



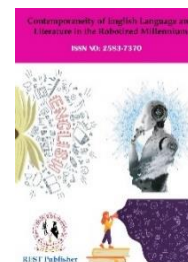
Contemporaneity of English Language and Literature in the Robotized Millennium

Vol: 4(2), June 2025

REST Publisher; ISSN: 2583 7370

Website: <https://restpublisher.com/journals/cellrm/>

DOI: <https://doi.org/10.46632/cellrm/4/2/5>



An Assessment on Service Innovation Using the Weighted Sum Method

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Abstract: Service innovation is the development and implementation of new or improved services that create value for customers and differentiate a company from its competitors. Better customer experiences can only be delivered by creating new service concepts, improving existing services, and employing technology and customer data. Service innovation is essential in the fast-paced business environment of today, when consumer expectations are always shifting. It enables companies to expand, enhance customer satisfaction, and maintain competitiveness. By introducing innovative services, businesses may attract new customers, retain their present ones, and expand their opportunities for revenue generation. One of the main forces behind competitive advantage is service innovation. Businesses that regularly roll out new and enhanced services can set themselves apart from rivals, draw in new clients, and keep hold of their current clientele. Research on service innovation assists in identifying successful tactics, organization standards, and new trends that can provide businesses a competitive edge. Understanding client wants, preferences, and expectations is a key component of research on service innovation. Companies can create services that meet client needs by researching user behavior, feedback, and developing trends. Customers who are happy with a product or service are more likely to stay loyal, recommend the business, and help it succeed in the long run. By multiplying each of our goals by a weight provided by the user, we can scale our collection of goals into a single goal using the weighted sum approach. One of the most popular strategies is this one. Finding the appropriate weights to give each aim while using the weighted sum approach is a concern. Alternative taken as Organization1, Organization 2, Organization3 and Organization 4. Evaluation preference taken as Performance, Market compliance, Organizational compliance, Technology, and information. From the result it is seen that organization 2 got the first rank whereas the organization 1s having the lowest rank. The first ranking is obtained by organization 2 with good performance.

Keywords: MCDM, Performance, Market compliance, Organizational compliance, Technology and information.

1. INTRODUCTION

The term "service innovation" now refers to innovation taking place in the different contexts of services, such as the introduction of new services or alterations to existing services. Although it is a potential setting for service innovation in the service sector, there is no requirement for it. New and enhanced services can also be provided by non-services sectors, such as manufacturing firms wanting to diversify their supply portfolio with value-added services. Service innovation frequently lacks the observable characteristics of product advancements, much like how a "product" and a "service" are essentially different from one another. Services may be highly tailored and involve a number of stakeholders depending on the needs of the client or consumer. Perhaps more people are familiar with the concept of service innovation in the knowledge-intensive economy, where it is important to differ radically the innovation of a product.

For example, the emphasis on technology developments and the concentration of innovation efforts around R&D departments fall short of accurately describing service innovation. [1]At the business, organization, and economic levels, service innovation is increasingly recognised as a driver of long-term growth and competitive advantage. Over the course of the twentieth century, innovation began to develop as a significant research topic. At first, research on innovation was primarily concerned with science, technology, and the new product development strategy for commercialising concepts and inventions, primarily in the manufacturing business.. Understanding

