, 0.0769). whose definite weight is equal to $\frac{0.076+4*0.0767+0.0769}{6} = 0.0766$.

Based on this, improving the quality of doing work with a weight of 0.102 has won the first rank. Improving the time to do work with a weight of 0.0999 has been ranked second, and the organization's greater focus on its competitive advantage activities has been ranked third with a weight of 0.0998.

The table details of this part are given in the attached file of the article.

In a similar way, for the basic sub-criteria, a linear optimization model is formed and solved by the software,

the results as a table details of this part are given in the attached file of the article.

4.3. Prioritizing outsourcing options

The purpose of this stage is to prioritize the options of the outsourcing candidate, which was done by receiving the opinions of experts and using the fuzzy response approach. The studied hospital was chosen to examine the options of the outsourcing candidate, Amir-Almomenin Hospital, and in that hospital, The following activities were suggested for further consideration:

1- Restaurant

2- Maintenance and repairs and technical support

3- Financial and accounting affairs

4- Pharmacy

In this section, the ranking of the said 4 sectors as outsourcing options is discussed. First, the decision matrix is formed. The decision matrix of the fuzzy wasp's method is a matrix consisting of "sub-criteria" and "research options" where each option is evaluated according to each criterion based on a 1-5 phase spectrum. This decision matrix is completed by experts and then integrated by the arithmetic mean method. The fuzzy feedback decision matrix is given in the table below. In this matrix, there are 25 research sub-criteria in the column and 4 options in the row.

Table 5
Fuzzy WASPAS decision matrix

alternatives	A1	A2	A3	...	B7	B8	B9
Restaurant	(7,9,11)	) 5.667,7.667,9.66 (7	) 6.333,8.333,10.33 (3	...	) 5.667,7.667,9.66 (7	) 5.667,7.667,9.66 (7	(7,9,11)
Maintenance and repairs and technical support	(5,7,9)	) 2.333,4.333,6.33 (3	) 3.667,5.667,7.667 (	...	) 2.333,4.333,6.33 (3	(3,5,7)	) 3.667,5.667,7.66 (7
Financial and accounting affairs	) 3.667,5.667,7.66 (7	(1,2.333,4.333)	) 1.667,3.667,5.667 (	...	(1,2.333,4.333)	(1.667,3,5)	) 1.667,3.667,5.66 (7
Pharmacy	(7,9,11)	) 4.333,6.333,8.33 (3	) 5.667,7.667,9.667 (	...	) 4.333,6.333,8.33 (3	(5,7,9)	) 5.667,7.667,9.66 (7

After normalizing the decision matrix, we calculate the values of WSM (weighted sum) (Q) and WPM (weighted product) (P) and at the end we de-fuzzy these values.

Table 6
WSM and WPM values

alternatives	Q	P	definite Q	Definite P
Restaurant	(0.585,0.788,0.992)	(0.586,0.79,0.993)	0.788	0.790
Maintenance and repairs and technical support	(0.328,0.531,0.734)	(0.321,0.528,0.733)	0.531	0.527
Financial and accounting affairs	(0.162,0.330,0.533)	(0.153,0.322,0.53)	0.342	0.335
Pharmacy	(0.531,0.734,0.937)	(0.528,0.733,0.937)	0.734	0.733

At the end, the score of each option is alculated.

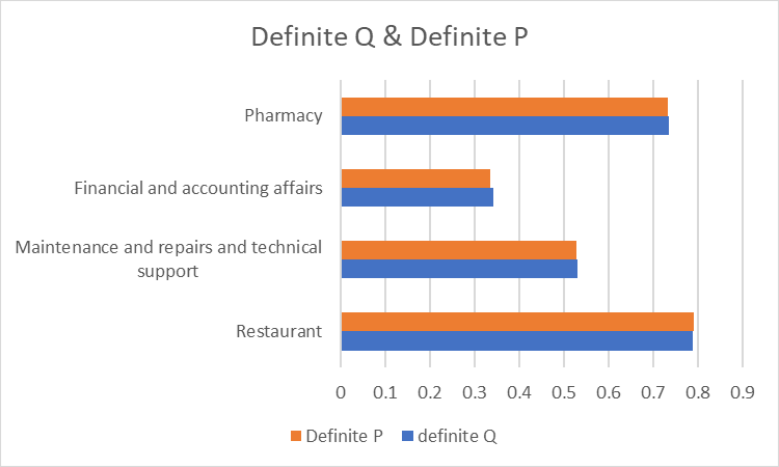


Fig.2. Score each option and rank them

Table 7
Score each option and rank them

Alternatives	K	Normal K	Rank
Restaurant	0.788	0.329	1
Maintenance and repairs and technical support	0.531	0.222	3
Financial and accounting affairs	0.342	0.143	4
Pharmacy	0.734	0.306	2

