



## ***EWG-ORSDCE***

### **NEWSLETTER OF EWG ORSDCE DECEMBER 2018**

ORSDCE - The OR in Sustainable Development and Civil Engineering Working Group of EURO  
<https://www.euro-online.org/websites/orsdce/>

#### ***Content of the issue***

<i>Words of chairman</i> .....	- 2 -
<i>Forthcoming Events</i> .....	- 3 -
<i>New website for EWG ORSDCE</i> .....	- 8 -
<i>A novel method for multi-criteria decision-making problems - a combined compromise solution (CoCoSo)</i> .....	- 10 -
<i>Journal Special Issues aimed at optimization of processes in engineering and management</i> .....	- 12 -
<i>International Recognition</i> .....	- 18 -
<i>Highly Cited Papers</i> .....	- 19 -
<i>New scientific papers</i> .....	- 28 -
<i>PhD Dissertations defended during 2018</i> .....	- 34 -

## ***Words of chairman***

Dear Members of EWG-ORS DCE, dear Friends,

This issue of newsletter presents this year news, achievements and forthcoming events.

This year EWG-ORS DCE launched the new website. Please visit <https://www.euro-online.org/websites/orsdce/> register or update your personal information on members' portal.

The active members of EWG-ORS DCE published several successful Special Issues in different Clarivate Analytics Web of Science journals and currently, some more issues open for submissions in journals related to the research field of our Working Group presented in this newsletter.

As usual, we invite you to submit the papers to the journals published by the active members of EWG-ORS DCE: *Technological and Economic Development of Economy*, *Journal of Civil Engineering and Management*, *Journal of Business Economics and Management*, *International Journal of Strategic Property Management*, and new journal *Engineering Structures and Technologies*.

I'm pleased to invite you to the joint meeting of researchers and practitioners: **17th Colloquium „Sustainable decisions in Built Environment“ and 7th meeting of EURO working group OR in Sustainable Development and Civil Engineering** will be held on **15<sup>th</sup> of May 2019 in Vilnius, Lithuania**. The ORSDCE Workshop 2019 will be held on 16<sup>th</sup> of May 2019 within the 13th international conference "Modern Building Materials, Structures and Techniques -MBMST".

In the year 2019 EURO Working Group "OR in Sustainable Development and Civil Engineering (ORS DCE)" will organize invited session in the field "OR for Sustainable Development" in forthcoming 30th EURO Conference, that will be held on 23-26 June 2019 in Dublin, Ireland.

Congratulations on all your achievements and best wishes for future activities.

With my best wishes, yours sincerely,

Edmundas Kazimieras Zavadskas, Chair of EWG-ORS DCE

## ***Forthcoming Events***

**17th Colloquium „Sustainable decisions in Built Environment“,  
May 15, 2019**

**13th international conference “Modern Building Materials, Structures  
and Techniques - MBMST”, May 16-17, 2019  
ORSDCE Workshop 2019, May 16, 2019**

### **Vilnius, Lithuania**

We are pleased to invite you to the joint meeting of researchers and practitioners active in the field of construction management: 17th Colloquium „Sustainable decisions in Built Environment“ and 7th meeting of EURO working group OR in Sustainable Development and Civil Engineering. The **17th Colloquium „Sustainable decisions in Built Environment“** includes official celebration of 75th birthday of Professor Edmundas Kazimieras Zavadskas at Vilnius Gediminas Technical University. In parallel, the **ORSDCE Workshop 2019** will be held on May 16 within the **13th international conference “Modern Building Materials, Structures and Techniques -MBMST”**.

**Venue** – Vilnius Gediminas Technical University,  
Vilnius, Saulėtekio al. 11, Lithuania

**General aims of the conference and workshop:**

- inspiration of young researchers to work,
- discussion and development of new ideas and solutions with partners from industry,
- presentation of innovative projects,
- knowledge bridge creation between academia – industry – PhD students,
- verification of the concepts in practice - case studies in progress.

**Topics of the workshop:**

sustainable development in built environment; operational research; decision making; civil engineering; construction technology and management; flexible management; lean management; building information modelling (BIM); agile management; buildings life cycle; qualification of human resources; real estate management; project management; quality management.





### Honorary Committee of Colloquium

O. Kaplinski (Poland)  
F. Peldschus (Germany)  
E.K. Zavadskas (Lithuania)

### International Programme Committee of Colloquium

A. Kaklauskas (Lithuania)  
J. Paslawski (Poland)  
V. Maliene (United Kingdom)  
A. Sobotka (Poland)  
J. Šelih (Slovenia)  
M. Yazdani (Spain)  
S. Hashemkhani Zolfani (Chile)  
R.M. Hosseini (Australia)  
Z. Turskis (Lithuania)  
L. Ustinovičius (Lithuania)  
T. Vilutiene (Lithuania)  
J. Tamošaitienė (Lithuania)

### Organising committee

T. Vilutiene (Lithuania)  
Contact us:  
[tatjana.vilutiene@vgtu.lt](mailto:tatjana.vilutiene@vgtu.lt)  
Phone: +37061290700