service innovation concepts and practises is more crucial given the rapid expansion of services in today's organizations and economy. Researchers have thus focused their emphasis on innovation in the context of services throughout the previous two decades [2]. Service innovations are widespread and increasingly contribute to growing prosperity and the economy. This is reflected in the vast volume of literature on service management, marketing, and innovation, as well as in the rise of the service-dominant logic paradigm and the widespread talk of a complete service science. But there aren't many models now available for the strategic management of service innovation. [3] Innovation in services Contrary to industrial companies, the majority of service businesses do not have sizable R&D departments. Instead of introducing new fundamental technologies, service innovation entails the creation of novel processes and concepts. This shows that the R&D department has a reduced role and effect on service development, especially given that NSD is structured around the market pull of the customers.[4] Several service features and associated management problems motivate the need for a service innovation technique like service blueprinting. Before characterising them, it is crucial to be clear about what we mean because the phrase "services" has so many different applications. Services include professional services, retail, financial, communications, healthcare, and a wide range of other service offerings. When we use the phrases "service" or "services," we're referring to product and/or service offerings that are developed for and/or in conjunction with clients. We also take into account complementary services provided with purchases of commodities services that are produced from a tangible product, like the service built into a car's onboard GPS system, or services like network support and training in a tech company. All of these services include communicating with actual clients, whether verbally or through technical methods.[5] Innovation is regarded as being essential to the effectiveness and survival of service providers. Innovation enables companies to generate goods and/or services that are different from those of competitors in order to add value for customers. Despite the growing interest in the value creation of services and the variety of definitions, there is no one description of the service innovation process that is widely acknowledged.[6] Many of the PSI typologies are profit-driven, based on studies of private enterprises, and emphasise product and process innovation. Because public managers may incorporate ideas from the private sector, and because reform initiatives like the NPM have aimed to make government more like business by emphasising an entrepreneurial attitude, drawing on a framework from the private sector has some relevance. These studies make the assumption that both private and public organizations undergo organizational change in a manner that is at least comparable to one another. The issue with this is that they don't all share the same the level of political or economic control and public visibility. As a result, we view the value of PSI through a prism that is intended to gauge various goals and results in various situations. The vast majority of classifications come from a focus on the private sector. These plans are often deductive and start with the assumption that there are already innovation typologies.[7] Gaining a competitive advantage now depends on service innovation. Traditional service industries are not the only ones looking for innovative offerings; manufacturing firms are too. For instance, energy companies add services to their energy products to increase energy efficiency, petrol stations have evolved into 24-hour businesses, software companies manage all of their clients' information technology needs, and more and more telecommunications companies are becoming media companies and/or content providers. The potential for service innovation is being recognised by entire industries, and individual businesses view service innovation as a crucial competitive aspect.[8] Most developed economies include sizable service sectors, and innovation is frequently cited as a key factor in corporate growth. According to a survey of the literature on innovation in services, despite its growth, this field is still understudied when compared to manufacturing sectors. New service development (NSD) frameworks are taking shape as a result of expanding research in this area. Researchers have discovered a variety of variables that make it challenging to research service innovations. The "fuzzy" nature of service outputs firstly makes it challenging to recognise and quantify innovation, improvement, or change. Unlike innovation in produced items, a service innovation generally lacks a tangible product, leaving observers unsure of where to "look" for the breakthrough. They are hence frequently underreported or overlooked. In addition, unlike manufactured goods, services are more immediately perishable, irreplaceable, and tend to be more varied; this makes them more difficult to define and quantify. The second reason services may have received so little attention from innovation scholars is because, according to some researchers, they are not particularly innovative. Again, a service innovation's inability to attract interest or attention might occasionally be hampered by the absence of a physical component.[9] The societal renewal engine that serves as the necessary impetus for the expansion of the service sector is service innovation. Despite the significance of service innovation, the idea is still vague and poorly understood. This study studies and explores how service innovation is defined and applied in research, building on a thorough and systematic review of 1046 academic articles. It's interesting to note that classifications of service innovation seem to ignore both customer value and financial performance.[10] Procedures for improving services, the development of competencies, learning, organizational flexibility, and culture are a few examples of innovation in action. The idea of service innovation is broad and encompasses many different traits. Businesses must handle the wide variety of component parts if they are to understand the intricacies of service innovation and fully benefit from it. The majority of service innovation frameworks, however, that are really put to use focus solely on adjustments to the firm's perspective on services or to the methods for offering services. The study here is predicated on the idea that managers charged

with planning and implementing service innovation must deal with a complex, organizational-wide issue, and that it is essential to have a complete understanding of this issue.[11]. Service innovation has been linked to the creation of customer value, which is a customer's perceived preference for a product's features, performances, and usage consequences. As market conditions change, the components of customer value are likely to alter as well. As a result, in order to value-add through service innovation, businesses frequently need to forecast future client needs. If companies wish to provide their customers a better value proposition, they must consider environmental changes while they develop new services. This frequently necessitates supplementing existing thorough solid information with new knowledge. The following sections emphasise the organizational characteristics that may be crucial for the development of new knowledge and subsequent service innovation inside a company.[12]Service innovations alter both current markets and business models, as well as existing offerings and business strategies. Service research has become increasingly interested in the idea of innovation over the past ten years, and by this point, it ought to be mature and have developed a solid theoretical foundation.[13]

2. MATERIALS & METHODS

Service Innovation Organization: The service innovation organization refers to the sector that focuses on developing and delivering innovative services to meet the evolving needs and preferences of consumers and businesses. It involves creating new or improved service offerings, enhancing customer experiences, and implementing novel service delivery models. Service innovation organization is driven by the recognition that services play a crucial role in today's economy, accounting for a significant portion of GDP in many countries. With the rise of digital technologies, globalization, and changing customer expectations, organizations across various sectors are increasingly investing in service innovation to gain a competitive advantage.

