



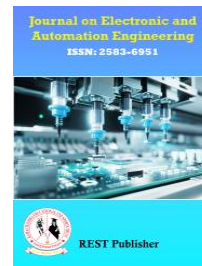
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Optimization of Urban Optical Wireless Communication Systems Using WSM Method

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Abstract: In the last ten years, there has been a tremendous growth in wireless communications, which has become an essential component of the advancing modern society. Offering mobile communication services that prioritize convenience and flexibility, wireless telecommunications has emerged as a rapidly expanding field. The utilization of Wireless Channel Adaptive Signaling in Communication Systems has shown significant enhancements across various performance metrics, highlighting its effectiveness and widespread adoption. A novel framework for wireless access systems, the Distributed Wireless Communication System (DWCS), employs distributed antennas, processors, and controls. This system introduces a decentralized approach where antennas, processors, and controls are spread out. By utilizing distributed antennas densely, DWCS enhances system efficiency by enabling frequency reuse and significantly reducing transmission power requirements. By overseeing dispersed processors, a computer functions akin to a software or a network radio, adhering to various standards to ensure coherence and transmitting signals to multiple antennas. This approach enhances computing capability through distributed processing. Optical Wireless Communication (OWC) is a field widely embraced across industries due to its distinctive attributes. It offers exceptionally high bandwidth, facilitates rapid deployment, and enables efficient allocation of both licensed and unlicensed bandwidth. Additionally, OWC boasts advantages such as low power consumption, minimal weight, and compact size. This paper offers a thorough examination of predictive models for terrestrial wireless communication systems. It encompasses a review of both traditional empirical models and deterministic diffusion models, with a specific focus on the application of ray-tracing techniques in their development. The significance of multi-access technology in wireless communication over previous decades is emphasized, highlighting its role in enhancing channel capacity and enabling simultaneous access for multiple users. The original intention was to prioritize human needs in network design, initially tailored for wireless communication. However, the conventional approach falls short in adapting to the demands of specialized wireless networks. Unlike the future-ready machinery required, conventional methods struggle to scale efficiently. While Fourth Generation Wireless Communication (4G) systems are prevalent in numerous countries or are in the pipeline for implementation, they don't fully align with the evolving requirements. Our proposed solution involves the adoption of a multiuser MIMO system, aimed at enhancing the Signal-to-Interference-to-Noise Ratio (SINR) to elevate the minimum threshold for signal quality. It seems like you're discussing a study or research paper that explores various methods for managing track conditions by comparing inspection methods (PSM) with written survey methods (WSM). Additionally, the study investigates different methods for selecting impact indicators and implements the Weighted Sum Method (WSM) and Weighted Product Method (WPM) for advertising and promotion using Facebook (FB). Furthermore, the study employs intuitive fuzzy values to measure Quality of Service (QoS). The objective of this thesis is to evaluate the effectiveness of wetland parks in addressing specific issues within urban environments. To achieve this, a tool called the Urban Wetland Park (UWP) index has been developed to assess and measure the performance of these parks. The most stable objective among the available options is to focus on water management in urban environments and determine alternative project plans. For the alternative project plans, an assessment will be conducted using the Sustainability Assessment Methodology (SAM) as a decision-making framework. SAM incorporates sustainability indicators to evaluate different criteria in achieving sustainable development goals. This case study demonstrates the application of SAM in assessing the sustainability of wetland parks in urban settings. Resilience are got the first rank whereas is the Mobility is having the Lowest rank.

