Research Article

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Stakeholder management decision-making process for circular economy practices in private health organizations using TOPSIS

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***Abstract*—** Circular economy is a restorative model that aims to preserve and enhance natural capital, optimize resources and to increase a productive system by eliminating negative externalities, integrating a multidisciplinary perspective that includes sustainability, economics, governance, and management. Given the relevance of the stakeholder management models in the modern era, as an essential approach to engage relevant interest parties in the production process of any organization, identifying essential links to a diversity of groups of interest, engaging ultimate stakeholders, and implementing a continuous improvement process in the interactions of companies with such incumbents, this research work introduces the use of TOPSIS, as a multicriteria decision analysis method to identify the best path of implementation for circular economy practices in an organization. The result of the research contributes to the understanding of a stakeholder salience model with a multicriteria model in a circular economy environment that promotes a proper managerial model including a decision-making process engaging profits, people, and the planet.

Keywords: TOPSIS, stakeholder salience, circular economy, operations research, sustainability.

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I. INTRODUCTION

In the present days, there is an imperative need for harmonizing economic activities with ecological responsibility in global supply chains of private organizations, mainly anchored in the Sustainable Development Goals of the United Nations, that requires management to address special needs and expectations, for both short and long run, through an exploration of metrics, measurement and stakeholder management practices delving into circular economy practices, and diverse ethical considerations underpinning environmental responsibility [1].

Since the application of circular economy practices has received wide coverage in the modern era, management practices in private health organizations need to tackle challenges related to environmental factors, creating the conditions for companies to be part of sustainable economic growth strategies, by engaging stakeholders, redesigning value chain activities to use low-carbon materials, and implementing new procurement activities to attain social, economic and environmental benefits [2], as well as stablishing new commercial priorities, project briefs and management plans, design management, risk management, ethics and professionalism, team building, information and knowledge management, among others [3]. In that sense, the way private health organizations are engaging in business activities requires and important shift towards sustainable development, using a systems thinking and circular economy mindset [4] to gain legitimacy facing society concerns, adopting holistic approaches by making significant changes to their production, technologies and transformation processes, promoting innovation that reconcile environmental and economic sustainability [5].

Nowadays, private health organizations must pay substantial attention to collaborative research and innovation projects in complex multistakeholder settings addressing sustainability concerns, using distinctive methods for stakeholder prioritization [6]; identifying a wide array of stakeholders that affect different phases of a value creation process, where key stakeholders must be identified, categorized, and the engagement process with the company must be designed by considering their influence, power and legitimacy in different phases of the value creation process [7] making the contribution of stakeholders an important source of sustainable competitiveness and value cocreation in the management of businesses operating proactively in various sectors of economic activity [8].

Using a multi-stakeholder management setting requires that private companies related to health services collaborate in co-creation practices [9], aiming to achieve circularity by setting collaboration projects both within vertical horizontal supply chains [10] to enable the circulation and cascading of resources for the co-design of Circular Economy value chains that focuses on selecting strategic partners and engagement processes [11].

For strategic purposes, to integrate conceptual and practical trends in private companies in the health industry is essential to engage key stakeholders roles in pursuing a more sustainable society [12] applying stakeholder management tools [13] to implement sustained and effective coordination processes across an array of stakeholders to facilitate systemic change at the desired scale, mobilizing multiple stakeholders for strategic engagement interventions by entities interested in accelerating the shift to a circular economy [14].

II. LITERATURE REVIEW

Circular economy

The circular economy concept is most frequently depicted as a combination of reduce, reuse and recycle activities, where the main aim is considered to be economic prosperity, environmental quality, social impact and care for future generations [15]; in what it comes to the strategic contribution of this approach to organizations, some primary activities in the value chain such as recovery, recycling, consumption and use are frequently featured, considering selected products, materials and sectors [16].

Thus, the so-called circular economy concept, regarding closing material loops to preserve products, parts, and materials in the industrial system and extracting their maximum utility gives such approach a strong intuitive environmental appeal, by closing material and product loops [17]; while previous research has identified the influence of society and regulatory policy on companies' ability to address larger sustainability concerns [18], in some empirical research, owners/shareholders are found as the most salient stakeholders [19].

In that sense, literature shows that CE business models from multiple industries in Europe, the US, and China, while cost-efficiency of circular operations remains essential, such companies need to be incentivized through reductions in customers' total waste management costs [20]; some of those models are related to adopting ecofriendly practice such as waste management, digital technology, and redesign of the supply chain [21] where organizations are implementing these practices by using the four Rs (reduction, repairing, remanufacturing and recycling), but mostly focusing on internal CE efforts [22].

