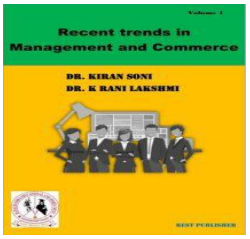
Recent trends in Management and Commerce
Vol: 2(4), 2021
REST Publisher
ISBN: 978-81-936097-6-7
Website: http://restpublisher.com/book-series/rmc/



Using an integrated MCDM technique to assess the development of information and communication technologies in G7 countries

Kuche Rajani Narendra
SSt College of Arts and Commerce, Maharashtra, India.
Email: rajanikuche@sstcollege.edu.in

Abstract

There is information and communication technology greatly helped various aspects of modern civilizations (ICT). Due to its rapid development and pervasive use across many industries, ICT in today's social and economic development makes a significant impact. Governments are continuously attempting to provide improved regulations and proposals to strengthen their ICT infrastructure, taking into account both the good and negative consequences. The fifth most important requirement for humans is knowledge. For sustainable development in this article as a measure of the importance of ICTs is estimated. It was investigated whether ICTs were important for sustainable development. It has also been assessed how other ICT components affect knowledge management. But in order to propose better policies, one must have a comprehensive understanding of both past and contemporary practices. In this sense, it is crucial to assess how well each nation is doing in terms of the advancement of information technology. This study uses an integrated MCDM approach to evaluate the development of ICT using social and economic factors. The G7 nations are assessed using actual data from OECD statistics as major industrialized countries to establish a realistic standard. This comparison of G7 country performance takes into account six significant variables, including Internet access, ICT employment, ICT goods export, ICT investment and ICT value addition. Results: The findings show that the United States and Japan are leading nations in ICT development, whereas Italy and Canada do poorly and need to strengthen their IT policies in order to perform better.

Keywords: Information and Communication Technology (ICT), G7 Countries, WPM method

Introduction

In recent decades, Information and Communication Technology (ICT) Society, In the Economy and Environment has significantly impacted [1]. Many knowledge-based elements, such as social development and national economic growth, have an impact on ICT adoption and access. ICT is now a crucial technology used in both national and international initiatives and has permeated every aspect of our life on a global scale. Over the past two decades, ICT and related technologies have drawn more and more attention, introducing ideas like sustainability or sustainable development. Governments use ICT as a major motivator to change the economy, culture, and environment in order to create societies that are more modern and sustainable [1-3]. Given the critical roles that ICT plays in all pillars of government, the adoption of such technologies has emerged as one of the most important concerns for governments seeking to improve their social and economic sustainability. [4,5]. Governments now have a difficult but crucial task: ensuring that every citizen of a nation always has access to ICTs or other comparable technology [6,7]. The basic infrastructure in this respect should be converted into digital and ICT-based settings through increased expenditures made by both individuals and governments in the ICT sector [8]. ICT has proven to be highly effective in addressing a variety of social and economic issues centred on health, retail, energy, manufacturing, and education through these improvements [14]. For instance, Skorupinska and Torrent-Cellens [15] examined factors that affect how management practises, ICT, and economic growth are connected. On linear and non-linear economic growth Effects of ICT,were also studied by Albiman and Chulong [16]. Their research shows a significant connection between ICT and CO2 emissions. Group of Seven (G7), Made up of Canada, France, Germany, Italy, Japan, the United Kingdom and the United States is an intergovernmental political organization, It is the European Union (EU) and Includes "uncounted members". Its members, who are legally organised around the shared ideas of pluralism and representative governance [1] [3], represent the major IMF advanced economies and liberal democracies throughout the world. By 2020, G7 nations will control between 32 and 46 percent of the world's GDP, more than half of its net worth, and 10% of its population (770 million people). [5] Members have strong political, economic, diplomatic, and military relations with one another and are key powers in international affairs. Additionally, during periods of acute digital disruption when nations and governments are confronted with significant difficulties and Social, economic and environmental issues and functions could not find a solution. ICTs have grown to be more crucial and useful tools. Given the effects on social and economic objectives, governments' capacity to create the required ICT infrastructure should be increased [18]. Governments are increasingly focusing on information and knowledge flows as they attempt to establish solid connections between social, environmental, and economic development through ICT. Sustainable development In order to achieve the goals, which were unveiled in 2015 as part of Agenda 2030, ICT is an essential component. Internet of Things, Robots for Green Goals, Smart Grid, Cloud Computing, Climate Change, Carbon Footprint Reduction, Digital Supply Chains, Blockchain and urban transport systems Some of the many important, long-term benefits of ICT are Various industries. In order to increase the