Keywords: *Mobility, Flexibility, Resilience, Accessibility and Innovation.*

1. INTRODUCTION

Presently, the GSM system enjoys widespread popularity within our nation as one of the leading digital cellular telecommunication systems globally. Its extensive usage spans across various regions worldwide. The escalating count of GSM subscribers underscores its significance in the telecommunication industry, primarily due to its wireless communication capabilities, which have garnered increasing attention over time. Addressing the challenge of overcrowded spectra and limited user capacity, the cellular concept emerged as a significant advancement without requiring substantial technical modifications. It achieves remarkable capacity within a confined spectrum allocation. Essentially, this approach involves a system-wide strategy, employing numerous low-power transmitters instead of a few high-power ones, thereby minimizing the need for transmitter replacements. Cellular technology stands out as a key component within the realm of Wireless Communication Systems (WCS) [1]. The notion of control systems, source coding, and information within fields like theory and communication theory has exerted a significant influence. Its impact spans across various domains, particularly in defining wireless communication systems. In current research, there's a notable emphasis on feedback applications, with a specific resurgence of interest in multiple-input multiple-output (MIMO) systems. This renewed interest underscores the evolving landscape of related systems and technologies. Our objective is to examine past endeavors and offer insights into the trajectory of research in this field. The surge in interest towards finite feedback applications over the recent years, coupled with advancements in 4G and standardization extending beyond wireless networks, undoubtedly indicates an evolving landscape in deployment methodologies [2]. As telecommunications, video services, and broadband technology continue to advance rapidly, an increasing array of communication-based services are being offered. The backbone of this expansion lies in optical fiber networks, which offer virtually limitless communication capabilities. However, despite the global infrastructure of these networks, there remains a significant challenge in efficiently connecting subscribers. The primary obstacle is ensuring seamless connectivity from the optical network directly to users, whether through direct connections or intermediary hops [3]. Atmospheric turbulence has a diminishing impact on coupling performance as wavelengths decrease. However, it's noteworthy that optical wireless communication experiments have revealed that the availability of connectivity remains largely unaffected by this turbulence. Additionally, implementing systems with multiple transmitters and wider receiver apertures can further mitigate the effects of scintillation and fading. Consequently, it can be inferred that the influence of turbulence on connectivity availability is negligible [4]. Before designing and planning wireless communication systems, it's crucial to have a precise understanding of the propagation characteristics within the environment. This entails knowing factors such as diffusion patterns and accurately forecasting large-scale trajectories. Additionally, accounting for losses and minimal fading is essential, both of which are closely tied to statistical analysis. Parameters associated with these statistical aspects need to be considered when determining and enhancing base station (BS) location coverage. Integral to this process is the acquisition of path loss information, which plays a vital role in optimizing system performance [5]. In mobile radio channel multipath reception, the receiver encounters more than just the direct line-of-sight signal. Alongside the direct signal, various reflected radio waves contribute to the received signal. These reflections can be caused by a variety of objects such as trees, hills, mountains, vehicles, or buildings, leading to delayed signals reaching the receiver. OFDM represents a type of multicarrier transmission where a data stream is divided into multiple low-rate subcarriers and sent. It serves as both a modulation and multiplexing technique [6]. In this section, we delve into the realm of Wireless Optical Communication Systems, focusing particularly on Optical Code Division Multiple Access (OCDMA). As we explore this specific and sophisticated facet, we find that wireless optical communication systems have evolved significantly and can now accommodate multi-user interactions. Advanced multiple access techniques, such as OCDMA, hold considerable appeal due to their flexibility, implementation simplicity, and synchronization capabilities among users. Moreover, their ability to manage traffic seamlessly adds to their allure in the realm of wireless communication systems [7]. All of these fiber transmitters connect to a central office via a distribution network, enabling multiple rooms to be served by a single central office. While these operations are typically costly, the devices also help to reduce expenses at the central office. The proposed system integrates Wi-Fi-based localization functionality into the optical wireless system, aiming to achieve complete coverage throughout the room and allowing for dynamic adjustment of beam positions [8]. In wireless communication systems, multiple access refers to the method of shared communication where numerous users simultaneously utilize the media to access the system. This technique enables multiple users to gain entry to the system. Various multiple access technologies exist, including integrated multiple access and uncoordinated multiple access, also known as random access. These methods can be