Circular economy and Stakeholder management decision making process

For what it comes to stakeholder management requires a strong collaborative association among all supply chain members, based on mutual support and coordination coupled with holistic information processing and sharing along the entire supply chain network to effectively create a basis for achieving sustainability [23] involving stakeholders as important factors for decision makers with the aim of creating a circular economy system at different levels [24].

This paradigm fosters manufacturing companies' sustainability taking place through different strategies, allowing companies to be internally committed to embrace circular values and externally aligned with several stakeholders, bounding the decision-making process of managers [25], since CE offers an opportunity to create a clear pathway towards sustainable, closed-loop resource systems, in a diversity of industries such as food, chemicals, metals, consumer electronics, and building and infrastructure sectors, guided by decision-oriented insight towards relevant stakeholders [26], creating solutions in areas of common interests of relevant stakeholders [27] research shows that the transition to a circular economy is likely to move faster than previous transformations, even maybe becoming the only economic system allowed, since it will become an essential model for competitiveness, as it is described in the following figure 1:

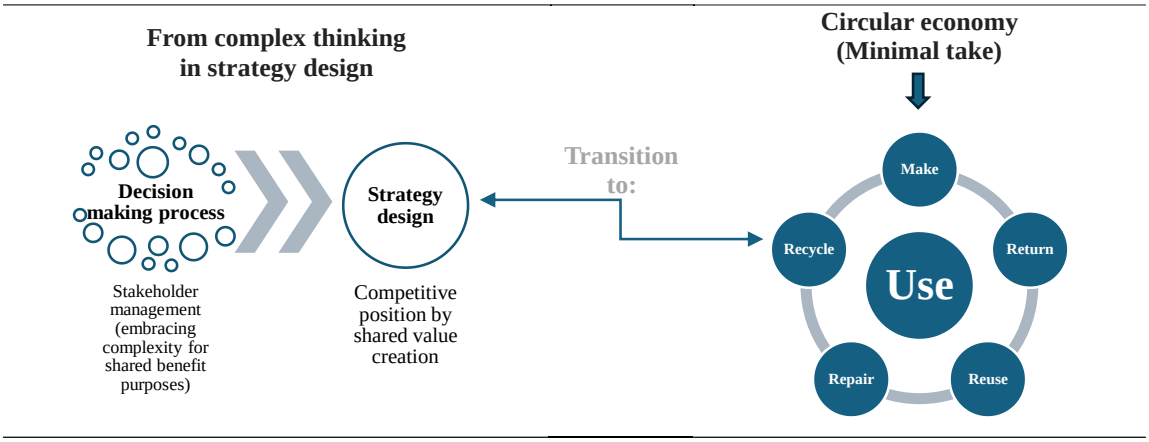


Figure 1: The transition to a circular economy is likely to move faster than previous transformations.
Source: Own elaboration based on WEF (n.d.)[1].

As it is described in Figure 1, an innovative stakeholder management decision-making process for circular economy practices in private organization based on the introduction of new practices and business models, will play an important role in achieving competitiveness by implementing circularity and improving the management of natural resources, reducing the cost, make organizations economically feasible, and broaden the scope of use of circular products ; this type of innovation based on introduction of new organizational methods focused in applying changes in management strategy [28], that initiates with the decision making process that must embrace complexity using a stakeholder management approach, must include stakeholder engagement processes, through a strategic identification of mutual needs from every stakeholder involved, creating social and market value [29].

To explore this multidimensional model, the present research describes a two-steps methodology that starts with a semantic differential measure to identify stakeholder salience in a power-interest multicriteria for three-dimension innovation model from UNECE2, to create a matrix structure that will become the basis for the use of the TOPSIS technique for decision making, as it is explained in the following section.

III. METHODOLOGY

This research paper introduces the use of TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) as a multicriteria decision-making useful to identify the best path of implementation for circular economy practices in an organization; TOPSIS is a multicriteria decision analysis method that calculates a preferred alternative that represents a closer option to an ideal solution as well as the furthest option to a negative ideal solution; thus, an ideal solution remains as a combinations of the best scores of each criterion included in the calculations, while the negative ideal solution represents a combination of the worst score of each criterion included, considering a numerical dataset where the importance weigths of the criterion know can be based on experts opinions [30], [31], [32], given its systematic ranking process, simple computation and the possibility to handle both quantitative and qualitative factors made it as the proper Multi-Criteria Decision-Making (MCDM) for the present work.