efficiency of many departments and promote economic, social, and environmental growth, policymakers are continually working to create novel ideas to enhance ICT systems and infrastructure. Policy making one of the first ways to promote the process is to The former principle is stronger and to identify the significance of weaknesses is to evaluate the historical performance of a country [19]. In the ICT literature, there aren't many limited methods that have tried to gauge ICT growth. Htun [25] used questionnaires and a qualitative methodology to examine the growth of ICT in several Myanmarn industries. Eight economic criteria were identified by Adeleye and Eboagu (2019) to evaluate the economic impact of ICT development on the economies of African nations. To evaluate actual data from World Bank databases, they employed a dynamics-based generalised moments approach. To determine how the advancement of ICT influences national economic growth, Fernô Andez-Portillo et al. [10] were recommended Organization for Economic Cooperation and Development (OECD) to employ the partial least squares approach. They used actual member state data from the Digital Economy and Social Index to produce trustworthy results. Many economic factors are variables defined as, thus the development of ICT How it affected the GDP The model can be analyzed. The creation of a framework for comparing ICT development across nations is one of the essential criteria for comprehending the behavior and state of ICT development. However, comparing the success of ICT development to that of other nations is a challenging and multifaceted issue. ICT development is evaluated using a variety of social and economic indicators as well as other options. In this situation, Multi-criteria decision-making (MCDM) is reliable for comparison and can be used effectively and rank the performance of different nations [27–29]. Using MCDM approaches, decision-makers and authorities can evaluate nations using data on significant Social and economic aspects in two different ways. First, MCDM techniques aid in evaluating the relative significance of ICT development-related variables. Additionally, MCDM methods simplify the multi-country evaluation process under various indicators by using easy but trustworthy soft computing that is low in complexity. As far as we are aware, no researches have previously employed the MCDM method to evaluate ICT development in relation to various social and economic indices. In this study, MCDM methodologies are used for the first time to examine ICT progress. The aforementioned facts make it clear that a thorough and efficient evaluation approach is needed to handle for different countries Complexity of comparative assessment of ICT development. This study utilises two freshly created MCDM tools despite the fact that there are other MCDM approaches for both weighting and ranking. In contrast to other MCDM weighting techniques like Analytical Hierarchy Process (AHP) and Hierarchical Weighted Ratio Analysis (SWARA), WPM is founded on a relatively simple framework, and real-life outcomes use a less complicated and more user-friendly framework. In contrast, WPM is sophisticated, To determine its final performance score Based on how well the alternatives perform To allow the decision-making environment to consider various factors, Application based using functions. Additionally, this work incorporates WPM One of the first studies to demonstrate their efficacy and accuracy in addressing complex problem-solving issues in decision-making, assessment, and evaluation. of the recommended technique and to demonstrate compatibility About real-life examples To know more, the Current paper is for G7 countries and presents a remarkable case study (Table 1). For rapid adoption of ICTs and computing In significant part due to the availability of real-world data, the G7 countries were chosen as the study's benchmark.

