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Multi-Criteria Decision-Making Analysis of Information and Communication Technology Using VIKOR

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Abstract. *The utilization of Information and Communication Technology (ICT) has greatly enhanced various sectors in modern societies. With the rapid advancement and widespread adoption of ICT across different fields, it now plays a significant role in both economic and social development. Recognizing the positive and negative effects of ICT, governments continually strive to propose improved policies and recommendations for enhancing their ICT infrastructure. However, the formulation of effective policies relies on a thorough understanding of past and present policies in order to develop better proposals. To assess ICT development and its impact on society, an integrated social and economic indicators MCDM (Multi-Criteria Decision Making) approach is employed. This approach involves comparing six key indicators: ICT employment, ICT goods exports, ICT investment, ICT value addition, and Internet access. By evaluating the performance of these indicators, a comparison can be made among the G7 countries. Notably, countries like Italy and Canada demonstrate relatively weaker performance in terms of ICT development.*

Keywords: *Behavior preference, Performance abilities, Identity features, GRA*

1. INTRODUCTION

Since the mid-80s, the term "Information and Communication Technologies" (ICT) has been used to describe various technologies used in telecommunications and transportation industries. Over the past decade, there has been significant progress in the development of these technologies, ranging from research prototypes to commercially available products and applications. In the transport sector alone, the development of such technologies has cost Africa, the world's poorest continent, approximately US$60 billion in 2010. For instance, individuals in Africa who own mobile phones spend a substantial portion of their monthly income on phone-related expenses, sometimes sacrificing essential needs like education, food, and clothing. Despite being home to many ICT multinationals, Africa experiences a flow of ICT development and investment funds from north to south. Organizations like the World Bank Group invest a significant amount of money, such as US$800 million annually in certain ICT-related loans and guarantees and US$11.5 billion annually in projects with significant ICT components. Moreover, the private sector invests around US$10 billion per year in mobile telephony in Africa. The advent of ICT has brought about substantial changes in our world. With increased connectivity and access to financial markets, media, and knowledge sharing, billions of people around the globe now have access to the Internet, facilitating information browsing and sharing regardless of geographic location. This shift has transformed the way information is disseminated, replacing linear forms of information sharing with circular forms. Throughout the text, the article discusses the roles of governments and civil society in promoting increased social access and use of ICTs. However, it highlights the uneven distribution of skills and infrastructure required to access and utilize ICTs across different countries. In education, the integration of ICTs is a significant concern for educators worldwide. These technologies include communication systems like email, discussion boards, and synchronous chat, as well as writing and assessment tools and integrated learning environments such as Blackboard and WebTV. In modern mass democracies, political parties play a crucial role in communication and representation, serving as the medium through which citizens are represented.

VIKOR METHOD

The VIKOR method was originally developed as a multi-criteria optimization technique for complex systems. It aims to provide a compromise ranking list and solution by utilizing predefined weights. This approach is particularly useful in situations where conflicting criteria and different units of measurement are present, as it allows for a resolution of conflicts by considering a solution closer to the ideal. The method was initially created by Seraphim Obryković to address decision-making problems involving conflicting criteria. The VIKOR method incorporates the work functions of L1 and L∞, which introduce the Co* function from the TOPSIS method. It also considers latency information and is based on the LP metric of the compromise programming method. When making decisions, the VIKOR approach takes into account two factors: criteria and maximum group usage. This makes it suitable for addressing multiple response problems by distinguishing between correspondence losses associated with different responses. In the context of simultaneous test runs, some existing methods fail to consider the variations in quality losses associated with different responses, leading to inconsistent quality and potential customer dissatisfaction. To overcome this issue, a systematic multi-response optimization procedure is proposed. The VIKOR method is applied in MCDM (Multi-Criteria Decision Making) to enhance the resolution of situations involving multiple responses. The suggested approach involves calculating optimal and negative-optimal solutions for each test, evaluating the quality loss and weight of each response, and determining the affected applications and actions. By applying the VIKOR index to each test run and calculating the upset from the measurements, engineers can utilize the developed VIKOR index to find the best parameter setting.