classified accordingly. With relatively small-sized antennas compared to the count, active services for devices can efficiently deliver a simple signal, focusing more on base stations with processing capabilities and a higher number of antennas. The implementation of Massive MIMO technology is considered a fundamental aspect of future wireless communication systems [9]. The promise of WIET 6G in communication seems to have fallen short. WIET Wireless Communication, touted as an innovative technology, operates in the same realm as traditional systems, utilizing waves for transmission. While it offers the potential for wireless electricity during communications and enables the transmission and charging of smartphones through sensors, WIET's ability to extend the battery life of wireless systems is particularly promising [10]. These oscillations help to stabilize the received signal, leading to a decrease in the probability of bit errors. Similarly, the transmitter is affected by these fluctuations. In order to ensure a clear line of sight (LOS) between the receiver and transmitter, it's necessary to adjust the angle of divergence of the transmitter beam while maximizing its power output. However, widening the angle significantly necessitates higher laser power, which incurs additional costs and complexity. Conversely, a narrower beam angle may risk interruptions in communication, especially during building sway [11]. Another obstacle lies in the deployment of advanced wireless technologies, which entails a significant energy consumption. This surge in energy usage in wireless communication systems indirectly contributes to CO2 emissions, posing a considerable environmental threat. Furthermore, the increasing demand for more affordable 5G services is expected to drive the development of innovative applications, thus enhancing user experience and authenticity [12]. The capacity of mobile carriers and other fixed channels is reaching its peak, highlighting the growing issue of spectrum scarcity. Meeting future demands for wireless services, particularly below 6 GHz, is becoming challenging due to limited spectrum availability. This scarcity extends to cellular and unlicensed wireless networks, as well as Local Area Network (WLAN) spectrum. Moreover, the allocation of broadband spectrum between 6 and 300 GHz worldwide is currently insufficient to support the increasing demand, resembling a constraint compared to the vastness of the electromagnetic wave spectrum [13]. Previous iterations of the system have already incorporated wireless communication for control purposes. These wireless standards in sensor networks can be categorized broadly into two types: those focused on high efficiency and those geared towards low power consumption [14]. Moving towards the widespread use of mobile devices, individuals experience swift connectivity while on the move. This facilitates the emergence of vital applications that rely on data. From an Internet of Things perspective, devices are omnipresent and interact seamlessly with cloud systems. However, the industry faces challenges in developing wireless solutions for control systems due to stringent requirements for reliability and minimal delay [15]. One significant benefit of this method is that the transmit antenna operates independently, allowing for a clearer understanding of the relationship between weights. Moreover, in a multiuser MIMO system, Channel Interference (CCI) significantly affects performance, and a lower bound can approximate its impact. Through this lower bound, the product under the Signal-to-Interference-Plus-Noise Ratio (SINR) guides the optimal joint maximization frontier for determining antenna weights, which can be expressed analytically [16].

2. MATERIALS AND METHOD

Mobility: The efficiency of movement within your joints relies on the strength of your muscles. The ease and fluidity of this movement are determined by it. Engaging in mobility exercises involves actively moving your joints. Here are some actions you can take to improve this process: incorporating specific exercises that target mobility. Mobility work concentrates on enhancing the range of motion in your joints and is frequently mistaken for flexibility training.

Flexibility: Collaborative efforts are crucial for fostering flexibility development. However, there are certain limiting factors to consider, such as intentional suppression or constraints, which can result in maintaining or even exacerbating limitations. To overcome these obstacles, it's essential to introduce stimuli that encourage muscle relaxation and stretching of muscles and ligaments. In practical terms, achieving flexibility necessitates both relaxation techniques and targeted stretching exercises.

Resilience: Resilience, often described as the capacity to effectively cope with stress and bounce back from adversity, is crucial for maintaining psychological well-being. It signifies the ability to recover from challenging experiences and adapt successfully to difficult circumstances. Resilience is not merely a characteristic inherent in some individuals; rather, it is a skill that can be developed and nurtured in anyone.

Accessibility: Accessibility refers to ensuring that information, activities, and environments are comprehensible and meaningful to as wide a range of people as feasible, making them usable and practical for everyone. A typical instance of this concept can be observed in architecture, which we frequently encounter as an underlying principle in design.

Innovation: Innovation encompasses a spectrum, whether it's refining a product, enhancing a service, or introducing novel methods. It involves implementing fresh approaches, techniques, or even proven concepts to generate added value. Continuously revitalizing through this process is key, with value creation standing as its fundamental hallmark.

Coverage and Range: Coverage is restricted to fulfill needs, with availability of an item still maintained within a specified timeframe. The work scheduler's coverage range, defined by the number of days, aims to stabilize demand fluctuations.

Interference and Coexistence: In telecommunications, interference occurs when external factors disrupt or alter the signal being transmitted from its intended source to the receiver during communication within a channel. This interference can manifest as unwanted signals interfering with the desired signal. Common examples include electromagnetic interference (EMI), where different radio technologies operating concurrently can overlap, leading to interruptions known as inter-device coexistence (IDC) interrupts.

Power Consumption: In electrical engineering, energy consumption through electric power refers to the amount of electrical energy utilized over a specific period. It is typically denoted in Watts (W) or kilowatts (kW), signifying the rate at which electrical energy is utilized.

Regulatory Compliance: Regulatory compliance experts ensure adherence to licensing requirements and contractual obligations for permits, as dictated by governing laws. They assess eligibility for regulations, conduct evaluations and investigations, and perform other compliance-related audits and analytical procedures that are not specifically categorized elsewhere.