Material and Methods

Based on the facts provided above, the first contribution of this study focuses on applying the MCDM approach to evaluate ICT progress. The identification of the key metrics for gauging ICT progress in the context of social and economic factors is the second contribution of this study. The creation of an integrated MCDM strategy employing WPM methodologies is the third contribution of this study. Finally, this study incorporates actual data from OECD statistics, unlike qualitative estimations with MCDM techniques. The suggested approach uses WPM to determine the ideal weighting coefficient of the indicators. The WPM model is then used to estimate ICT development using actual data from the OECD dataset. Using the WPM technique, countries are ranked according to how well they perform against predetermined indicators. The following contributions are made by the suggested decision-making model overall: • Outlining a strong integrated MCDM strategy that makes use of WPM methodologies, • Based on social and economic variables Using real-world case studies to assess ICT development, • Based on the results of this study Assessment of ICT Development in G7 Countries, the G7 countries may offer fresh ideas and approaches for developing ICT tools and services in a variety of fields to advance their goals and objectives. For a number of other nations, the suggested technique and determined indicators can serve as important case studies. Computer access at home (C1) Proportion of all households with at least one computer. Employment in ICT (C2) The proportion of persons employed in business-related industries. ICT goods exported are worth (C3) USD million and are utilised for ICT-related tasks. ICT investment (C4) Percentage of a year's output of software, communication devices, and IT hardware. Information and communication technology value addition (C5) The percentage of value added is the difference between the sector's total output and consumption. Access to the internet (C6) as a percentage of all households the proportion of homes with Internet connectivity. In this section, a proposed MCDM technique is offered to assess While taking into account the pillars of economic and social development Based on the development of information technology Performance of seven major economies (G7 countries). First, the development of countries is measured using six main indicators (Table 1). To provide results that are realistic and useful, the OECD databases are coupled with actual data from these nations. The sources listed for each indication in Table 1 are used to acquire the data for this purpose. Then, using WPM approaches, the relative significance of the indicators and the performance of the countries are determined. Due to its considerable influence on the two pillars of sustainable development—economic and social development—ICT development has become a major concern for all nations. The most significant and practical metrics are thus chosen to evaluate ICT progress in Context of economic and social factors. Table 1 identified Indicators are their unit, Lists with definitions and references. ICT development benefits other sectors, as was previously mentioned, by enhancing their efforts to meet goals for economically and socially sustainable development. ICT development will undoubtedly have a favourable impact on social

aspects through indicators like computer access, employment, and internet access, according to the identified indicators. The development of ICT, on the other hand, has a substantial impact on important variables like exports, investments, and value addition that can improve each country's economic viability. A number of SDGs that aim to boost employment rates in various ways are linked to ICT employment. Internet connectivity and computer access are two of the most important requirements for our modern world, ranking as one of the top objectives in the socially sustainable development goals. For online training, schooling, remote employment, and social media activities, Having a computer at home And having internet access is a must. Along with the social advantages, the three key advantages for the economic aspect of ICT development are ICT exports, ICT investment, and ICT value addition. Each of these factors significantly affects the country's ability to maintain economic growth. Additionally, ICT advancements give governments better access to new financial services and markets, which helps their economy expand. Additionally, ICT exports and investment significantly contribute to domestic technical advancement and global ICT access, which are important objectives of infrastructure, innovation, and business (SDG9). An strategy to issue solving that is used to solve problems chosen from a constrained number of possibilities is known as multi-attribute decision making (MCDM). A Decision Science Letters 2 (2013) 225 by V. Jain and T. Raj The MCDM approach describes how to specify the data that must be analysed in order to make a decision. The weighted product method (WPM), a decision-making tool, is paired with the Analytical Hierarchy Process to better utilise the information at hand (AHP). The goal of using AHP is to offer attribute weights, and the WPM approach uses these weights to rank flexibility in FMS. Additionally, the method converts qualitative attributes into quantitative attributes using fuzzy logic. On fuzzy MCDM, Rao (2007) has accumulated material. Fuzzy set theory was originally utilised to address decision-making issues by Bellman and Jadeh in 1970. The weighted product method is one approach to decision-making using multiple attributes (WPM). Below is a list of the steps for utilising WPM [13]. Step 1 For the decision problem Discovers the properties and options. A value, quantity, or quality, will be assigned to each selected feature. The identified alternatives will be evaluated using the presented methodology. For selected alternatives, The values of the selected attributes are the decision maker's estimates or determined using the information at hand. Step 2: Normalize the provided data based on the decision matrix's beneficiary and non-beneficiary features. Let mij represent the attribute's value. • Normalized values can be determined using (mij)K/(mij)L if the beneficiary is the attribute. The Kth alternative is represented by (mij)K in this case, while the Lth alternative, of all alternatives has the highest attribute value, is represented by (mij)L. And among all the possible values for the same property, (mij)K/(mij)L must be determined. • As an attribute beneficiary If not, Normalized values can be determined by (mij)L/(mij)K, taking into account the lowest attribute value. The ratio (mij)L/(mij)K must be determined between all possible values for the same property. Step 3 uses the AHP approach to weight Attributes based on relative importance matrix. Step 4 As instructed in Eq Multiply the dynamic values in the array and power the normalised data with the appropriate weight of the attribute (1). where wj is the attribute's weight

$$P_i = \prod_{j=1}^{M} \left[(m_{ij})_{normal} \right]_j^{w} . \quad \text{---------- (1)}$$

Step 5: Sort the options according to their scores or values.

