Resilient and Sustainable Group Decision

Subjects: Others | Management | Business
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Group decision-making should contribute to resilience and sustainability and, particularly, the achievement of the objectives in view of future risks. Further, transparency in and participation in the decision process are needed to limit problems in the implementation phase of the decision. The literature survey here presented suggests some of the key attributes for supporting sustainable and resilient group decisions. To this aim, a focused systematic review was conducted to study the existing group decision-making methods in the literature and how the concepts of sustainability and resilience have been employed.

Keywords: group decision-making ; decision process ; resilience ; multi-criteria ; sustainable decision ; resilient decision ; sustainability

1. Introduction

Resilience is a recent concept which is popular in ecology, social science, technology and engineering. On the other hand, Sustainable decision-making tries to assess the outcomes of a decision against the three pillars of sustainability (environment, social and economic). The core of this study was a systematic review of the literature in order to individuate a set of the main factors that influence the resilience and sustainability of decision-making. the results present the increasing trend of intrest in the group decision on resilience and sustainability of the functions and deliveribles of aproject. the current research reports the subject areas of the performed researches with a focus on resilient and sustainable (R&S) Group Decision Making (GDM), the methods that take into consideration the sustainability issues in GDM and the risks in the GDM process; finally, it identifies the main factors of effective GDM. An organized pattern will be discussed, which gives a new interpretation of existing GDM methods in light of sustainability and resilience, which serve the decision-making when individuals collectively make a choice from the existing alternatives.

2. Resilience and Sustainabity in GDM

Putting the selected articles in chronological order discloses the sharp rise of the importance of the issue and the need for investigating GDM from multidisciplinary perspectives. Figure 1 shows the published articles by year. The first paper published in 2004[1]shows that GDM plays a role in improving the social pillar of sustainability. The subject area of this article is bio-cultural conservation and proposes some approaches that are useful for improving the efficacy of consultative processes within conservation programs. Wilson focused on four main themes, “1) the purpose of the consultative group; 2) the nature and types of group membership; 3) the decision-making procedures within the group, and 4) the impact of location on group decisions”[2]. He maintained that as long as consultation is approached in a philosophically honest way, producing ecological integrity and social justice will be possible. This was a reason behind considering group decision-making as a means of participation, in which the members of the group and the process of decision-making becomes a method to improve social factors of sustainability. Figure 1 depicts a slight increase from 2004 to 2017; however, the steep rise of the number of publications started in 2017 and, after that year, the quantity of publications doubled each year. This sharp increase shows the interest of researchers in GDM considering resilience and sustainability in the last decade.

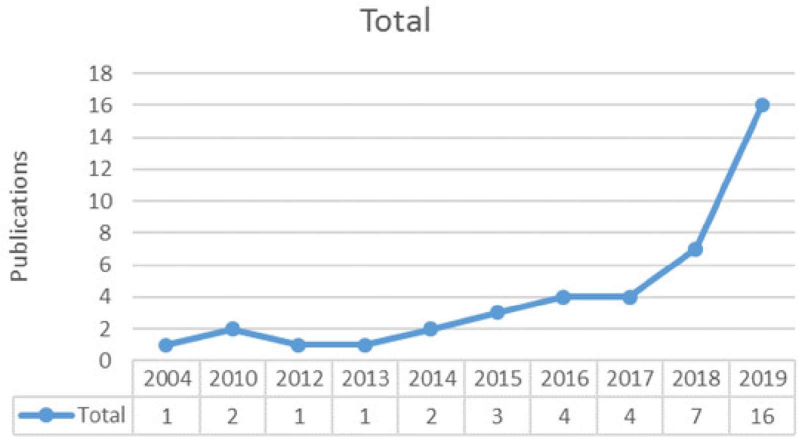

Figure 1. Selected publications in chronological order

In this study, we consider sustainability and resilience as two main categories and then classify the articles regarding the risk management methods and metrics that are associated with the sustainability pillars and resilience.

Table 1 shows that the majority of the published work is associated with environmental issues (20 papers). The values in the last line of Table 1 show that the sustainability pillars and resilience concept have been considered in supply chain, city planning, and disaster management more than in other topics. In city planning, researchers mostly focused on the sustainability of transportation in cities and emergency management including seismic risk mitigation and resilience in coastal cities. Moreover, in 48% of cases, the authors considered both the sustainability pillars and resilience in GDM.

Table 1. Scope of the articles.