WSM Method: Written Survey Methods (WSM) have several disadvantages. Firstly, they often impose a significant response burden on participants, particularly in field studies. Additionally, there's a risk that important impact indicators might be overlooked in the survey questions. Furthermore, respondents may interpret identical items differently or provide varying explanations, which can complicate data analysis. Moreover, selecting appropriate terminology presents another challenge in implementing WSMs [17]. The Weighted Sum Method (WSM), although a specific approach within Multiple Criteria Decision Analysis (MCDA), can be adapted to various other MCDA methods. In this study, we apply the MCDA approach known as Sopol0 to evaluate and test its effectiveness. Ten criteria are utilized to assess seven different alternatives, which are ranked based on their performance in a water resource study drawn from existing literature [18]. Furthermore, the reliability of internet provision significantly influences the majority of online businesses, which in turn prompts researchers to explore and conduct studies in this field. Additionally, it leads to integration and development of various theoretical concepts and measurement techniques concerning the quality of internet service. This evolution in understanding quality of service on the internet encompasses multiple dimensions and is approached through two main methods [19]. In brief, when it comes to assessing the effectiveness of Urban Wetland Parks in environmental stabilization, a significant limitation arises in the development of a scientific evaluation model. Specifically, this research focuses on the Urban Wetland Park (UWP) and its evaluation model. The UWP model follows a waterfall process method, structured into three distinct phases [20]. Recently, there has been a growing recognition of the significance of environmental concerns and social repercussions stemming from infrastructure development projects. Additionally, the economic advantages associated with such endeavors are being increasingly acknowledged. It is now widely understood that these aspects are at least as crucial as the approval of projects themselves. Society's advancement is intricately tied to the pursuit of a high quality of life, fostering reciprocal relationships, and addressing various emerging challenges such as those related to environmental sustainability and societal well-being. Ensuring access to clean water, for instance, is not only vital for human survival but also contributes significantly to economic prosperity. Therefore, the provision of essential infrastructure services plays a pivotal role in enhancing the overall well-being of communities, given the substantial scale and profound impacts on human lives that these infrastructure systems entail [21]. When compared to the current approach, the utilization of the K-stiffness method aims to decrease the loads on reinforcement. The feasibility of this approach and its cost implications, particularly regarding the expenses associated with reinforcement, will be evaluated. Normally, within the overall cost of the wall, the expenses related to Mechanically Stabilized Earth (MSE) constitute a relatively minor portion. Nonetheless, certain concerns have been identified. In terms of the reinforcement load at End of Construction (EOC), projections derived from the K-stiffness method align reasonably well with established values. Moreover, when employing the AASHTO Simplified Method, the estimations tend to be significantly more conservative than necessary, indicating a higher level of accuracy with the K-stiffness method [22]. WSM, coupled with a rudimentary comprehension of shapeshifting, lacks clarity. Earlier studies have delved into its investigation, employing Call-to-Action (CTA) to transform web data format. These studies have mainly focused on detection rather than thorough analysis. Our observations indicate that WSM is consistently present in larger diameters, albeit not necessarily in the widest diameter of aneurysms. Predictions regarding WSM behavior in 2D-

DSA (2-Dimensional Digital Subtraction Angiography) have been somewhat accurate. To enhance understanding, we've devised a computational code for assessment purposes [23]. The weighted sum method (WSM) is among the various methods employed in multi-criteria decision making (MCDM). MCDM, a branch of Operations Research, focuses on evaluating criteria across multiple dimensions. Numerous studies have explored the application of the weighted sum method in various fields, including finance, energy, and query optimization such as reducing execution time. This method is particularly useful for accommodating diverse objectives. For instance, in the context of a mobile cloud database environment, the weighted sum method was utilized to derive an optimal query processing plan [24]. Alternatively, in situations where the risks are significant, it becomes crucial to accurately outline the problem and thoroughly assess the relevant criteria. This is particularly vital in decisions such as constructing a nuclear power plant, where considerations encompass not only whether to proceed with construction and its location, but also the multitude of complex factors and their far-reaching implications involving various stakeholders. The Weighted Sum Method (WSM) emerges as a favored approach for decision-making in such scenarios, recognized for its effectiveness and widespread adoption [25]. The thesis will focus on conducting deeper investigations into the relationship between WSM and HIM, as previous investigations have provided summaries but lack clear descriptions of this connection. Various analytical methods have been employed to analyze HIM if visible using WSM. However, further exploration is needed to fully understand this relationship [26]. Choosing the right components isn't determined by set evaluation criteria, as these criteria might clash with each other. This can lead to complications when selecting components. To address this issue, proposed decision-making techniques such as multi-criteria decision-making (MCTM) methods are employed [27]. Over the last forty years, the upstream operations of the oil and gas industries have focused on enhancing production, cutting costs, enhancing safety measures, improving operational efficiency, and ensuring environmental protection. Various established methodologies have been employed by industry leaders to achieve these goals. Decision-making in the upstream sector of oil and gas involves addressing multiple challenges, including complexities, uncertainties, and risks. Therefore, stakeholders, including practitioners and policymakers, play a crucial role in providing substantial input towards effective decision-making processes [28]. Acquiring knowledge in construction research involves understanding well-structured complex problems and articulating diverse regulations. This informed approach leads to enhanced outcomes, particularly relevant in functional sectors and pervasive sustainable development initiatives. Conceptualization is integral for researchers in construction to grasp as part of their knowledge base [29].