Results and Discussions

The **Table 1** Evaluation parameters

Access to the computer from home	C1
ICT employment	C2
ICT goods exports	C3
ICT investment	C4
ICT value added	C5
Internet access	C6

Table 1 showing in evaluation parameters. Computer access from home (C1), ICT employment (C2), ICT goods export (C3), ICT investment (C4), ICT value addition (C5), and Internet access (C6).

Table 2 data set

Alternatives	C1	**C2**	**C3**	**C4**	**C5**	**C6**
Canada	85.6	2.6	10,249	5.1	83.9	17.01

France	84.12	3.33	22,606	5.1	90.17	16.33
Germany	92.86	3.94	61,850	5.13	94.82	12.69
Italy	72.5	3.15	9339	4.94	95.84	11.02
Japan	74	4.73	72,781	8.07	67.1	13.53
UK	91.66	4.26	20,080	7.36	85.17	23.76
USA	72.03	3.79	1,38,651	7.1	77.97	32.13

Table 1 shows the data set for C1, C2, C3, C4, C5 and C6 in Canada, France, Germany, Italy, Japan, UK and USA.

Table 3 Performance value

Alternatives	C1	**C2**	**C3**	**C4**	**C5**	**C6**
Canada	0.9218	0.5497	0.0739	0.6320	0.8754	0.6479
France	0.9059	0.7040	0.1630	0.6320	0.9408	0.6748
Germany	1.0000	0.8330	0.4461	0.6357	0.9894	0.8684
Italy	0.7807	0.6660	0.0674	0.6121	1.0000	1.0000
Japan	0.7969	1.0000	0.5249	1.0000	0.7001	0.8145
UK	0.9871	0.9006	0.1448	0.9120	0.8887	0.4638
USA	0.7757	0.8013	1.0000	0.8798	0.8135	0.3430

Table 2 shows the Performance value data that The Normalized data is calculated from the data set value is divided by the sum of the column value. Figure 1 shows normalized data for variables C1, C2, C3, C4, C5 and C6 from Canada, France, Germany, Italy, Japan, UK and USA.

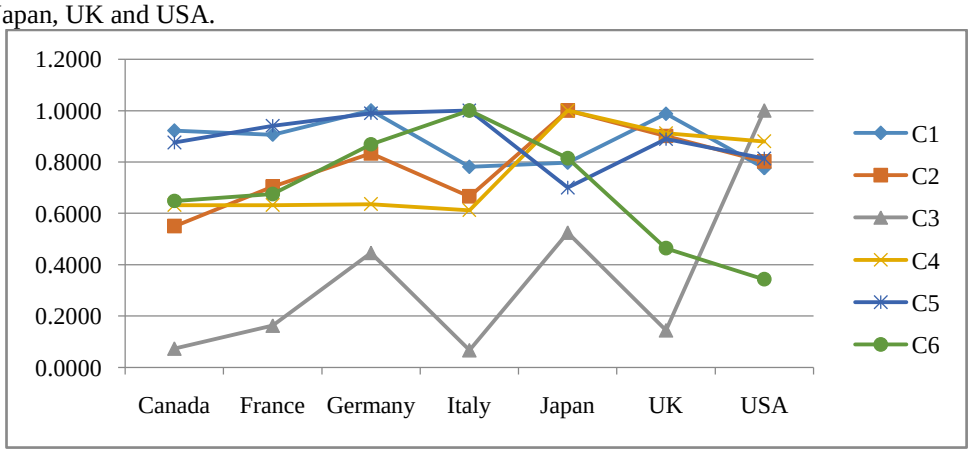


FIGURE 1 Performance value

Figure 1 shows the Performance value data that The Normalized data is calculated from the data set value is divided by the sum of the column value. This is a normal data set of C1, C2, C3, C4, C5 and C6 found in USA, France, Germany, Italy, Japan, UK and Canada.