To complete the analysis, a Semantic Differentiation (SD) approach is also used, since SD measures people's reactions to stimulus words and concepts in terms of ratings on bipolar scales defined with contrasting adjectives at each end, using simple and clear adjective scales, where typically, a concept is rated on several pure scales associated with a single dimension, providing a single factor score for a diversity of dimensions [33].

Thus, the SD is used, a TOPSIS method analysis is being performed, in which the decision rule is that the selected alternatives should have the shortest distance to the ideal solution and the largest distance to the negative solution, will be used as the way to implement a decision-making process considering a diversity of objectives to be achieved, in which, however, there is a certain degree of conflict and, consequently, there is no solution or logic; this method seeks to achieve a diversity of purposes in such a way that maximizing one aspect of the solution competes with the goal of minimizing another aspect, simultaneously, which is a description for a typical multiple stakeholder management problem [34].

IV. RESULTS

First, the dimensions that serve as the basis for the construction of a three-dimensional multicriteria TOPSIS model are based on the innovation for circular economy model from the United Nations Economic Commission for Europe (UNECE), which includes technological change and the introduction of new practices and business models that can contribute to the steady reduction of the cost of circular practices, make business models and economic systems feasible, considering three fundamental aspects of innovation for sustainability and circularity: creating the demand for circular products, replacing materials with sustainable alternatives, and adopting new practices in a sharing economy, which are defined as follows:

Table 1: Three-dimension innovation model from UNECE.

Dimension	Variables	Stakeholders
Creating the demand for circular products	The public sector can be a significant source of demand to steer the economy towards increased circularity (public procurement globally accounts globally for 13–20 percent of gross domestic product). Sustainable public procurement can facilitate cooperation across sectors and value chains.	Government Managers Customers Suppliers
	International harmonization of purchasing practices supporting CE.	
	Public policies that support and promote urban areas designed for the circular economy.	
Replacing materials with sustainable alternatives	Using renewable products from sustainable practices (recycled or reused), to create and environment pursuing a "bioeconomy", promoting the role of forests in a circular economy, as well as the potential role of new biofriendly products.	Suppliers Managers Owners Employees
New practices in a sharing economy	Sharing platforms and business models, shifting the focus of value creation from a product to a service model can contribute to maximizing efficiency and reducing waste.	Clients Employees Owners Managers Suppliers Governments
	Changes in technical provisions and other regulations may facilitate the extension of such models.	

Source: Own elaboration based on UNECE (n.d.).

The table 1 describes the three dimensions considered in the multidimensional concept of innovation according to UNECE, including the dimensions, variables and stakeholders identified as relevant to every dimension, which is needed to create a multicriteria decision-making matrix for the TOPSIS analysis; evolved from that description, the following table shows how every criterion is being considered including a stakeholder power interest grid corresponding to every corresponding dimension using a discrete distribution of a 10 point scale per stakeholder, and also, identifying 3 different weighting possibilities to calculate every alternative that will be analyzed as feasible scenarios, as follows:

Table 2: Multicriteria decision making matrix for TOPSIS.

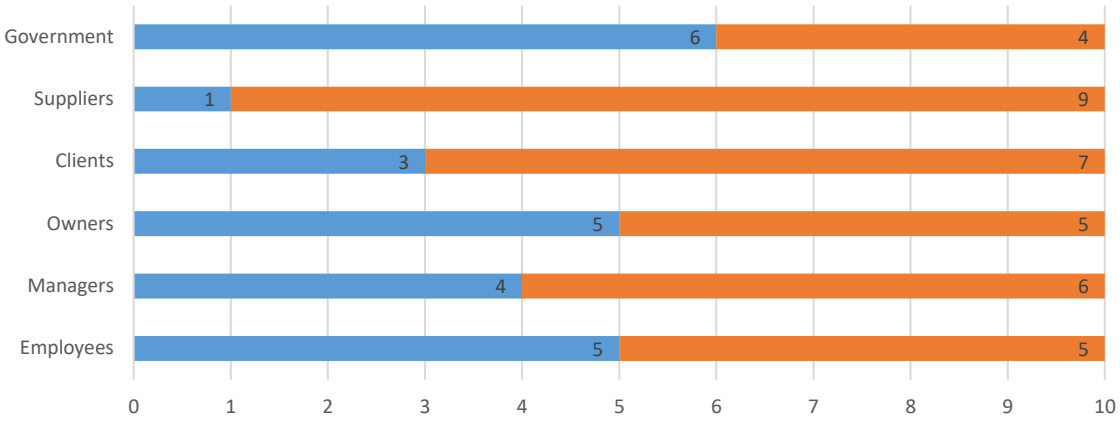
	Creating the demand for circular products		**Replacing materials with sustainable alternatives**		**New practices in a sharing economy**	
Stakeholder	*Power*	*Interest*	*Power*	*Interest*	*Power*	*Interest*
Employees	5	5	7	3	6	4
Managers	4	6	6	4	5	5
Owners	5	5	5	5	5	5
Clients	3	7	6	4	6	4
Suppliers	1	9	5	5	2	8
Government	6	4	1	9	2	8
Weights	**20**	**20**	**15**	**15**	**15**	**15**
Weights	**15**	**15**	**20**	**20**	**15**	**15**
Weights	**15**	**15**	**15**	**15**	**20**	**20**

