

## **Analysis of challenges of digital service enabled by big data analytics technologies using a new integrated multiple-criteria decision-making (MCDM) method**

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### **Abstract**

*The digitalization of services and products is an approach adopted by modern companies to produce value. The key to success is knowing what your customers are saying about your company by compiling data in many aspects and reviewing the digital content collected from digitally enabled services. On the other hand, text review is a highly subjective task. The raw data has complex features, making analyzing the data on digital services a very complex and intriguing problem. This study collects the main challenges of digitally enabled services to offer an inclusive framework and describes the framework's potential in dealing with application-specific challenges. This study aims to suggest a data-driven decision-making model using the "intuitionistic fuzzy sets (IFSs)", "method based on the removal effects of criteria (MERECE)", "rank sum (RS), and the "multi-attribute multi-objective optimization with ratio analysis (MULTIMOORA)" approaches. The IF-MERECE-RS tool computes the weights of the digital service challenges that big data analytics technologies enable and the IF-MULTIMOORA method prioritizes the technologies to assess the challenges. Then, an integrated decision-making framework is developed to investigate these challenges' subjective and objective weights using expert opinion. Using big data analytics, the proposed model can assess the preferences of technologies over different challenges.*

**Keywords:** *Digital service; big data analytics; social media; digital technologies; data-driven decision-making.*

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## **1. Introduction**

In recent years, every facet of business and organizational activities has been digitized, which has resulted in the creation of huge datasets analysis purposes. Through big data and analytical procedures, these datasets can provide insights for offering sustainable value to enhance business performance and competitive benefits (Wamba et al., 2017). The recent literature is enriched with "big data analytics (BDA)" because of the massive acceptance of the Internet as well as the emergence of Web 2.0 technologies. Both academicians and practitioners are greatly interested in BDA due to the increased demand for understanding the trends in massive datasets (Ghani et al., 2019). More and more data are being compiled in many domains, such as supply chains, health care, and finance, due to the new developments in cyber-physical systems, sensing networks, and IoT. Though, the data gathered this way suffer from an inherent uncertainty because of incompleteness, noise, and inconsistency. To effectively analyze such data, there is a need for progressive analytical approaches to efficiently review and/or predict future courses of action with high accuracy and innovative decision-making policies. With a great and fast increase in the amount and variety of data and, consequently, the increase of its uncertainty degree, the outcomes of analyses and also the decisions made accordingly lack confidence. It is not easy to conduct big data analyses with the use of conventional data analytics (Tsai et al., 2015). This failure is due to the fact that the conventional methods may lose effectiveness because of the five V's characteristics of big data, i.e., "high volume, low veracity, high velocity, great variety, and high value" (Chen et al., 2014; Ma et al., 2014).

Big data also has other features, e.g., viability, validity, viscosity, and variability (Djafri & Gafour, 2022; Xin et al., 2021). A number of "artificial intelligence (AI)"-based techniques, for instance, data mining, "natural language processing (NLP)", "machine learning (ML)", and "computational intelligence (CI)", have been developed to offer BDA solutions due to their higher speed, accuracy, and precision when applied to massive data (Chen et al., 2014). These techniques typically aim to discover the information, indefinite correlations, and hidden patterns in massive datasets (Tsai et al., 2015).

Digital service has a leading role in our daily lives, leading to massive data generation. The big data associated with digital service finds the most progressive applications in the socio-economic domains. Many studies have been carried out on the challenges that inherently exist in specific applications of digital service or big data separately; however, the literature lacks research into digital service enabled by big data analytics. To bridge this gap, the current study discusses the latest digital service enabled challenges by big data analytics applications used in the industry 4.0 era. In addition, this study presents an inclusive framework of digital service enabled by big data analytics technologies and describes its potential to deal with application-specific challenges. This study aims to suggest a data-driven decision-making model for the evaluation of the multi-attribute decision analysis (MADA) problem. In this

line, the proposed method will discuss computing the weights of the digital service-enabled challenges by big data analytics technologies. Then, the proposed method prioritizes the technologies to assess the digital service challenges that big data analytics technologies enable. In this regard, this study aims to suggest an integrated framework based on the removal effects of criteria (MERECS)”, and the “multi-attribute multi-objective optimization with ratio analysis (MULTIMOORA)” approaches called the “MERECS-MULTIMOORA” for the evaluation of the MADA problem. In this line, the MERECS tool is discussed to compute the weights of challenges of SM in the era of BDA technologies.