3. RESULTS AND DISCUSSION

TABLE 1. Wireless Communication System

	Coverage and Range	Interference and Coexistence	Power Consumption	Regulatory Compliance
Mobility	45.120	87.230	87.250	77.630
Flexibility	25.130	65.140	14.250	88.650
Resilience	65.120	97.630	11.280	99.420
Accessibility	55.160	46.920	77.960	44.610
Innovation	85.170	33.450	60.258	66.540

Table 1 Shows the Wireless Communication System for Analysis using the WSM Method. Mobility, Flexibility, Resilience, Accessibility and Innovation. Coverage and Range, Interference and Coexistence, Power Consumption and Regulatory Compliance it also the data set value.

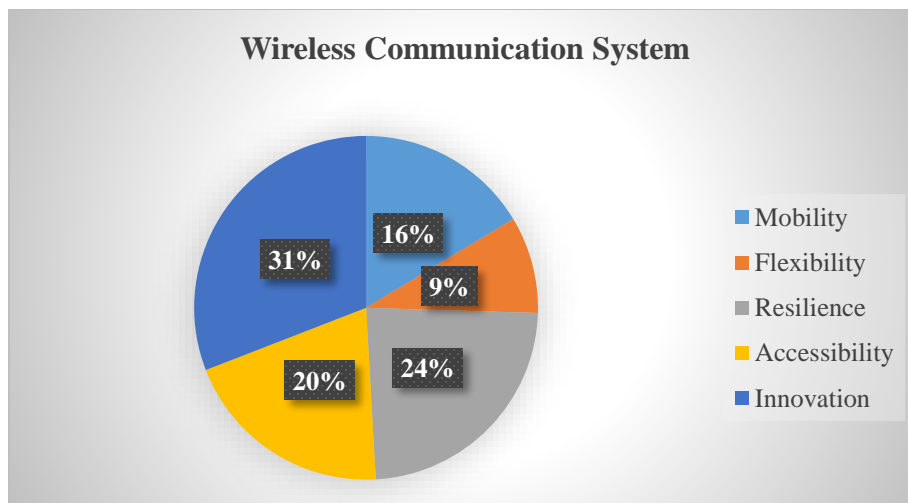


FIGURE 1. Wireless Communication System

Figure 1 Shows the Wireless Communication System for Analysis using the WSM Method. Mobility, Flexibility, Resilience, Accessibility and Innovation. Coverage and Range, Interference and Coexistence, Power Consumption and Regulatory Compliance it also the data set value. From it is seen that Innovation is showing the Highest Value for Coverage and Range and Flexibility is showing the lowest value. Resilience is showing the Highest Value for Interference and Coexistence and Innovation is showing the lowest value. Mobility is showing the Highest Value for Power Consumption and Resilience is showing the lowest value. Resilience is showing the Highest Value for Regulatory Compliance is showing the lowest value.

TABLE 2. Normalized Data

Mobility	0.52976	0.89348	0.12928	0.57465
Flexibility	0.29506	0.66721	0.79158	0.50321
Resilience	0.76459	1.00000	1.00000	0.44870
Accessibility	0.64765	0.48059	0.14469	1.00000
Innovation	1.00000	0.34262	0.18720	0.67042

Shows the Table 2 Normalized data for Wireless Communication System. Mobility, Flexibility, Resilience, Accessibility and Innovation. Coverage and Range, Interference and Coexistence, Power Consumption and Regulatory Compliance it is the also normalized data value.