Source: Own elaboration (2025).

As it can be seen in the previous table, the criteria used for these possible scenarios consider balanced interaction among a diversity of stakeholders including an interacting process with the three dimensions suggested by UNECE, in relation to the adequate involvement of every interest party in the process to gather a diversity of perspectives [35], to develop better regulatory frameworks [36], and to properly engage both primary and secondary stakeholders in the process [37].

Thus, there are 3 possible scenarios that consider one of the dimension per calculation slightly different in terms of relevance; thus, the 100 points possible for the total sum of weights are distributed in a 20 to 15 points (in this case 20-20-15-15-15-15 for the first alternative giving higher importance to creating the demand for circular products; 15-15-20-20-15-15 for the second alternative giving higher importance to replacing materials with sustainable alternatives; and 15-15-15-15-20-20 for the third alternative, giving higher importance to new practices in a sharing economy).

Using this structure of corresponding punctuation for every stakeholder, and corresponding weights for every possible alternative (including 6 main groups of interest) the following stakeholder matrix with a semantic differential scale describes the use of a set of bipolar adjectives to identify the level of power and interest concerning every relevant stakeholder, including the 3 dimensions listed above; the first graphic shows the variable "Creating the demand for circular products".



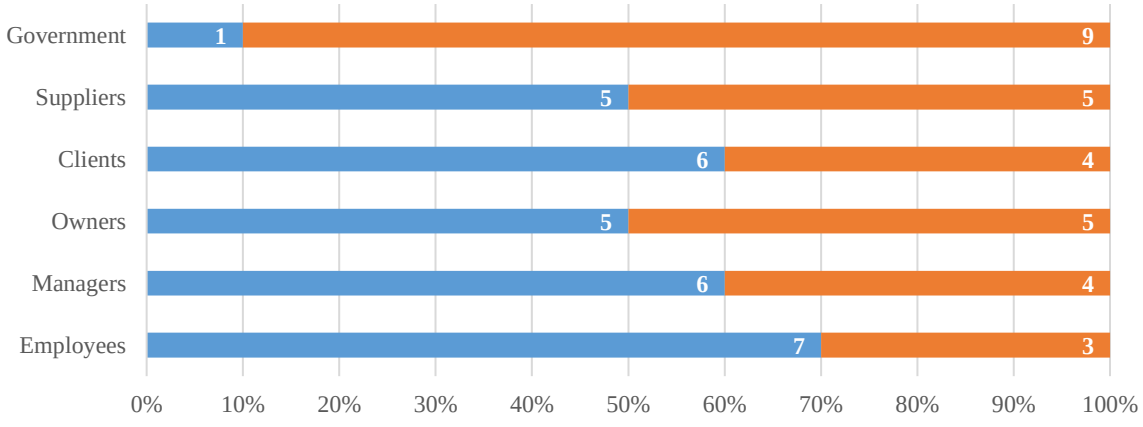
	Employees	Managers	Owners	Clients	Suppliers	Government
Power	5	4	5	3	1	6
Interest	5	6	5	7	9	4

Figure 2: Involvement of every stakeholder in the dimension "Creating the demand for circular products".
Source: Own elaboration (2024).

In figure 2, the level of involvement of every stakeholder shows a distribution of 10 possible corresponding points distributed in a discrete scale for a bipolar structure that considers two alternatives of engagement (power and interest), so the involvement of every stakeholder represents a balance between those two attributes; the graphic shows that in what it comes to creating the demand for circular products, the level of involvement of the Government as a relevant stakeholder is slightly related to power than interest (given the fact that this interest party is able to create and impose norms to promote this kind of circular economy practices as part of a public policy, but since it is not directly involved in the value chain activities of companies, the interest is slightly lower in comparison.