## 2. Literature review

### 2.1. Digital service enabled by big data analytics

Big data refers to huge or complicated data sets that typically surpass conventional systems' technical capability in the storage, processing, management, interpretation, and visualization of data (Kaisler et al., 2013). At present, we face an exponentially growing trend in the volume of data, which is expected to reach zettabytes per year in a few years. Scholars and practitioners believe such an overflow of data brings about new opportunities; for that reason, numerous companies are attempting to improve their BDA capacities to understand the hidden values of big data better. Kambatla et al. (2014) comprehensively discussed the trends in BDA, including both software and hardware. Two challenging tasks are collecting and storing data from widely-distributed sources in the storage systems and running a diverse set of computations. Zhong et al. (2016) investigated the currently used big data technologies, including those introduced for storing, processing, and visualizing data. There is still a need to systematically review novel analytical methods, tools, and techniques to discern decisions in different domains (Hagel, 2015).

Big data and progressive techniques of data analytics could be applied to developing analytical and computational models (Iqbal et al., 2020). The literature shows that there is still interest in finding the best ways to develop the infrastructure, which has led to the introduction of different data mining and ML algorithms in various study areas.

Big data is mainly focused on the psychological aspect of predicting the consumers' requirements rather than understanding them. It is essential to investigate how the customers behavior and the things they will buy next after purchasing the goods could be predicted. This will help to understand the consumers' perception regarding the brand, and it will show the way to enhance the quality and effectiveness of target advertising.

A score was developed by Scholz et al. (2018) covering the position effect of digital service such as social media (SM) inside. This score helps to analyze the inside impact on individuals and firms. The results of the study by Goldberg (1990) give the social facilitation inspiration,

participating and socializing inspiration, and information inspiration that pressures the consumers' common attitudes in the direction of SM sites. It had a well-constructed outcome on their attitudes in the direction of marketers social networking sites. In SM posts, there are many potentials that could be used for data mining and analysis. With understanding such potentials, platform providers tend to put a limitation on individuals access to such data. This shift causes new challenges for social scientists and other non-profit scholars seeking to analyze public posts to better understand human interactions and improve human conditions. SM analytics is a research axis that is concentrated on extracting insights from SM-induced data to aid individuals and organizations in making the best decisions about different disciplines of life. There is a need for big data technologies to be applied. For that reason, the current study aims to help researchers working in this field discover the challenges faced with data analysis using big data technologies. A comprehensive review was conducted to collect the challenges and obstacles faced when integrating big data technologies with digitally enabled services, and the result is presented in Figure 1. To the best of our knowledge, this set of challenges is the main contribution of this study. However, we need to look for practical multi-criteria decision-making tools to examine the subjective and objective weights of these challenges. The conventional MCDM methods are proposed to aid decision-makers in making the best decisions in different situations. Though, most decision-making situations necessitate considering the decision experts (DE) experiences and judgment. The use of the Fuzzy sets theory could accomplish this.

### **3. Research method**

Fuzzy sets (FSs) and their generalizations feature can help handle information that suffers from incompleteness and imprecision. However, not all fuzzy multi-criteria decision-making tools can be applied to incomplete and uncertain data, which may appear recurrently in real situations. To effectively address such challenges, a robust formal general framework was developed by Atanassov (1986) as a novel branch of mathematics, termed "intuitionistic fuzzy sets (IFSs)", to treat the problem with uncertainty and ambiguity of information. IFSs define each object with a "membership function (MF)", a "non-membership function (NF)", and an "indeterminacy function (IF)" to reflect the unknown/neutral environment. Later on, an IFS MCDM model was introduced by Mishra et al. (2021) for ranking and assessing suppliers using the "combinative distance-based assessment (CODAS)" tool.