TABLE 1. Evaluation parameter.

Access to the computer from home	C1
ICT employment	C2
ICT goods exports	C3
ICT investment	C4
ICT value added	C5

Table 1; Evaluation parameter Access to computer from home, ICT employment, Export of ICT goods, ICT investment, ICT value added, C1, C2, C3, C4, C5best values negative factors low value data set and positive factors high value data set. Bad values are positive factors at a low value for a data set and negative factors at a high value for a data set.

TABLE 2. Information and Communication Technology

Alternatives	C1	C2	C3	C4	C5
Canada	85.6	2.6	10,249	5.1	83.9
France	84.12	3.33	22,606	5.1	90.17
Germany	92.86	3.94	61,850	5.13	94.82
Italy	72.5	3.15	9339	4.94	95.84
Japan	74	4.73	72,781	8.07	67.1
UK	91.66	4.26	20,080	7.36	85.17
USA	72.03	3.79	1,38,651	7.1	77.97
Best	92.86	4.73	138651	8.07	95.84
worst	72.03	2.6	9339	4.94	67.1

Table 2. Canada, France, Germany, Italy, Japan, UK, USA show alternatives. Best value C1 has Germany 92.86, worst value C1 has 72.5, best value C2 Japan, worst value C2 Canada 2.6. Best value is C3 America 1, 38,651, worst value is C4 Italy 9339. Best value is C4 Japan 8.07; worst value is C4 Italy 4.94. Excellent value

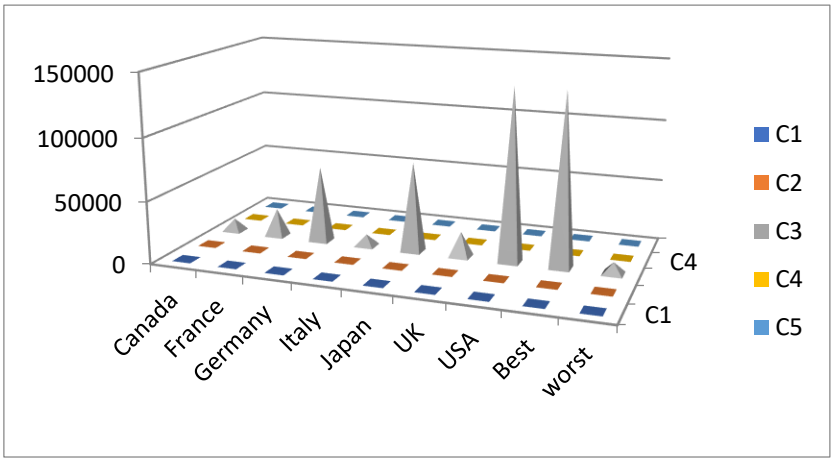

FIGURE 1. Information and Communication Technology

Figure 1. Canada, France, Germany, Italy, Japan, UK, USA show alternatives. Best value C1 has Germany 92.86, worst value C1 has 72.5, best value C2 Japan, worst value C2 Canada 2.6. Best value is C3 America 1, 38,651, worst value is C4 Italy 9339. Best value is C4 Japan 8.07; worst value is C4 Italy 4.94. Excellent value.

TABLE 3. Information and Communication Technology in Calculation Sj and Rj

	C1	**C2**	**C3**	**C4**	**C5**	Sj	Rj
Canada	0.087134	0.25	0.248241	0.23722	0.103862	0.926457	0.25
France	0.104897	0.164319	0.224351	0.23722	0.049322	0.780109	0.23722
Germany	0	0.092723	0.14848	0.234824	0.008873	0.4849	0.234824
Italy	0.244359	0.185446	0.25	0.25	0	0.929805	0.25
Japan	0.226356	0	0.127347	0	0.25	0.603703	0.25
UK	0.014402	0.055164	0.229234	0.056709	0.092815	0.448325	0.229234
USA	0.25	0.110329	0	0.077476	0.155445	0.59325	0.25

Table 3 shows the calculation of the Sj and Rj, it is calculated.