For what it comes to the rest stakeholders, for this dimension, the owners and employees have a balanced involvement, since they are strongly related to the primary activities in the value chain creation process, as well as they have some decision power directly involved with the organization; managers, clients and suppliers are more involved in terms of interest for the promotion of such demand conditions given that the market trade-offs are based fundamentally in the quality of the interactions of these interests parties.

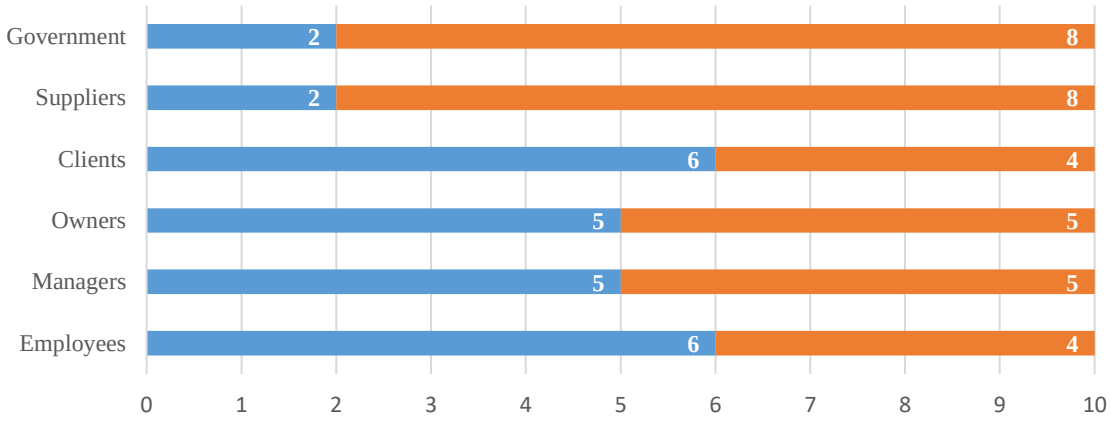
Next, in relation to replacing materials with ecofriendly alternatives, the following figure depicts a semantic differential scale describing the level of power and interest concerning every relevant stakeholder, concerning the variable "Replacing materials with sustainable alternatives, as follows.



	Employees	Managers	Owners	Clients	Suppliers	Government
Power	7	6	5	6	5	1
Interest	3	4	5	4	5	9

Figure 3: Involvement of every stakeholder in the dimension "Replacing materials with sustainable alternatives".
Source: Own elaboration (2024).

As it can be seen, the balance between power-interest grid is different for every stakeholder, considering that both suppliers and owners have a 5-5 combination of those attributes for identifying and using new materials to promote biofriendly processes in organizations, representing a different case from employees, managers and clients as powerful stakeholders in relation to a company making the decision to adopt the use of new materials for both the production and consumption processes; the Government remains as a interest party, but with no real power since it doesn´t intervene directly in the decisions of the most relevant stakeholders for this dimension. The next figure 4 shows the following power-interest structure for every stakeholder in what comes to using new practices in a sharing economy.



	Employees	Managers	Owners	Clients	Suppliers	Government
Power	6	5	5	6	2	2
Interest	4	5	5	4	8	8

Figure 4: Involvement of every stakeholder in the dimension "New practices in a sharing economy".
Source: Own elaboration (2024).

Figure 4 includes a power-interest structure where the clients and employees have slightly more power to promote and implement new practices in a sharing economy, followed by the interaction of managers and owners with a balance grid between the two attributes; conversely, in what it comes to suppliers and government, the interest is higher than the level of power, since those interest groups are indirectly related to such dimension.

Using the previous matrix structure for a multicriteria decision making process, based on the TOPSIS calculations, the following figures present the results obtained for every alternative, that distributes weights giving a slightly different level of importance for every dimension in terms of promoting innovation involving stakeholders in circular economy model, starting with a 20 to 15 weighting structure for creating the demand for circular products, showing the following results.