Table 4 Weight aged

Alternatives	C1	**C2**	**C3**	**C4**	**C5**	**C6**
Canada	0.25	0.25	0.25	0.25	0.25	0.25
France	0.25	0.25	0.25	0.25	0.25	0.25
Germany	0.25	0.25	0.25	0.25	0.25	0.25
Italy	0.25	0.25	0.25	0.25	0.25	0.25
Japan	0.25	0.25	0.25	0.25	0.25	0.25
UK	0.25	0.25	0.25	0.25	0.25	0.25
USA	0.25	0.25	0.25	0.25	0.25	0.25

Table 3 shows the weight of the data set the weight is equal for all the value in the set of data in the table 1. The weight is multiplied with the previous table to get the next value.

Table 5 Normalized decision matrix with weights

Alternatives	C1	**C2**	**C3**	**C4**	**C5**	**C6**
Canada	0.97985	0.86105	0.52142	0.89161	0.96728	0.89716
France	0.97559	0.91600	0.63544	0.89161	0.98487	0.90636
Germany	1.00000	0.95534	0.81725	0.89292	0.99733	0.96534
Italy	0.94000	0.90336	0.50944	0.88453	1.00000	1.00000
Japan	0.94482	1.00000	0.85118	1.00000	0.91473	0.94999
UK	0.99675	0.97418	0.61689	0.97724	0.97092	0.82525
USA	0.93847	0.94612	1.00000	0.96849	0.94972	0.76528

The weighted normalisation choice matrix, shown in Table 4, is created by multiplying the performance value and weight from Tables 2 and 3.

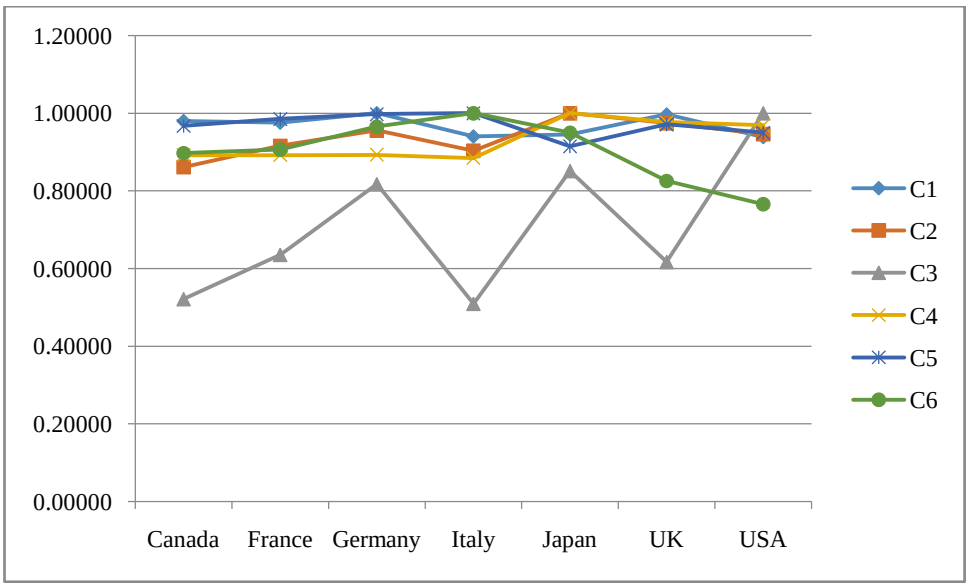


FIGURE 2 Weighted normalized result matrix

C1, C2, C3, C4, C5 and C6 are represented in Figure 3 by Canada, France, Germany, Italy, Japan, UK and USA.

Table 6 Preference Score

	Preference Score
Canada	0.34039
France	0.45195
Germany	0.67118
Italy	0.38265
Japan	0.69886
UK	0.46903
USA	0.62499

By summing the weighted normalised decision matrix, Table 5 displays the Preference Score for the data set. This score is derived from a weighted normalized result matrix.