Performance: in service innovation refers to a company's or organization's capacity to provide effective outcomes and results as a result of its initiatives to create, put into practise, and provide new services. It includes a number of aspects, such as the success, efficacy, and impact of service innovation efforts.

Market compliance: Market compliance in innovation refers to how closely a company's innovative products, services, or solutions abide by regulatory requirements, commercial conventions, and organization standards. It involves ensuring that the innovations meet the moral, ethical, and quality criteria set by the relevant authorities and are favoured by customers and other market participants.

Organizational compliance: In the context of service innovation, organizational compliance is the observance of internal policies, processes, and guidelines within an organization during the development and implementation of new services. It entails making sure that the organization's innovation initiatives are in compliance with its set structures, regulations, and ethical standards.

Technology and information: Technology and information are essential to the development and delivery of innovative services that satisfy client expectations and promote economic growth.

Weighted sum method (WSM): The workforce selection issue is addressed by the Weighted Sum Model (WSM) and the Weighted Product Model (WPM). These techniques should make it easier to select the ideal operator from a range of options. Each employee is assessed based on three criteria for each function they execute. A Quality Index (QI), an Activity (A), and an Attendance Rate (AR) make up the criteria. Scores generated by MCDM algorithms enable the objective classification of operators. The same workers' ratings of the best to worst possibilities are used to make the same decisions when using the AHP, WSM, and WPM approaches, according to experimental results. The generated database facilitates line balance optimisation by selecting the most qualified operator for each operation.[1]

The weighted sum model (WSM) is likely the earliest and most popular technique. An alternative to the WSM that has been suggested to solve some of its drawbacks is the weighted product model (WPM). Later, Saaty [Saaty, 1980 and 1994] proposed the analytic hierarchy process (AHP), which is currently becoming more well-known. The updated AHP that Professors Belton and Gear [1983] suggested appears to be more consistent than the original technique (as it is demonstrated in the following chapters). Two additional well-liked strategies are TOPSIS and the ELECTRE algorithms.[2]

One of the simplest and most popular MCDM methods is the weighted sum method, commonly known as the simple additive weighted method. WSM typically works with benefit criteria, converting cost criteria into benefit criteria. The highest cost becomes the lowest after the transition, and the lowest cost becomes the largest. Then, each criterion value can be divided by the total number of criteria to produce a normalised matrix [20]. The final

step is to multiply the combined score of each choice by its weight. The option with the highest overall score is considered to be the best one. Bagoius et al. [71] used the weighted product method (WPM) and aggregated WSM to choose the optimal wind power facility based on technical, economic, and environmental factors.[3]

In non-convex regions, the weighted sum approach discovers Pareto optimal solutions and ignores non-Pareto optimal options, producing well-distributed solutions. This final point, which is mostly brought about by Normal Boundary Intersection's reliance on equality requirements, can be a possible weakness of the otherwise successful multi objective method. Two numerical examples and a straightforward structural optimisation problem serve as illustrations of the resilient algorithm's potential.[4]

The weighted sum approach has broad ramifications. There is little in-depth discussion regarding the conceptual significance of the weights and techniques for maximising the effectiveness of the method with respect to a priori articulation of preferences, despite the fact that this method has many published applications and that literature addresses its shortcomings with regard to illuminating the Pareto optimal set. In light of preferences, the Pareto optimal set, and objective-function values, this paper investigates the fundamental relevance of the weights. We identify the variables that have an impact on which solution point emerges from a specific weight distribution. After major problems in the preference articulation are found, guidelines are provided to help prevent the method from being used blindly.[5]

The weighted sum technique, as opposed to employing a priori weight selections, concentrates on unknown areas by introducing additional inequality constraints and modifying the weights adaptively. The adaptive weighted sum method is shown to yield uniformly distributed solutions, locate Pareto optimal solutions in non-convex regions, and ignore non-Pareto optimal responses. This third point, which is mostly brought on by Normal Boundary Intersection's reliance on equality criteria, can be a potential weakness of the multiobjective method, which is generally effective. Two numerical examples and a straightforward structural optimisation problem serve as demonstrations of the resilient method's potential.[6]