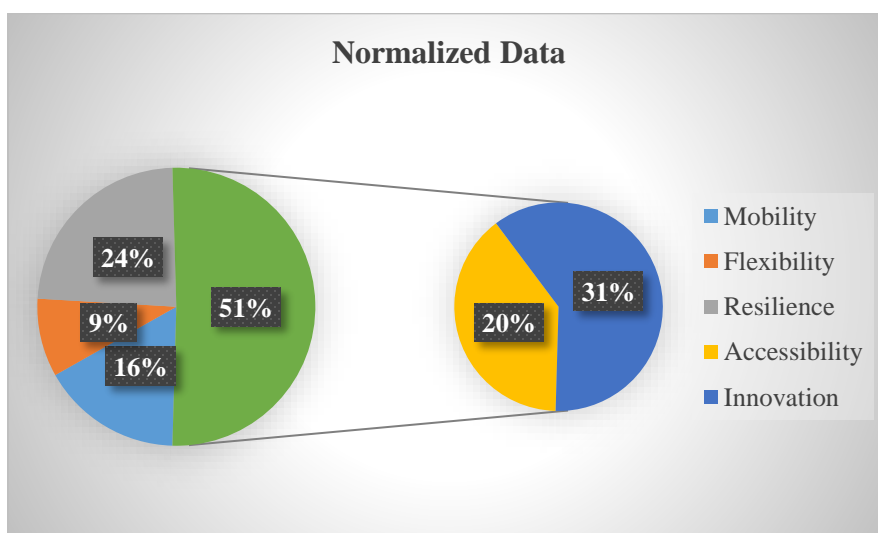


FIGURE 2. Normalized Data

Shows the Figure 2 Normalized data for Wireless Communication System. Mobility, Flexibility, Resilience, Accessibility and Innovation. Coverage and Range, Interference and Coexistence, Power Consumption and Regulatory Compliance it is the also normalized data value.

TABLE 3. Weightages

Weight			
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
0.25	0.25	0.25	0.25

Table 3 shows Weightages used for the analysis. We take same weights for all the parameters for the analysis

TABLE 4. Weighted Normalized Decision Matrix

	Weighted normalized decision matrix			
Mobility	0.13244	0.22337	0.03232	0.14366
Flexibility	0.07376	0.16680	0.19789	0.12580
Resilience	0.19115	0.25000	0.25000	0.11218
Accessibility	0.16191	0.12015	0.03617	0.25000
Innovation	0.25000	0.08566	0.04680	0.16761

Table 4 shows the weighted normalized decision matrix for Mobility, Flexibility, Resilience, Accessibility and Innovation. Coverage and Range, Interference and Coexistence, Power Consumption and Regulatory Compliance it is the also multiple value.

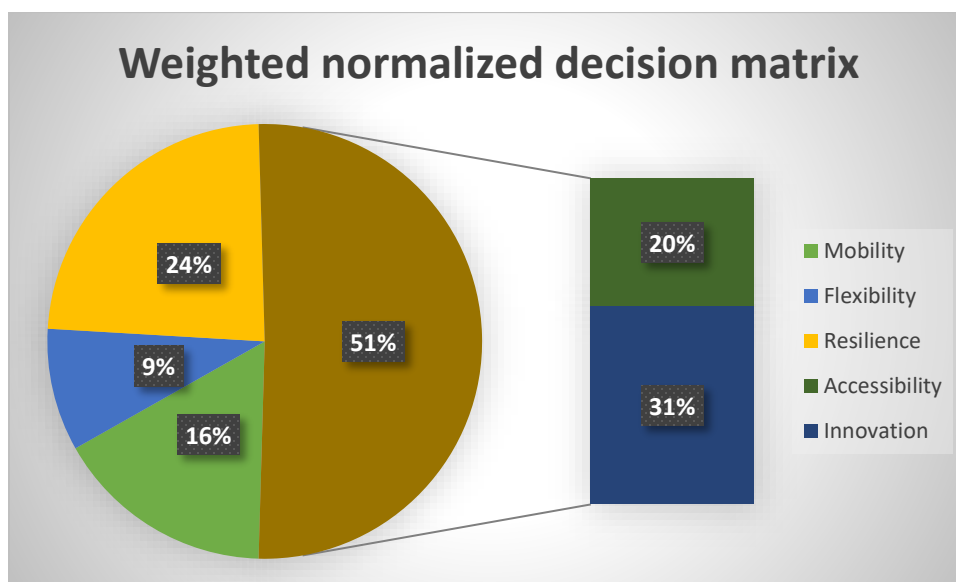


FIGURE 3. Weighted Normalized Decision Matrix

Figure 3 shows the weighted normalized decision matrix for Mobility, Flexibility, Resilience, Accessibility and Innovation. Coverage and Range, Interference and Coexistence, Power Consumption and Regulatory Compliance it is the also multiple value.