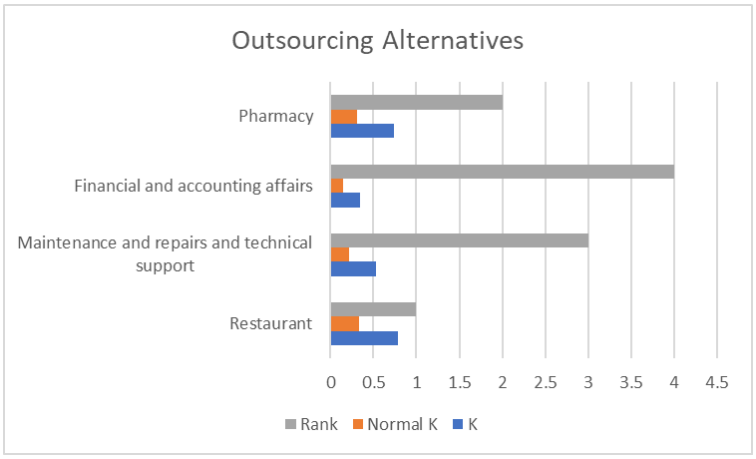


Fig. 3. The numbers of K, Normal K, and the ranking of outsourcing Alternatives.

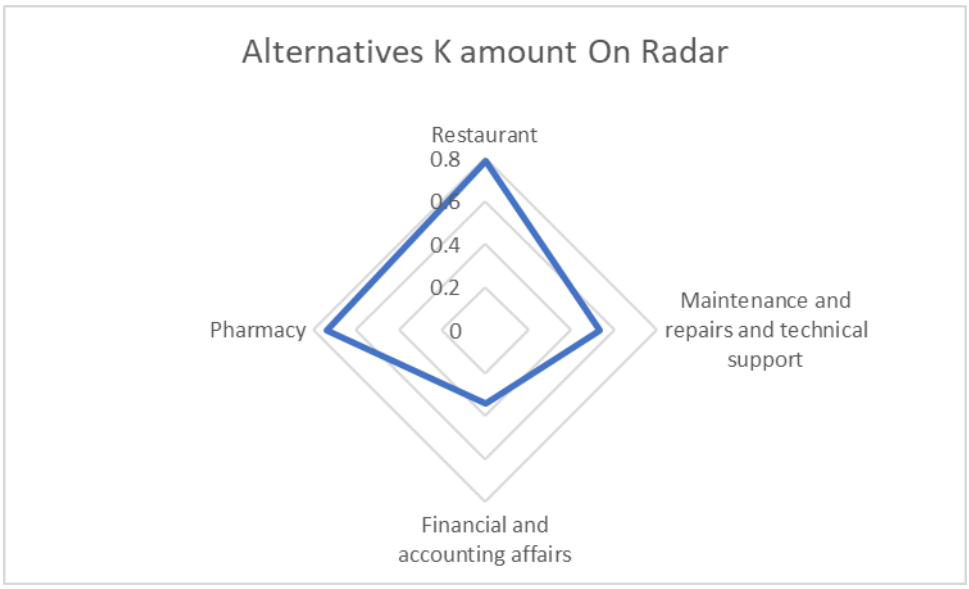
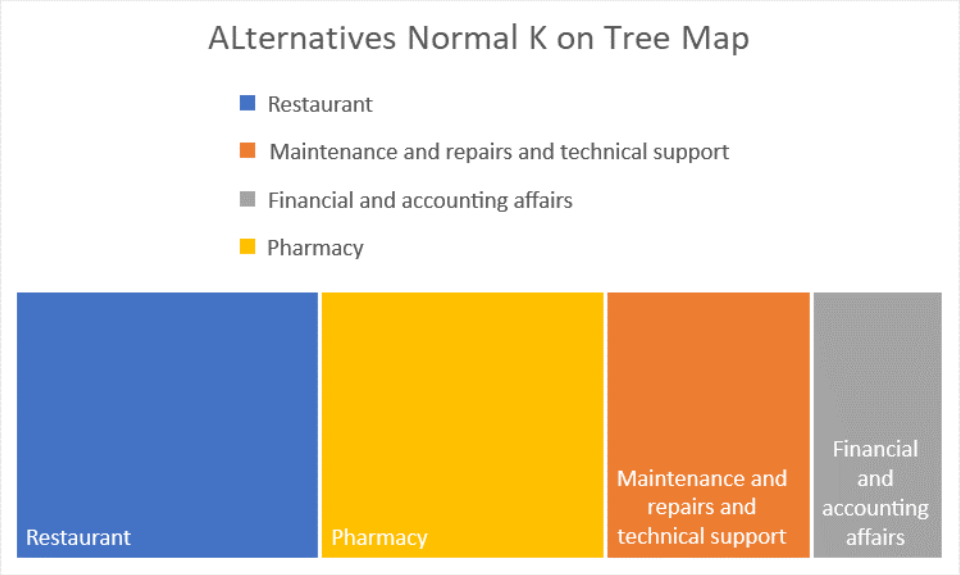


Fig. 4.The more the calculated K numbers are from the center of the radar, it indicates that there is more ability to outsource for that activity or field, which has the highest number in this chart.