TABLE 4. Sj, Rj, Qi and Rank

	Sj	Rj	Qj	Rank
Canada	0.926457	0.25	0.996523	2
France	0.780109	0.23722	0.536837	5
Germany	0.4849	0.234824	0.172578	6
Italy	0.929805	0.25	1	1
Japan	0.603703	0.25	0.661355	3
UK	0.448325	0.229234	0	7
USA	0.59325	0.25	0.650499	4
S+ R+	0.448325	0.229234		
S- R-	0.929805	0.25		

Table 3 shows the calculation of So and Rj, which is the sum of normalization of the table calculated from determining the best and worst value. The Job value is calculated from the sum of the above Qj value calculated from Sj and Rj. The ranking is taken from the Qj value, which is the calculation for Sj and Rj, which is determined from the sum of the normalization of the table and the determination of the best and worst value. According to Table 5, Japan ranks 7th, Germany ranks 6th, France ranks 5th, America ranks 4th, Japan ranks 3rd, Canada ranks 2nd, and Italy ranks 1st.

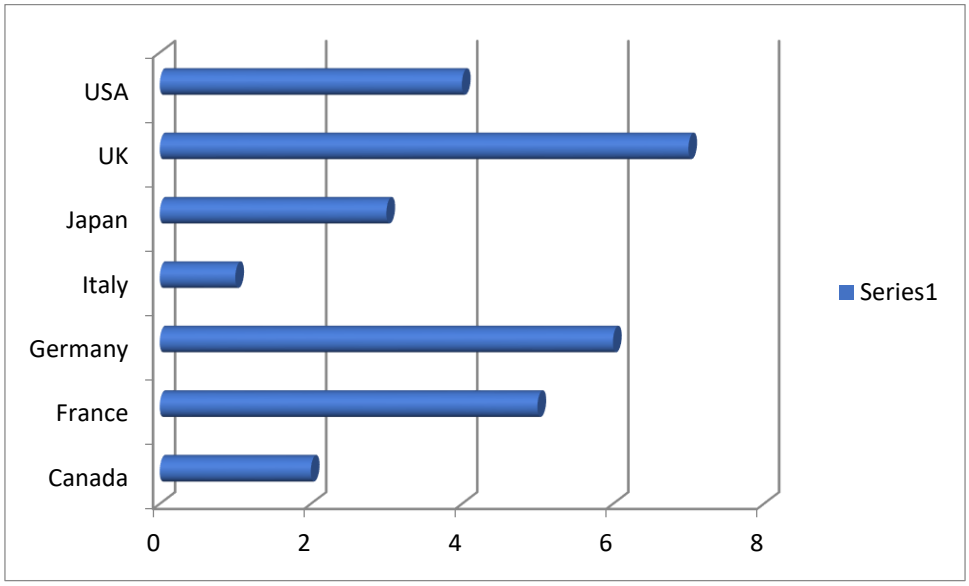

FIGURE 2. Final rank

Figure 2. Information and Communication Technology using Vikor method. Japan ranks 7th, Germany ranks 6th, France ranks 5th, America ranks 4th, Japan ranks 3rd, Canada ranks 2nd, and Italy ranks 1st.

2. CONCLUSION

The term "Information and Communication Technologies (ICT)" was first coined in the mid-1980s to describe the various communication and information technologies utilized in the transportation sector. More recent research on ICT work environments focuses increasingly on analyzing both types of technologies, taking into consideration the global restructuring of ICT value chains and production networks. This research also examines the effects of information and communication technologies (ICTs) on disparities in access to services. Moreover, the VIKOR method has been developed to optimize complex systems with multiple dimensions. It enables the determination of a compromise ranking list and solution by considering the initial weights provided.

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