Table 5. Preference Score & Rank

	Preference Score	Rank
Mobility	0.53179	5
Flexibility	0.56427	3
Resilience	0.80332	1
Accessibility	0.56823	2
Innovation	0.55006	4

Table 5 shows the final result of WSM for Wireless Communication System. Preference Score is calculated using the Resilience (0.80332) is having is Higher Value and Mobility (0.53179) is having Lower value.

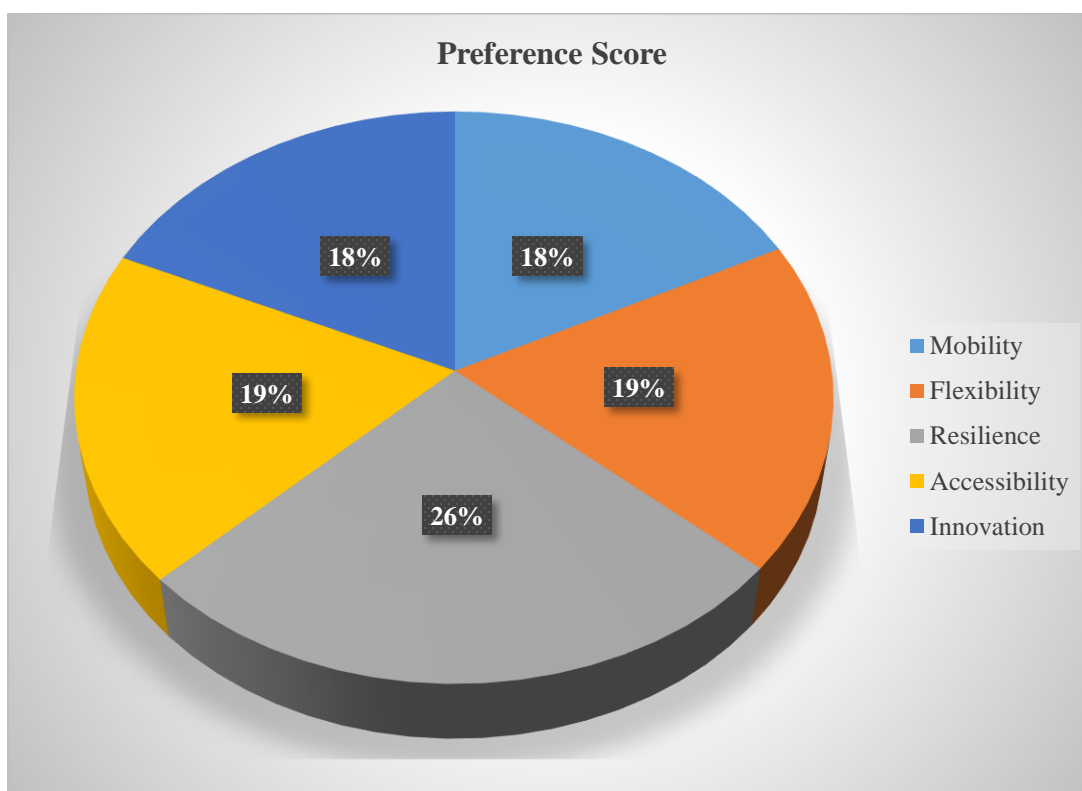


FIGURE 4. Preference score

Figure 4 shows the final result of WSM for Wireless Communication System. Preference Score is calculated using the Resilience (0.80332) is having is Higher Value and Mobility (0.53179) is having Lower value.