The Pareto surface is swiftly estimated using the weighted sum method, and a mesh of Pareto front patches is found. Then, for each Pareto front patch, additional equality constraints that connect the pseudonadir point to the projected Pareto optimal solutions on a piecewise planar hypersurface in the m-dimensional target space are added to improve the results. The method's ability to locate solutions in nonconvex regions is demonstrated, and it also shows how to produce a well-distributed Pareto front mesh for actual visualisation. As case studies, two numerical instances and a straightforward structural optimisation problem are discussed.[7]

A weighted sum technique is provided. The locations produced by this method in the related multi-objective optimisation problem are all Pareto optimal. A method for producing weighting coefficients $w_i > 0$ in the MATHEMATICA programming environment is provided. The focus is on the symbolic run-time transformation of the constraints and objective functions of the associated single-objective constrained issue. Implementation information and graphical depictions of the two and three variable situations are provided[8] to demonstrate the newly proposed approach.

The weighted sum method then conducts regular weight adjustments, resulting in the discovery of a unique optimal solution for each and every objective optimisation. The generated solutions are nearly in ahead of the Pareto principle. The weighted sum method has the earliest study, according to Zadeh³. Koski⁴ employed the weighted sum method for structural optimisation. Lin⁶ developed the equality constraint approach, whereas Marglin⁵ developed the -constraint strategy. Multiobjective optimisation was carried out using simulated annealing by Suppaitnarm⁷, genetic algorithms by Goldberg⁸, Fonseca and Fleming⁹, and others. Multiobjective optimisation also uses heuristic methods.[9]

The main goal of this article is to provide a modified version of the WSM as a solution for decision-makers who must consider many criteria when another source of data is needed to rank or weigh a specific criterion or criterion(s). The WSM (Weighted Sum Method) is chosen using the most popular MADM techniques. The five steps of the upgraded WSM are presented. Using a numerical example, the updated WSM's viability is examined and validated. After reading this page, other MADM might decide to handle two or more sources of information using the same procedure.[10]

It is well known that spots on the convex Pareto front with unpredictable distributions are produced using the weighted sum approach of vector objective scalarization. This study's nonlinear weight selection method can be used to enhance the weighted sum approach's distribution of Pareto points. Numerical examples are given to illustrate the strategy's effectiveness.[11]

A framework for concurrent subspace optimisation using the weighted sum approach is offered. The bilevel concurrent subspace optimisation methodology uses the adaptive weighted sum to trade off several, conflicting goals. To develop better distributed solutions, two improvements are made. The bilevel optimisation framework, in the first place, relaxes an additional equality criterion that slows suboptimal convergence for each anticipated solution. It is also possible to reduce the possibility of becoming trapped in local minima. The mesh of the Pareto front patches is changed because the prior technique wasn't very effective.[12]

3. RESULT AND DISCUSSION

TABLE 1. case study on service innovation

	Performance	Market compliance	Organizational compliance	Technology and information
Organization1	88.456	52.765	64.4345	74.124
Organization2	67.465	77.687	77.7632	81.456
Organization3	75.468	48.354	69.354	87.987
Organization4	80.875	68.245	58.754	78.537

Table 1 data on four organizations (Organization1, Organization2, Organization3, and Organization4) and their performance measures in different categories: Performance, Market Compliance, Organizational Compliance, and Technology and Information. Performance refers to the measure of how well each organization performed, with Organization1 achieving the highest score of 88.456, and values ranging from 67.465 to 88.456. Market Compliance indicates the level of adherence to market requirements or standards, with Organization2 having the highest score of 77.687, and values ranging from 48.354 to 77.687. Organizational Compliance reflects the degree of conformity within each organization, with Organization2 achieving the highest score of 77.7632, and values ranging from 58.754 to 77.7632. Technology and Information relates to how effectively each organization utilizes technology and information, with Organization3 achieving the highest score of 87.987, and values ranging from 74.124 to 87.987. In summary, the table provides a comparative analysis of the performance and compliance of the four organizations in the specified areas relevant to service innovation.