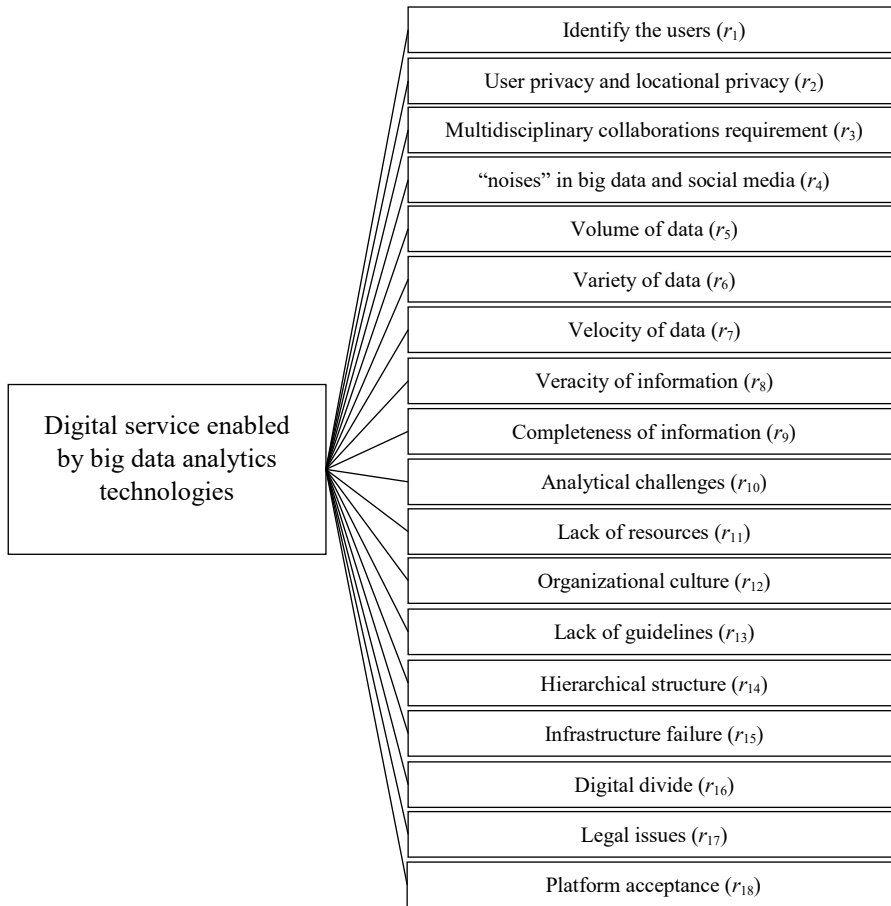


Figure 1: Challenges of digital service enabled by big data analytics technologies

Rani et al. (2021) also proposed the Fermatean fuzzy information-MEREC-additive ratio assessment (ARAS) method to provide a solution to the problem of selecting the best available method for the treatment of food waste. Mishra et al. (2022) developed an integrated MEREC-MULTIMOORA tool for the selection of "low-carbon tourism strategies" in the "single-valued neutrosophic sets (SVNSs)" setting. In this proposed MCDM method, the MEREC is utilized for finding the objective weighting coefficients. The ranking sum (RS) method is employed to find the subjective weighting coefficient.

The RS developed by Stillwell et al. (1981) is used for ranking values of selected criteria with the help of the decision maker's opinions. Later, Hezam et al. (2022) introduced a hybrid MCDM methodology by combining the "MEREC-RS-DNMA" approach with IFSs and applied it to evaluate the "alternative fuel vehicles (AFVs)" problem.

In 2006, the "multi-objective optimization with the ratio analysis (MOORA)" tool by combining the "reference point (RP)" and "ratio system (RS)" was introduced in W. Brauers and Zavadskas (2006) study to treat the MCDM issues. W. K. M. Brauers and Zavadskas (2010) renamed MOORA into "multiattribute multi-objective optimization with the ratio analysis (MULTIMOORA)" by adding "full multiplicative form (FMF)". (W. K. M. Brauers and Zavadskas (2010) validated that the MULTIMOORA has higher efficiency, and better stability with advanced robustness by comparing it with other tools such as the "technique for order of prioritization by similarity to ideal solution (TOPSIS)", the "analytic hierarchy process (AHP)", and the "VIKOR (visekriterijumska optimizacija I kompromisno resenje in Serbian)".

### ***3.1. Proposed data-driven decision-making model***

We are working on a new methodology to propose MEREC-MULTIMOORA, an extended decision-making methodology. MULTIMOORA properly integrates the benefits of various aggregation functions. The final integration function of MULTIMOORA extensively considers the utility values and the alternative ranks; this will cause the final ranking result highly reliable considering the attribute of data collected from digitally enabled services.

### ***3.2. Case study***

There are several challenges for SM in the era of BDA technologies; therefore, this study will implement a survey approach with the current literature review and interviews with experts to identify these challenges. In the first step, we discuss the important challenges for SM in the era of BDA technologies using the current literature review. In the following stage, we will send the identified challenges to different experts to select the most important challenges for SM in the era of the BDA technologies section. A total of 25 analytic data managers from different online learning websites will be invited. In the next stage, we will invite four DEs in the area of SM and BDA to evaluate the identified challenges.

## **4. Conclusion**

The biggest proportion of big data surge is in words, videos, images, or a combination of them. Big data is exponentially growing, and it is expected even to accelerate its growth pace in the future. Only a small amount of digital service-generated data is analyzed effectively; however, business managers believe that these data greatly support making intelligent decisions if correctly analyzed. Several tools are being designed and proposed in the literature for using digital service-produced data to gauge consumers behavior and turn it into actionable information. For the analysis, ranking, and evaluation of the most important challenges that arise in digital service in the BDA technologies era, the current paper proposes an integrated decision-making method to analysis the challenges of different online

learning websites. Big data technology helps organizations to take deeper insights from consumer feedback. Accordingly, a decision-making model will be introduced using the MEREC and the MULTIMOORA tools called the MEREC-MULTIMOORA method to evaluate the main challenges of digital service in the era of BDA technologies in different online learning websites. To rank the main challenges of digital service in the era of BDA technologies online learning websites, the MEREC is applied, and the MULTIMOORA method is used to find the rank of different technologies over different challenges.

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