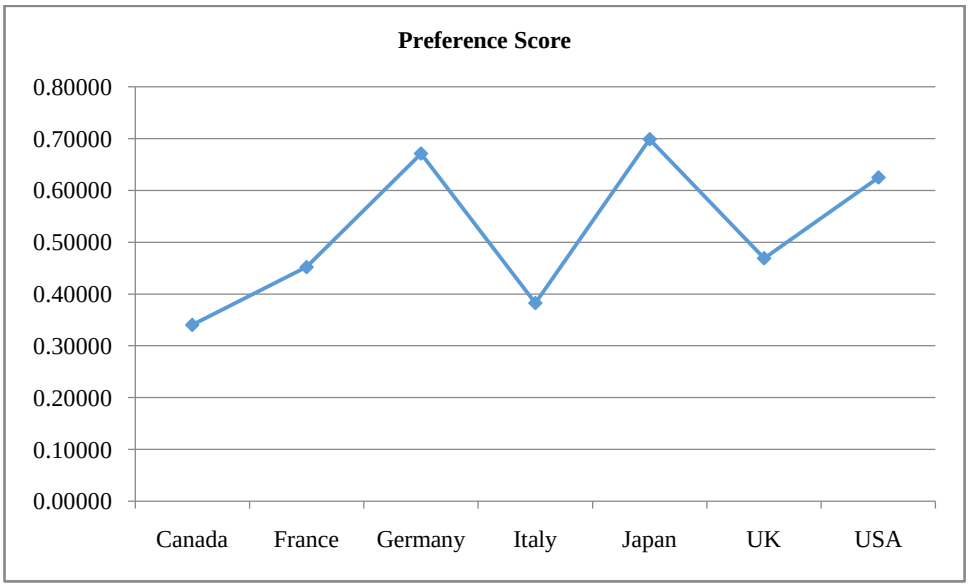


FIGURE 3 Preference Score

By computing the sum of the weighted normalized decision matrix, Figure 5 displays the positive matrix of the data set that was obtained from the weighted normalised decision matrix.

Table 7 Rank

	Rank
Canada	7
France	5
Germany	2
Italy	6
Japan	1
UK	4
USA	3

The United States is placed third, France is fifth, Germany is second, Italy is sixth, Japan is first, the United Kingdom is fourth, and Canada is seventh in Table 8.

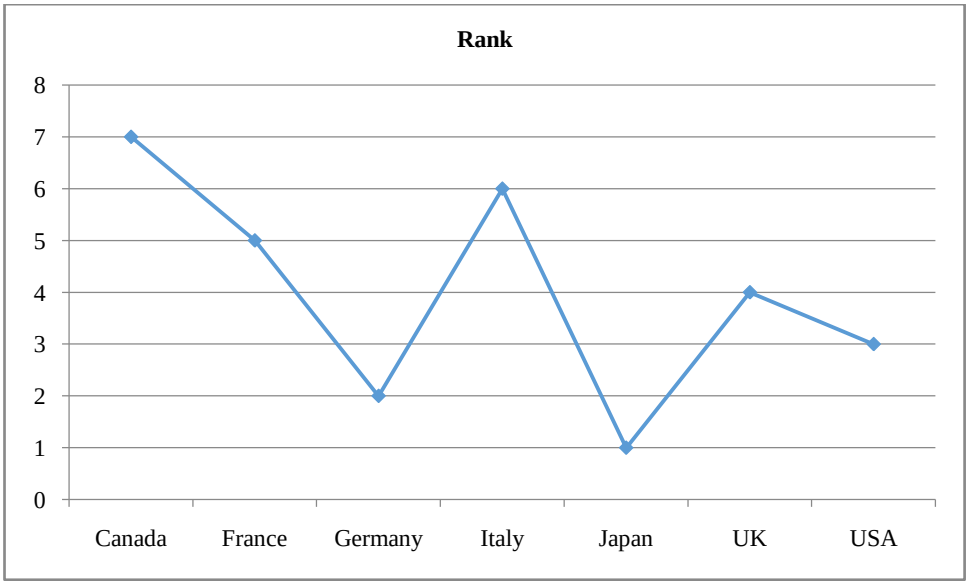


FIGURE 4 for Rank

In Figure 4, Canada is ranked seventh, followed by France on fifth, Germany on second, Italy on sixth, Japan on first, The United Kingdom is fourth and the United States is third.