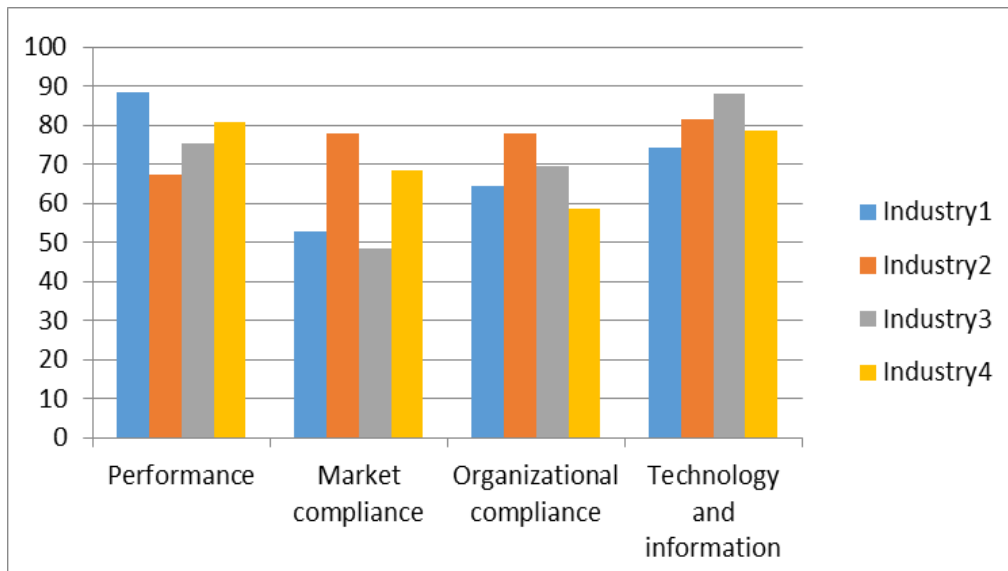


FIGURE 1. Service innovation

Figure 1 displays information regarding four organizations (Organization1, Organization2, Organization3, and Organization4) and their performance assessments across various categories, including Performance, Market Compliance, Organizational Compliance, and Technology and Information. Organization1 stands out with the highest performance score of 88.456, whereas Organization2 excels in Market Compliance (77.687) and Organizational Compliance (77.7632). Organization3 achieves the highest score in Technology and Information (87.987). This figure offers a comparative analysis of the organizations' performance and compliance in the context of service innovation.

TABLE 2. Normalized Data

1	0.679199866	0.828598875	0.842442634
0.762695577	1	1	0.925773126
0.853169938	0.62242074	0.891861446	1
0.914296373	0.878461004	0.755550183	0.89259777

Table 2 presents normalized data using the WSM (Weighted Sum Model) method. The table consists of four rows and four columns, with each row corresponding to a specific entity or organization. The table provides a representation of normalized data using the WSM method, allowing for a comparison of the relative importance or weight assigned to each column for different entities or organizations.

TABLE 3. Weightages

0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

The given data presents Table 3, which showcases the weightages assigned to each column in the WSM (Weighted Sum Model) method. Each row in the table represents a distinct entity or organization. The weightages determine the relative significance or impact of the columns in the overall evaluation or analysis conducted using the WSM method. Notably, all columns receive an equal weightage, indicating that they are considered equally important and relevant during the evaluation process.

TABLE 4. Weighted normalized matrix.

0.25	0.1698	0.20715	0.210611
0.190674	0.25	0.25	0.231443
0.213292	0.155605	0.222965	0.25
0.228574	0.219615	0.188888	0.223149

Table 4 presents the weighted normalized matrix, which is derived using the WSM (Weighted Sum Model) method. It is obtained by multiplying the weightages from Table 3 with the normalized data from Table 2. This process allows for the evaluation of the relative importance of each column, taking into account both the assigned weightages and the normalized values. The resulting matrix in Table 4 represents the influence and significance of each column for the entities or organizations based on the WSM method.

TABLE 5. Preference value

Organization	Preference value
Organization 1	0.83756
Organization 2	0.92211
Organization 3	0.84186
Organization 4	0.86022

Table 5 presents the preference values obtained through the WSM (Weighted Sum Model) method, revealing the relative rankings or preferences of the organizations based on the evaluation process. The preference values for each organization are as follows: Organization 1 has a preference value of 0.83756, Organization 2 has a preference value of 0.92211, Organization 3 has a preference value of 0.84186, and Organization 4 has a preference value of 0.86022. These values signify the organizations' positions in terms of preference, determined by the WSM evaluation. Higher preference values indicate that an organization is more favored or regarded as more desirable based on the assigned evaluation criteria and weights.