Subject Area	Environment	Social	Economic	Resilience	Total
Bio-cultural conservation		1			1
Building material selection	1				1
City planning	3	1	1	2	3
Consensus level in a group			1	1	2
Cost line	2	1	1	1	2
Culture		1		1	1
Development studies			1		1
Disaster management	2	2	1	1	3
E-commerce			2		2
Energy sector	1	1			1
Facility location	2		1		2
Information, data, cybersecurity		1		2	2
Infrastructure			1		1
Land use management		1			1
Organizational resilience				1	1
Partner selection			1	1	1
Resilient strategies	1			2	2
Safety	1		1		1
Satisfaction maximization of group members	1				1
Self-confidence	1			1	1
Settlement resilience	2	2	1	2	2
Supply chain	2	4	3		4

Subject Area	Environment	Social	Economic	Resilience	Total
Water supply and waste management	**1**	**1**			**2**
Grand total	**20**	**16**	**15**	**15**	**38**

3. Methods and Metrics that are Employed in Real Cases

In 2019, Chen claimed that environment, natural resources, health and comfort of inhabitants are important criteria in the selection of building material[3]; he developed a novel hybrid multi-criteria group decision-making model based on Quality Function Deployment (QFD) and ELECTRE III. The business simulation game is another method, employed by Phadoongsitthi et al. in 2017 in GDM, that discloses the effects of national culture on GDM[4]. In this study, the authors remarked the existence of differences in the approach to cooperation among teams from Japan, China, Hong Kong and Thailand.

In 2019, Setiyowati et al. aimed to develop a Group Decision Support System (GDSS) to identify development priorities in six regions[5]. They combined two important factors that usually influence the regional development priorities and used a combination of GDM concepts: MVHAC cluster technique and the item-based cluster hybrid method. In the economic development sector, focused on E-commerce, two processes were introduced in 2019. First, Satisfaction maximization of group negotiation and deviation minimization of system coordination utilized by Yong et al.[6] and second a “novel fuzzy group decision method, which not only integrates QFD and an improved version of technique for Order Preference by Similarity to the Ideal Solution (TOPSIS) but also combines the qualitative analysis and quantitative analysis,” introduced by Liu[7]. However, Chen et al. used satisfaction maximization of group members in a different sector[8]. Looking for environmental benefits and competitive advantages, they proposed a hybrid model for evaluating the sustainable value requirement. The proposal is a combination of the fuzzy set, rough set, decision-making trial and evaluation laboratory and analytical network process methods.

Wu (2016) used traditional ELECTRE-III under an intuitionistic fuzzy environment to an offshore wind power station site selection in the energy sector[9]. Qin et al. proposed TODIM, which handles information in the form of crisp numbers[10]. Two years after TODIM, Tadić et al.[11] conducted the most recent study on the selection of the most appropriate locations by a two-objective genetic algorithm (GA) and they claimed this is the most suitable method for the same routing issues. GA is a fruitful method to find the optimal solution, and Arsovski et al.[12] also used a combination of the fuzzy group decision-making problem and GA. In this case, the authors calculated organizational resilience potential factors (ORPFs) relative importance first and then they used GA to find the near optimal enhancement of ORPFs' values. Arsovski et al. studied the enhancement of organizational resilience towards 120 Small and Medium Enterprises (SMEs). The importance of resilient strategy selection is here crucial.

Besides Arsovski, three other articles used fuzzy multiple criteria decision-making for complex decision systems in strategy selection:

1. Fuzzy analytical hierarchy process (FAHP) with the aim to select the appropriate resilient strategy for seaport operations[13];
2. Triangular and trapezoidal linguistic data and fuzzy multiple criteria decision-making in strategic supplier selection[14];
3. Combination of Intuitionistic Fuzzy Analytic Hierarchy Process (IF-AHP) and Ideal Solution (IF-TOPSIS) in order to partner selection[15].

Another implication of TOPSIS is used for wastewater treatment plan selection by applying an intuitionistic fuzzy set and then ranking various plans[16]. Another more complex method, employed in the decision-making process to balance water supply-demand strategies used a novel three-phase approach[17]. The first phase is data collection; the second phase is problem structuring. They used the SODA method for problem structuring which includes surveying alternatives (supply and demand) and criteria; and then structured a model regarding the results of the survey. The third phase is the decision-making process using PROMETHEE II, integer linear programming and sensitivity analysis.

The Analytical Hierarchy Process (AHP) is another popular method to support GDM. Mostofi Camare and Lane implemented AHP in a comprehensive resilience study[18]. They considered all pillars of sustainability including environmental, economic, social and cultural dimensions, aiming to estimate vulnerability, resilience and adaptive capacity measures associated with adaptation strategies in coastal communities.