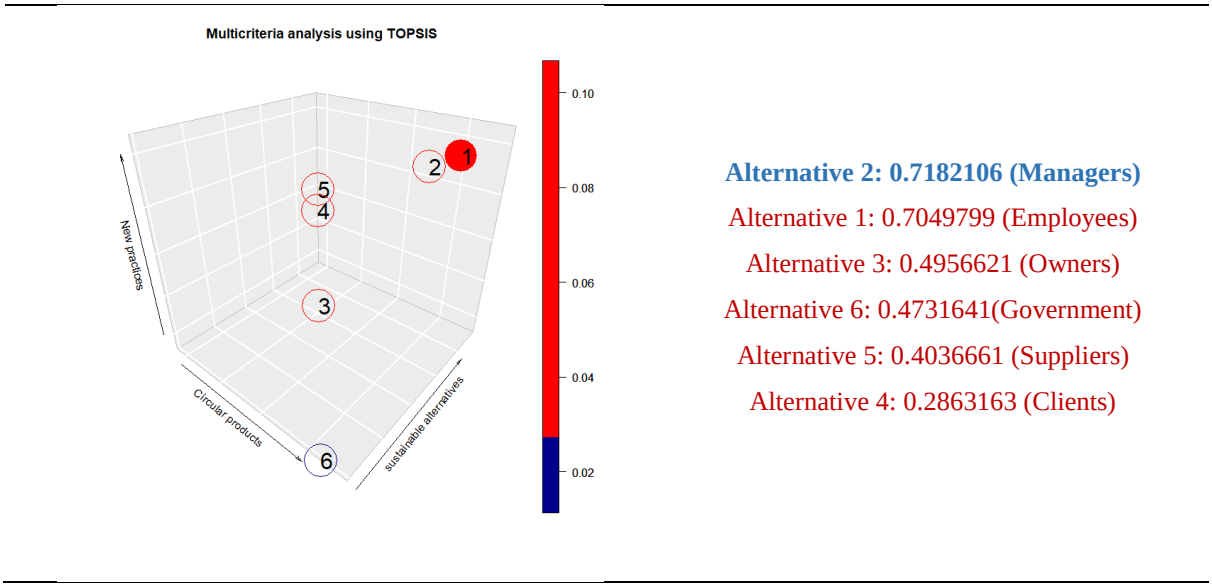


Figure 5: TOPSIS analysis giving higher weight for "Creating the demand for circular products in a (20-20,15-15,15-15) weighting structure.
Source: Own elaboration (2024).

As it can be seen in the previous figure, the alternative that represents the ideal solution in what it comes to engage stakeholders for creating the demand for circular products as the dimension of higher importance in the decision-making process shows that the involvement of managers will represent the best alternative to an ideal solution to engage multiple stakeholders to promote circular economy practices for sustainable innovation in a given organization, which represents the need for emphasis in an internal stakeholder that is involved in the strategic decisions of a company.

The next scenario gives a higher weight for the multicriteria decision of replacing traditional materials with sustainable alternatives, which after calculations presents the following results included in figure 6.

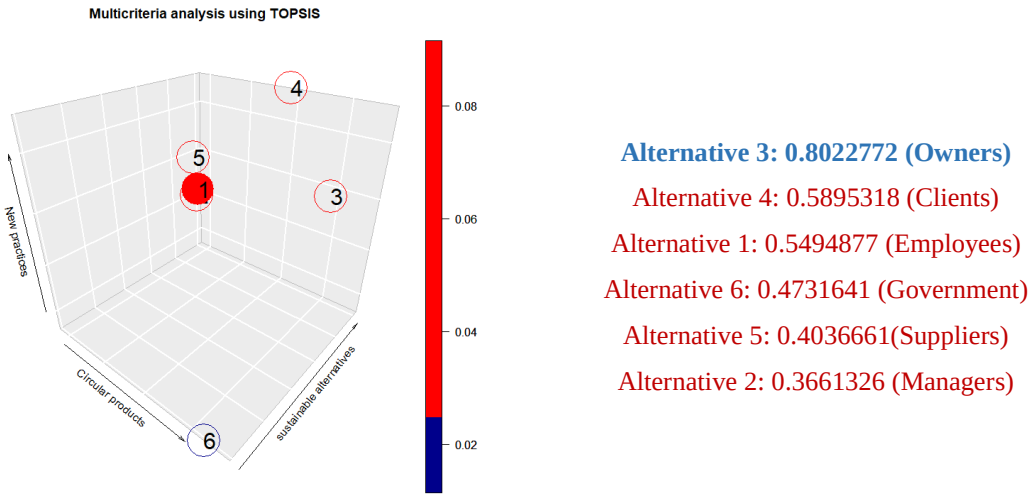


Figure 6: TOPSIS analysis giving higher weight for "Replacing materials with sustainable alternatives" in a (15-15, 20-20,15-15) weighting structure. Source: Own elaboration (2024).