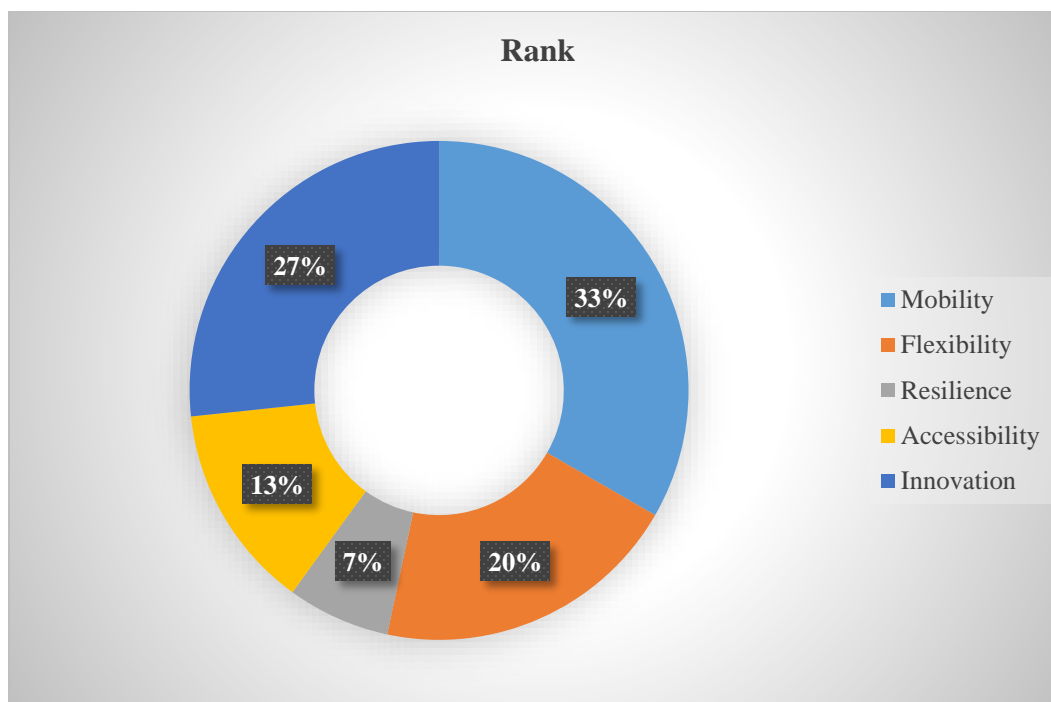


FIGURE 5. Rank

Figure 5 Shows the Ranking of Wireless Communication System. Resilience are got the first rank whereas is the Mobility is having the Lowest rank.

4. CONCLUSION

The escalating count of GSM subscribers underscores its significance in the telecommunication industry, primarily due to its wireless communication capabilities, which have garnered increasing attention over time. Addressing the challenge of overcrowded spectra and limited user capacity, the cellular concept emerged as a significant advancement without requiring substantial technical modifications. In current research, there's a notable emphasis on feedback applications, with a specific resurgence of interest in multiple-input multiple-output (MIMO) systems. This renewed interest underscores the evolving landscape of related systems and technologies. Our objective is to examine past endeavors and offer insights into the trajectory of research in this field. Atmospheric turbulence has a diminishing impact on coupling performance as wavelengths decrease. However, it's noteworthy that optical wireless communication experiments have revealed that the availability of connectivity remains largely unaffected by this turbulence. Additionally, accounting for losses and minimal fading is essential, both of which are closely tied to statistical analysis. Parameters associated with these statistical aspects need to be considered when determining and enhancing base station (PS) location coverage. Integral to this process is the acquisition of path loss information, which plays a vital role in optimizing system performance. The promise of WIET 6G in communication seems to have fallen short. WIET Wireless Communication, touted as an innovative technology, operates in the same realm as traditional systems, utilizing waves for transmission. While it offers the potential for wireless electricity during communications and enables the transmission and charging of smartphones through sensors, WIET's ability to extend the battery life of wireless systems is particularly promising. The Weighted Sum Method (WSM), although a specific approach within Multiple Criteria Decision Analysis (MCDA), can be adapted to various other MCDA methods. In this study, we apply the MCDA approach known as Sopo10 to evaluate and test its effectiveness. Ten criteria are utilized to assess seven different alternatives, which are ranked based on their performance in a water resource study drawn from existing literature. Our observations indicate that WSM is consistently present in larger diameters, albeit not necessarily in the widest diameter of aneurysms. Predictions regarding WSM behavior in 2D-DSA (2-Dimensional Digital Subtraction Angiography) have been somewhat accurate. This is particularly vital in decisions such as constructing a nuclear power plant, where considerations encompass not only whether to proceed with construction

and its location, but also the multitude of complex factors and their far-reaching implications involving various stakeholders. The Weighted Sum Method (WSM) emerges as a favored approach for decision-making in such scenarios, recognized for its effectiveness and widespread adoption.

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