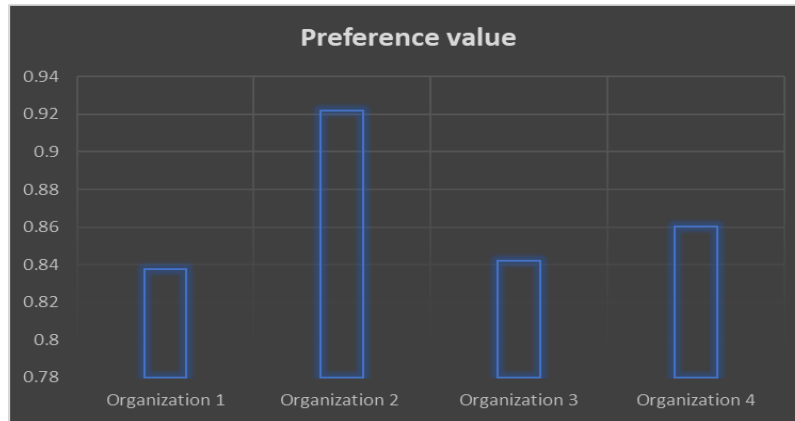


FIGURE 2. Preference value

Figure 2 illustrates the preference values obtained using the WSM (Weighted Sum Model) method, which reveals the relative rankings or preferences of the organizations based on the evaluation process. The preference values for each organization are as follows: Organization 1 has a preference value of 0.83756, Organization 2 has a preference value of 0.92211, Organization 3 has a preference value of 0.84186, and Organization 4 has a preference value of 0.86022. These values represent the organizations' positions in terms of preference, as determined by the WSM evaluation. Higher preference values indicate that an organization is more favored or considered more desirable, taking into account the assigned evaluation criteria and weights.

TABLE 6. Rank

Organization	Rank
Organization 1	4
Organization 2	1
Organization 3	3
Organization 4	2

Table 6 provides the rankings of the organizations obtained using the WSM method, reflecting their relative positions or preferences based on the evaluation process. Organization 1 has a rank of 4, Organization 2 has a rank of 1, Organization 3 has a rank of 3, and Organization 4 has a rank of 2. These rankings represent the relative positions or order of preference for the organizations based on the evaluation conducted using the WSM method. The organization with the lowest rank (in this case, Organization 2) is considered the most preferred or highly ranked, while the organization with the highest rank (Organization 1) is considered the least preferred or lowest ranked.



FIGURE 3. Rank

Figure 3 depicts the rankings of organizations acquired through the WSM (Weighted Sum Model) method, revealing their relative positions or preferences determined by the evaluation process. Organization 1 holds a rank of 4, Organization 2 holds the top rank of 1, Organization 3 possesses a rank of 3, and Organization 4 holds a rank of 2. These rankings signify the relative positions or preference order of the organizations based on the evaluation conducted using the WSM method. The organization with the lowest rank (in this case, Organization 2) is regarded as the most preferred or highly ranked, while the organization with the highest rank (Organization 1) is considered the least preferred or lowest ranked.

4. CONCLUSION

The service innovation organization is a dynamic and rapidly evolving sector that focuses on developing and delivering innovative services to meet the changing needs and expectations of consumers and businesses. It involves leveraging technology, designing exceptional customer experiences, exploring new service delivery models, fostering co-creation, and developing service ecosystems. By investing in service innovation, organizations can gain a competitive edge, enhance customer satisfaction, and drive growth. Through the adoption of digital technologies, organizations can create technology-enabled services that leverage AI, machine learning, and IoT to deliver personalized and efficient solutions. Customer experience design plays a vital role in service innovation, as organizations strive to understand customer needs and design services that exceed expectations. By involving customers in the co-creation process, organizations can tailor services to individual preferences and foster customer loyalty. Moreover, service innovation involves exploring new service delivery models, such as subscription-based models, on-demand services, and sharing economy platforms, to meet the changing demands of consumers. By collaborating with other organizations and building service ecosystems, companies can create seamless and comprehensive service offerings. Overall, the service innovation organization is driven by the recognition of the critical role services play in the economy. Organizations that embrace service innovation can adapt to the evolving landscape, deliver value to customers, and thrive in a highly competitive marketplace. the first ranking is obtained by organization 2 with good performance.

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