Conclusion

For the first time, this study benchmarks ICT growth for the G7 nations within Environment of social and economic development. For this purpose, a brand-new integrated MCDM strategy based on WPM methods is developed. In order to undertake a thorough comparative benchmarking analysis, six critical elements for both social and economic gains are identified. OECD open source datasets are used in the data collection process to examine a real-world case study. The findings reveal that Japan, Germany, United Kingdom and United States When compared to other G7 members from their ICT development infrastructures High profit countries. Important findings are also revealed by the results for nations like France, Italy, and Canada, which are ranked worst. To get the most out of ICT development, these nations should analyse and improve their prior policies. Using real data To assess ICT progress Integrated MCDM-based In developing an evaluation model This work is primary. However, this study has some limitations, they account for further research should be taken. To make a thorough assessment of ICT progress across many countries, it would be necessary to discover more indicators connected to economic and social issues. On the other hand, ICT development would undoubtedly have a noticeable impact on other components of sustainable development, such as political and environmental pillars. Therefore, a thorough benchmarking review would undoubtedly also contain political and environmental aspect indicators. Another option is to change the proposed approach for both the weight calculation process and the ranking component. One two or Incorporating more MCTM techniques, of indicators using both objective and subjective weights Get the right weight. In addition, such as gray numbers using uncertainty models create ranking functions, fuzzy logic, and neutrosophic sets in scenarios without access to real data to provide decision-makers more leeway to express their doubtful judgements. Among the identified indicators On Global Performance, if the data are taken into account, this challenge can be seen as a big data estimation problem. Big data techniques such as clustering and classification algorithms, to solve the problem with vast data May be added to the instructions provided.

Reference

1. Torkayesh, Ali Ebadi, and Sajjad Ebadi Torkayesh. "Evaluation of information and communication technology development in G7 countries: An integrated MCDM approach." *Technology in Society* 66 (2021): 101670.
2. Schware, Robert. "Information and communications technology (ICT) agencies: functions, structures, and best operational practices." *info* (2003).
3. Akarowhe, K. "Information communication technology (ICT) in the educational system of the third world countries as a pivotal to meet global best practice in teaching and development." *American Journal of Computer Science and Information Technology* 5, no. 2 (2017).
4. Saleem, A., T. S. Z. Shabana, and M. Sadik Batcha. "Application and uses of Information Communication Technology (ICT) in academic libraries: an overview." *International Journal of Library Science* 2, no. 3 (2013): 49-52.
5. Mohamed, Mirghani, Arthur Murray, and Mona Mohamed. "The role of information and communication technology (ICT) in mobilization of sustainable development knowledge: a quantitative evaluation." *Journal of knowledge management* (2010).
6. Nath, Hiranya K., and Lirong Liu. "Information and communications technology (ICT) and services trade." *Information Economics and Policy* 41 (2017): 81-87.
7. Gnambs, Timo. "The development of gender differences in information and communication technology (ICT) literacy in middle adolescence." *Computers in Human Behavior* 114 (2021): 106533.
8. While, Alison, and Guy Dewsbury. "Nursing and information and communication technology (ICT): a discussion of trends and future directions." *International journal of nursing studies* 48, no. 10 (2011): 1302-1310.
9. Sarkar, Sukanta. "The role of information and communication technology (ICT) in higher education for the 21st century." *Science* 1, no. 1 (2012): 30-41.
10. Audi, Marc, and Amjad Ali. "The advancement in Information and Communication Technologies (ICT) and economic development: a panel analysis." (2019).
11. Khizbullin, Faiz F., Tatyana G. Sologub, Svetlana V. Bulganina, Tatiana E. Lebedeva, Vladimir S. Novikov, and Victoria V. Prokhorova. "The direction of transformation of information and communication technology (ict) at the present stage of development into an electronic and information society." *Pertanika Journal of Social Sciences and Humanities* 25, no. S (2017): 45.
12. Tella, Adeyinka, and Emmanuel Olusola Adu. "Information communication technology (ICT) and curriculum development: the challenges for education for sustainable development." *Indian Journal of Science and Technology* 2, no. 3 (2009): 55-59.
13. Al-Rahmi, Waleed Mugahed, Ahmed Ibrahim Alzahrani, Noraffandy Yahaya, Nasser Alalwan, and Yusri Bin Kamin. "Digital communication: Information and communication technology (ICT) usage for education sustainability." *Sustainability* 12, no. 12 (2020): 5052.
14. Kundishora, S. M. "The role of information and communication technology ict) in enhancing local economic development and poverty reduction." *Harare: Zimbabwe Academic and Research Network* (2010).
15. Singh, Virendra, Shweta Sankhwar, and Dhirendra Pandey. "The role of information communication technology (ICT) in agriculture." *Global Journal of Multidisciplinary Studies* 3, no. 4 (2015): 2-10.
16. Brady, Mairead, Martin R. Fellenz, and Richard Brookes. "Researching the role of information and communications technology (ICT) in contemporary marketing practices." *Journal of Business & Industrial Marketing* (2008).