Janssen is the only researcher that used an agent-based model in 2010 (ABM) in a population aggregation study[19]. He focused on an ancient settlement to study the long-term vulnerability of small-scale human societies. In this study, ABM was used to evaluate small-group decision-making on movements.

4. Resilience and Sustainabity Risk Assessment in GDM

The project management body of knowledge (PMBOK) defines “risk” as an uncertain event which could have a positive or negative effect on the objectives[20]. The importance of risk management in sustainability studies has been particularly highlighted in decisions associated with the transition to sustainability, where the effects of accepting some risks in this transition have been investigated[21]. Martins and colleagues used MCDM in a group decision model in 2012[22]. They presented a model based on a geographic information system (GIS) to evaluate the social vulnerability to seismic risk. In their investigation, they recommend the integration of social vulnerability indexes into seismic risk mitigation policies. This integration of social indexes into risk mitigation policies was a novel approach.

Two papers investigated GDM in cost line area resilience. Levy in 2010 focused on cost line resilience and used Drama Theory II (DT II)[23]. Levy upheld the important characteristics of this method. He used this method because “DT II emphasizes that decision-makers engage in a rational-emotional process”. Chen et al. introduced the new concept of group decision support systems as an emergency management support tool[24]. Licuanan et al. studied two issues in coastlines: Climate change and human activities[25]. The main objective was to identify the consequences of these issues such as marine flooding and erosion, besides identifying measures to minimize the impacts of these two issues on coastline areas. The tool introduced by this group in 2015 suggests engaging more stakeholders in participatory planning and group decision-making as this provides opportunities for learning about the issues. There are three articles on other subjects associated with disaster management[26][27][28].

The subjects are evacuation decision-making in wildfire, a risk-based emergency group decision method for haze disaster and flood adaption. Nguyen et al. in 2019 studied individual and group evacuation decision-making separately[26]. On the other hand, Loos and Rogers in 2016 showed that utility functions can demonstrate the role of individual decision-maker values in decision outcomes[27]; however, they conclude that MCDM ensures that decision-makers consider multiple benefit qualities of natural capital projects.

Another example of decisions made by individuals in joint objectives is decision-making in joint infrastructures. For example, the development of joint irrigation as an infrastructure in the agriculture industry increasingly depends on individual investment decisions of farmers. The “make” decision is based on their current knowledge and understanding. However, researchers claim that it is ultimately a group decision[29].

Wilmer et al. in 2018 used a data-oriented group decision in the land use management sector[30]. They analyzed meeting transcripts, interviews and focus group data related to stakeholder group decision-making. However, in data-oriented decision-making, data security is defined as a risk. To manage the risk of mis/disinformation, which influences the final decision, Nielsen et al. in 2019 suggested providing a mapping of how information affects the decision-making context[31]. Another problem in group decision-making is information security. Regarding the study by Bharathi in 2017, data brokering, global exposure to personal data and lack of governance-based security design are the top three risk factors in this case[32].

In the supply chain sector, two articles have completely different focuses on sustainable supply chain management considering social and economic aspects. Both articles, published in 2019, show an increase of research interest in this sector regarding resilience and sustainability. Samani et al. studied a completely different supply chain network[33]. This paper is focused on the blood supply chain network which is a crucial network associated with healthcare systems in society. This supply chain network has a great social impact and also its economic effect on society is important. In the proposed model the authors considered risk mitigation and used quantitative factors aiming to minimize the loss of product freshness and total cost of the network.

On the other hand, in a well-known topic of supply chain management, Bai et al. considered economic, environmental and social sustainability dimensions in supplier selection[34]. The authors claim that social sustainability issues have received relatively minor investigations compared to the economic and environmental sustainability dimensions. They proposed a social sustainability decision framework in this article and provided a case study on the novel group decision-making approach, a grey-based multi-criteria decision-support tool composed of the ‘best-worst method’ (BWM) and TODIM.

5. Main factors of Resilient and Sustainable GDM

It is worth remarking that, in the reviewed literature, different authors name the key factors taken into consideration for evaluation or analysis purposes differently. The terms “index,” “measure,” “metric,” “factor” or “indicator” are used and, in many cases, a clear distinction of meaning is not made in the paper. This fact required using different terms as keywords in the systematic literature review.