Figure 6 shows that the alternative that represents the ideal solution in what it comes to engage stakeholders for creating the conditions for a company to replace traditional materials with sustainable alternatives in order to contribute to the creation of a circular economic systems considers that the involvement of owners will represent the best alternative to an ideal solution to engage multiple stakeholders to promote the use of ecofriendly materials in a production process, which represents a need for emphasis in an internal stakeholder that is involved in the resource available decisions from the corporate governance structure of a company that is oriented to sustainable competitive advantage, making decisions for the long run. Interestingly, such alternative is consistent with the following scenario, since in what it comes to the promotion and implementation of new practices in a sharing economy (which basically is focused on an overall engagement for a diversity of relevant actors in a new way to design, maintain, and improve an economic system for creating sustainable conditions for every participant, considering the effect of productive activities for the next generations) shows the involvement and engagement of owners as the ideal solution for a multidimensional problem, as figure 7 shows.

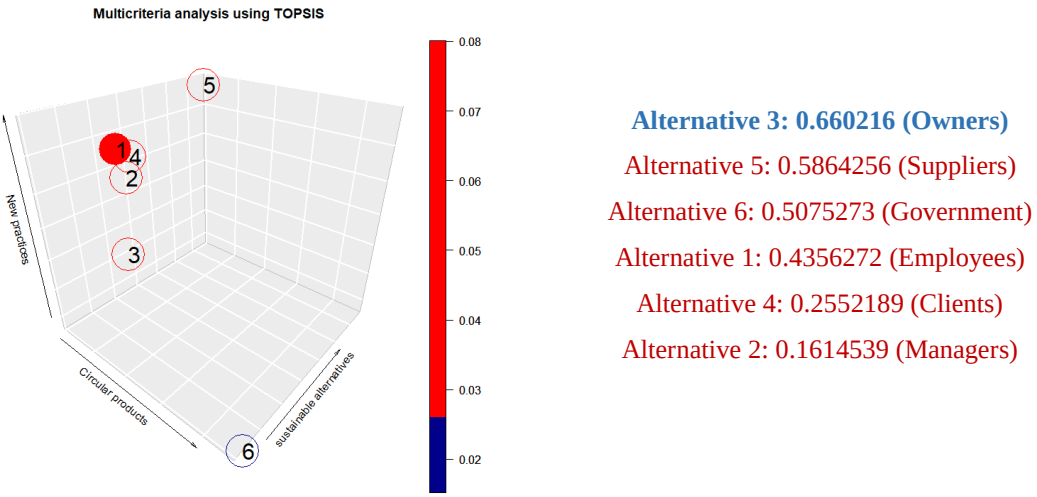


Figure 7: TOPSIS analysis giving higher weight for "New practices in a sharing economy" in a (15-15,15-15,20-20) weighting structure. Source: Own elaboration (2024).

As mentioned previously, figure 7 shows that the alternative that represents the ideal solution in what it comes to engage stakeholders for creating the conditions for a company to engage as a relevant economic participant in the promotion and adoption of new practices in a sharing economy to contribute creating a circular economic systems considers that the involvement of owners will represent the best alternative to an ideal solution, which represents a need for emphasis in an internal stakeholder that is involved in the resource available decisions from the corporate governance structure of a company that is oriented to sustainable competitive advantage in the long term.

V. CONCLUSIONS

The present research contributes to the understanding of a stakeholder salience model, using a multicriteria model to promote and implement practices related to innovation for sustainability in a circular economy environment that engages a diversity of internal and external stakeholders in a strategic decision-making process in a private health organization.

In that sense, considering that strategic purposes in value creation in the field of Operations Research as a discipline related to problem-solving and decision-making process, applying TOPSIS analysis allows to use an advanced analytical method helping management practices for sustainable innovation, taking into consideration the relevance of making a stakeholder saliences analysis by applying a multicriteria method with different alternatives and weighting scenarios, allowing the integration of conceptual and practical concepts essential to engage key stakeholders in pursuing a more sustainable society.

First, the research introduces a variable operationalization model that facilitates the understanding of how every element in the research problem is included, with pointed definitions for each dimension, variables and stakeholders included, according to the circular economy model from the UNECE; this approach to research design is innovative and novel to the conceptual contributions that are available in the literature, since it describes a multidimensional framework including punctual definitions to every element included in the three-dimension innovation model (creating the demand for circular products, replacing materials with sustainable alternatives, and new practices in a sharing economy).

Evolving from that conceptual descriptive framework, a multicriteria decision making matrix is developed, using a discrete distribution of a 10 point scale per stakeholder, which is used as a basis for 3 different scenarios that represents a shared participation for every interest group with a diversity of power and interest distribution in the mentioned scale (using a level of incidence from 1 to 10 points, different for every dimension and interest party), which also is useful in a descriptive manner for a decision making process, following the recommendations of the literature, as well as the ones included in the UNECE bibliography, which recommend that an adequate involvement of every relevant primary and secondary stakeholder group by gathering a diversity of perspectives in the process.