F. 5. Tree map chart Score each option and rank them

In the Figure 5 Tree Map chart, each activity has a larger volume than the bottom of the chart, which means that it has a larger share of Normal K, according to the chart, the restaurant unit has the largest volume and the financial unit has the smallest volume. Accounting has been assigned to itself, which shows the priority in the ability to outsource.

In the table 8, the first column is the options of the outsourcing candidate requested to be reviewed by Amir-Almomenin ul Mominin Hospital, the second column is the calculation made by the fuzzy scale method, in other words, the combination of the weighted total numbers and weighted multiplication by the fuzzy scale method, which in other words is the score Each option specifies the direction of outsourcing, and at the end, the last column is the outsourcing rank of each option. As it is clear from the numbers, among the investigated options, it is strongly recommended to outsource the restaurant area, then the pharmacy area is suggested, and then the maintenance and repairs and technical support area, and finally the financial affairs area. and administrative to be considered for outsourcing. It is worth noting that some of these areas are currently outsourced based on previous decisions, such as the restaurant area and technical support, and the scientific calculations and analyzes performed in this research have been a confirmation of the correct decision.

5. Conclusion

In the matter of correct outsourcing as an effective strategic decision, it is necessary to revise the reviews and decisions with the passage of time, therefore, in this research and model, an attempt has been made to provide a model that in certain time periods, the decision makers of the organizations compared to rank the activities of the outsourcing candidate and take appropriate decisions, in this article, an attempt has been made to present a model that can be used in the field of outsourcing decision support in service areas, in this context, firstly, identification evaluation indicators And based on the fuzzy BWM weighting method and then by the fuzzy WASPAS method, the activities of outsourcing volunteers were prioritized, regarding the weighting of indicators, hospital experts were polled, and these weights are expected in all other hospitals as well. be used, and in the part of prioritizing activities for the outsourcing of Amir-Almomenin Hospital, it was examined as a case and the model was implemented in it, it is expected that this model can be used in other service areas as well, considering The point that the weighting of indicators and prioritization is necessary to be repeated in each studied area, because generally the weight of indicators in different areas are not the same.

Therefore, in summary, in this research, after carrying out library and field studies, the pool of outsourcing indicators includes 285 identification indicators, and in the first stage, clearly repetitive indicators were removed by the researcher, and the number of indicators was reduced to 60, and then from Through the distribution of questionnaires and the declaration of experts' opinions, as well as according to Lawshe's method and CVR analysis, the number of final indicators was reduced to 25. The experts were classified into two categories of functional and basic indicators, in the next step, the weighting of the indicators based on the fuzzy BWM model and the determination of their importance based on the opinions of the experts in the hospital field, and finally the ranking of the outsourcing candidate options. In the studied hospital, it was obtained based on the Waspas fuzzy pattern.

6. Research limitations.

In this research, the slow reception of information was observed due to the busy schedules of relevant experts, including doctors and hospital managers. Additionally, in other areas, obtaining input from high-level managers of organizations is essential as outsourcing decisions are strategic in nature. However, gathering information from these individuals presents similar challenges.

Providing suggestions for future research.

Considering the importance and scope of the service field and the importance of making a correct decision of outsourcing or not outsourcing in this field, the following items are presented in the form of research and management suggestions for future research:

Suggestions for the future studies:

1- Using other methods of weighting indicators as well as ranking options and combining those methods and comparing them with the results obtained from the model of this research.
2- Weighing indicators in other service areas and comparing the results with the results of this research.
3- Examining this research in another hospital as a case study and comparing the results of ranking activities with the results of this research.

Management and executive suggestions:

1- The model presented in this research is expected to provide accurate information in other service areas as well. Therefore, it is recommended to utilize this information to rank the outsourcing candidates in other fields as well.
2- It is recommended to examine this model not only for subjects that are currently outsourced but also for those that have not been outsourced yet. In certain cases, the decision to outsource a particular area that has already been made may prove to be incorrect and require correction.
3- The implementation of this model should be conducted periodically within specific time frames, such as one year, with respect to organizational activities. If changes in outsourcing conditions have occurred over time, it becomes necessary to modify previous decisions accordingly.

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