Wilson in 2004 studied biocultural conservation and concluded that it is crucial to carry out a consultation in a philosophically honest and rigorous fashion[1]. This means that “honesty” is an important factor in assessing the performance of decision-making. Honesty is a human moral characteristic and a social factor that plays an important role in a decision’s success. Classical decision-making models do not incorporate the role and influence of honesty; in fact, only three papers were found in SCOPUS that study the effect of honesty in group decision-making: A significant gap in the research on this topic remains[35][36].

Marleau Donais in 2019 focused on the popular advocate “streets for everyone” in a workshop and introduced novel support decision-making[37]; he also emphasized being transparent and improving communication of the outcome. The body of knowledge on the impact of human psychological behaviors in decision-making is not completely structured yet. The positive effects of “transparency” in environmental impact assessment, with the establishment of explicit goals in decision-making in committees, the effectiveness of dialogues and communications at all levels and the increasing capabilities for communicative actions have been already discussed[38][39][40]. Thus, transparency can be considered another meaningful factor of R&S GDM.

Liu et al. in 2019 considered “self-confidence” as a component of human psychological behavior[41]. They apply this new index to the environmental pollution emergency management decision-making. They implemented self-confident fuzzy preference relations to express the experts’ evaluations and, in a case study, they designed a self-confidence score function. The case study aimed to identify the best solution for environmental pollution emergency management, but the authors concluded that the proposed method is feasible and effective in general. In general, self-confidence is an individual's subjective evaluation of their own worth[42]. This positive or negative evaluation of the self is interrelated with concepts of self-efficacy and an individual’s beliefs about their capacity to influence the events[43]. This concept is also crucial between group decision members because it affects the final decision of each member[44].

Two articles in 2019 studied the behavioural characteristics that exist in group decision-making. Tang et al.[45] and Liu et al.[6] considered the consensus level of the group members as an important index in GDM. The five-step process for decision-making that Tang et al. presented is as follows:

1. Obtaining ordinal preferences;
2. Classifying all decision-makers into several subgroups using the ordinal k-means clustering algorithm;
3. Measuring consensus levels of subgroups and the global group using novel ordinal consensus indexes;
4. Providing suggestions for decision-makers to revise preferences using feedback strategies;
5. Obtaining final decision results.

Altogether, having a shared opinion, among the members of a decision group, about the problems at stake enables the group to reach their goals; consensus level can then be considered another key factor of R&S GDM.

Tadic et al. in 2017 studied environmental protection and seaport safety considering competitive advantage and long-term sustainability[46]They proposed a modified fuzzy extended analytic hierarchy process and finally concluded future improvement lay on benchmark and knowledge sharing. Knowledge sharing could be defined as an index that measures the information flow between the decision-makers in a group and its influence on decision-making performance. There are two important aspects regarding this factor. The first aspect is the sensation of the group members; in a group of decision-makers, DMs' sense of group identity and personal responsibility leads the members to share their knowledge and experience[47]. The second aspect is the channel of knowledge exchange. Modern information and telecommunication technology is available to support such exchanges across time and distance barriers[48]. In short, the exchange of information among decision makers is a vital component of the knowledge-management process in group decisions and knowledge sharing is an important factor of R&S GDM.

Supply chain sustainability management is rather new but very popular among researchers and there are still many gaps in the literature and methods. Osiro et al. in 2018 implemented a new metric to fill the gap of considering the degree of difficulty of collecting data in supply chain studies[49]. They proposed a combination of techniques—Hesitant Fuzzy Linguistic Term Sets (HFLTS) and QFD—with the aim of providing a group decision model in supply chain sustainability management for selecting metrics. In brief, the evaluation based on a range of linguistic expressions regarding data collection and its difficulties (information availability, human resource, time required and other resources) led to a better representation of judgments. Therefore, degree of difficulty of data collection is another factor of the R&S GDM.

In a different sector, Pishdar et al. studied the Internet of Things and its challenges in supply chain management in 2015[50]. They used rough group decision-making and trial evaluation laboratory (DEMATEL) and finally provided a group of suggestions for managers. This paper suggests security policies and emphasizes the importance of security risk assessment. This result is significant and shows that data security level could be an index in group decision-making. Data security means safeguarding digital data from destructive forces, unwanted actions of unauthorized users and unauthorized disclosure of confidential information[51]. In effect, data security considerations including data storage location, access and modifications regarding the information that is used in the group decision processes of a company influence the performance of final decisions.

In conclusion, a closer look at the identified factors shows that they are attributes of the group decision-making activity, not criteria that are used in the decision process. The seven key factors, identified in the literature as the main attributes of R&S GDM, are honesty, proper self-confidence level, transparency, communication and knowledge sharing, degree of difficulty of collecting data, data security and consensus.

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