Following such logical analysis, the figure corresponding to the variable “Creating the demand for circular products” in the decision-making process to engage the diverse stakeholder groups, shows a level of involvement of every stakeholder with a distribution of 10 possible corresponding points distributed in a discrete scale for a bipolar structure, showing that the level of involvement of the Government as a relevant stakeholder is slightly related to power than interest, reinforcing the nature of the relationships of the private sector with this important interest group, even if the interaction is indirect, but whose legitimacy is fundamental in the design, implementation, and coordination of public policies, norms, benefits and potential punishment in relation to circular economy practices; for making this strategic relationship to work, it is essential to count with the formal involvement of the managers, which are appointed by the technique as a necessary factor to promote circular economy practices, emphasizing the need for top executives support to make this approach to work properly.

Not only government represents a powerful and influential stakeholder in the implementation and promotion of those practices, but also, owners and employees gain a high influence in the primary activities of the value creation process, being directly involved in such activities; this also depicts the relevance of designing, implementing and actions for improvement of processes, procedures, and measurement in the working environment. Being the level of influence of these interest parties, the quality and frequency of training process represent a logical opportunity to strengthen the circular economic practices in the private industry sector.

Continuing with the results, the graphical analysis regarding the relevance of the involvement of every stakeholder in relation to replacing materials with sustainable alternatives, the results are showing that a given balance between power-interest grid remains different for every stakeholder, with an important influence from the Government (again, indirectly by the design and implementation of public policies, potential rewards and/or punishments, in where the sole intervention of this important group of interest changes the nature of interaction for any given organization with the rest of the stakeholder network (including employees and managers as internal stakeholders, and clients as well); the inclusion of the clients (as an important actor in the market) remains relevant, showing that organizations can also create and bring value to the market by increasing the level of consumer surplus for customers in a non-economic approach, being this replacement process with sustainable materials yet remaining a discretionary decision for many companies in many industries, the changes in the perception from the customers pivoting to environmental friendly organizations are shaping the ways to compete.

Subsequently, in the dimension related to engaging stakeholders to replace traditional materials with sustainable alternatives, the results emphasize the relevance of the owners in terms of adopting a promoting ecofriendly materials, which is an important element for a decision-making process related to competitiveness and strategy, since in the long run, this decisions will contribute to strengthening the legitimacy of the companies in the future (considering that owners are the ones making a decision about allocating resources for the company, that commonly is made upon the expectations of reinvesting in the company´s tangible resources or being considered as only earnings for discretionary personal use); thus, deciding to reinvest in sustainable alternatives to improve the competitive position of a company in terms of differentiation will only be possible by the positive and affirmative involvement of the owners.

To summarize the contributions of this research to the stakeholder management decision-making process for circular economy practices in private health organizations, the formal and active involvement of owners for replacing materials with sustainable alternatives, as well as implementing new practices in a sharing economy represents the ideal alternative to better fostering a sustainable business model, given the need of investment in resources needed to pivot the value creation process of a given organization to a sustainable way of producing and competing; this must be introduced formally in the company along with an active involvement of the managers, implementing executive decisions for creating the demand for circular economy, which in terms of competitive position, must be implemented in the value creation process as a way of differentiation, increasing the market power of the private health organization, and reducing the threat of competition by creating a unique service to overcome the threats of competition in a highly competitive industry.

VI. RECOMENDATIONS

For the introduction of new practices and business models, the ideal solution for engaging stakeholders in the process of creating the demand for circular products shows that the involvement of managers will represent the best alternative to an ideal solution, since this in an internal stakeholder that is involved in the strategic decisions of a company.

Conversely, for what it comes to replacing traditional materials with sustainable alternatives, Figure 6 shows that the alternative that represents the ideal solution in what it comes to engage stakeholders for creating the conditions for a private health organization for the

promotion and implementation of new practices in a sharing economy shows that the involvement and engagement of owners as the ideal solution for a multidimensional problem, since it represents the need for an overall engagement for a diversity of relevant actors in a new way to design, maintain, and improve an economic system for creating sustainable conditions for every participant, considering the long term.

To conclude, the contribution of the present research address to highlight the relevance of considering the implementation of circular economy practices as a multidimensional process that needs to address the needs and expectations of a set of stakeholders, which holds different levels of power and interest, depending on the dimension of sustainable innovation practices, to achieve and maintain competitiveness in the long term.

VII. ACKNOWLEDGMENTS

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