17. Maumbe, Blessing M., and Julius Juma Okello. "Uses of information and communication technology (ICT) in agriculture and rural development in sub-Saharan Africa: Experiences from South Africa and Kenya." In *Technology, Sustainability, and Rural Development in Africa*, pp. 113-134. IGI Global, 2013.
18. Abubakar, Bappah Magaji. "Availability and use of Information and Communication Technology (ICT) in six Nigerian University library schools." *Library philosophy and practice* (2010).
19. Iskandarani, Mahmoud Z. "Effect of information and communication technologies (ICT) on non-industrial countries-digital divide model." *Journal of Computer Science* 4, no. 4 (2008): 315.
20. Kaino, Luckson Muganyizi. "Information and Communication Technology (ICT) developments, utilization and challenges in ICMI history." In *Symposium on the Occasion of the 100th Anniversary of ICMI. Rome*, pp. 5-8. 2008.
21. Jain, Vineet, and Tilak Raj. "Evaluation of flexibility in FMS using SAW and WPM." *Decision Science Letters* 2, no. 4 (2013): 223-230.
22. Rao, Ch Maheswara, and K. Venkatasubbaiah. "Application of WSM, WPM and TOPSIS Methods for the Optimization of Multiple Responses." *International journal of hybrid information technology* 9, no. 10 (2016): 59-72.
23. Savitha, K., and C. Chandrasekar. "Vertical Handover decision schemes using SAW and WPM for Network selection in Heterogeneous Wireless Networks." *arXiv preprint arXiv:1109.4490* (2011).
24. Balusa, Bhanu Chander, and Jayanthu Singam. "Underground mining method selection using WPM and PROMETHEE." *Journal of the Institution of Engineers (India): Series D* 99, no. 1 (2018): 165-171.
25. Myskowiak, J-B., G. Masselot, L. Fanton, and Y. Schuliar. "Freshwater invertebrates and Wagner's parsimony method (WPM): Tools for the submersion time estimation of a cadaver found in a natural aquatic environment. Description of a sampling protocol." *La revue de médecine légale* 1, no. 2 (2010): 47-60.
26. Chakraborty, Shankar, Edmundas Kazimieras Zavadskas, and Jurgita Antucheviciene. "Applications of WASPAS method as a multi-criteria decision-making tool." *Economic Computation and Economic Cybernetics Studies and Research* 49, no. 1 (2015): 5-22.
27. Platonov, Alexander, Prasad S. Thenkabail, Chandrashekhar M. Biradar, Xueliang Cai, Muralikrishna Gumma, Venkateswarlu Dheeravath, Yafit Cohen et al. "Water productivity mapping (WPM) using Landsat ETM+ data for the irrigated croplands of the Syrdarya River basin in Central Asia." *Sensors* 8, no. 12 (2008): 8156-8180.
28. Chourabi, Zouhour, Faouzi Khedher, Amel Babay, and Morched Cheikhrouhou. "Multi-criteria decision making in workforce choice using AHP, WSM and WPM." *The Journal of The Textile Institute* 110, no. 7 (2019): 1092-1101.
29. Zavadskas, Edmundas Kazimieras, Zenonas Turskis, Jurgita Antucheviciene, and Algimantas Zakarevicius. "Optimization of weighted aggregated sum product assessment." *Elektronika ir elektrotechnika* 122, no. 6 (2012): 3-6.
30. Zavadskas, Edmundas Kazimieras, Jurgita Antucheviciene, Jonas Šaparauskas, and Zenonas Turskis. "Multi-criteria assessment of facades' alternatives: peculiarities of ranking methodology." *Procedia Engineering* 57 (2013): 107-112.