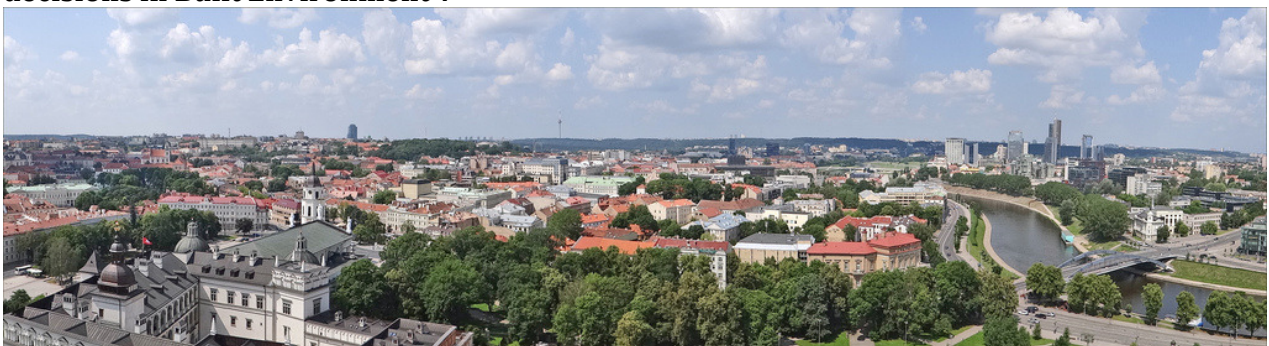
### Important dates

**01.02.2019** – paper submission  
**15.03.2019** – confirmation of paper acceptance  
**01.05.2019** – deadline for registration  
**15.05.2019** – 17<sup>th</sup> Colloquium  
**16.05.2019** – ORSDCE 2019 workshop  
**16-17.05.2019** – 13<sup>th</sup> MBMST Conference  
**01.07.2019** – publication of Proceedings

See the website of the 13th international conference “Modern Building Materials, Structures and Techniques –MBMST” for the details and participant fees:

<https://www.conference-service.com/MBMST-2019/access.html>

No additional fees will be applied for the participants of the 17th Colloquium „Sustainable decisions in Built Environment“.



EWG ORSDCE website: <https://www.euro-online.org/websites/orsdce/>



## ***EURO XXX - European Conference on Operational Research 23-26 June, 2019 Dublin, Ireland***

EURO 2019 is the largest and most important conference for Operational Research and Management Science (OR/MS) in Europe organized by EURO – the European Association of Operational Research Society.

The conference aims at bringing together operational researchers from around the globe to discuss the full spectrum of topics in OR. All researchers, academics, practitioners, and students interested in all branches of operational research are invited to participate to EURO 2019 by submitting an abstract, or organizing a session or a stream of sessions. EURO 2019 is an exciting international forum and a great opportunity to meet new and old friends and colleagues from all over the world!

Oral presentations will be organized in parallel sessions. Authors can present only one paper at the Conference. Submission invited on, but not limited to, the following areas:

- *Analytics, Data Science and Data Mining*
- *Artificial Intelligence, Fuzzy Systems and Computing*
- *OR Education*
- *Continuous Optimization*
- *Control Theory and System Dynamics*
- *Decision Analysis, Decision Support Systems, DEA and Performance Measurement*
- *Discrete Optimization, MIP and MINLP*
- *Emerging applications of OR*
- *Energy, Environment, Natural Resources and Climate*
- *Financial Modeling, Risk Management and Managerial Accounting*
- *Game Theory and Mathematical Economics*
- *Routing, Logistics, Location and Transportation*
- *Metaheuristics*
- *Multiple Criteria Decision Making and Optimization*
- *OR History and OR Ethics*
- *OR for Developing Countries and Humanitarian Applications*
- *OR in Health, Life Sciences and Sports*
- *OR in Industry and Software for OR*
- *Practice of OR (Making an Impact)*
- *Production, Service and Supply Chain Management*
- *Revenue Management*
- *Scheduling, Timetabling and Project Management*
- *Simulation, Stochastic and Robust Optimization*
- *Soft OR, Problem Structuring Methods and Behavioural OR*
- *Graphs and Networks*

Abstracts: max. 1500 characters; submission deadline: February 8, 2019.

**Important dates:**

<b>Registration start</b>	December 2018
<b>Abstract submission deadline</b>	8 February 2019
<b>Early bird registration deadline</b>	8 March 2019
<b>Author registration deadline</b>	22 March 2019
<b>Conference</b>	23-26 June 2019

More information: <https://www.euro2019dublin.com/>

Registration type	Cost (€) *
Regular Early until March 8, 2019 (inclusive)	375
Regular Late until March 22, 2019 (inclusive)	500
Student/retired Early until March 8, 2019 (inclusive)	180
Student/retired Late until March 22, 2019 (inclusive)	240
Accompanying persons	90

\* The registration fee does not include VAT; because the conference is being organized by universities, the activity is exempt from VAT and therefore no amount is due.

*The regular/student registration fee includes:*

- Admission to all sessions and the exhibition
- Conference materials (printed conference handbook with short programme; online access to a complete programme with abstracts; sponsor & exhibitor materials)
- Tea, coffee and lunches throughout the conference (for each day, you will receive a lunch coupon)
- Admission to the Welcome Reception on 23rd June 2019 at University College Dublin Transfer ticket
- Please note that the Conference Gala Dinner on Tuesday is not included in the registration fee.

*The registration fee for an accompanying person covers the same except the admission to sessions and conference materials.*

For detailed information about Dublin, please, visit the Conference webpage:

[ <http://www.euro2019dublin.com/> | [www.euro2019dublin.com](http://www.euro2019dublin.com) ]

EWG-ORS DCE contributes to the organization of ***Stream on "OR for Sustainable Development"***. Stream organizers: Dr. Sadia Samar Ali (King Abdul-Aziz University, Saudi Arabia), Dr. Vida Maliene (Liverpool John Moores University (LJMU), United Kingdom), Dr. Tatjana Vilutiene (Vilnius Gediminas Technical University, Lithuania), Dr. Gerhard-Wilhelm Weber (Poznan University of Technology, Poland)

For registration please visit the web site of EURO conference:

<https://www.euro2019dublin.com/registration>

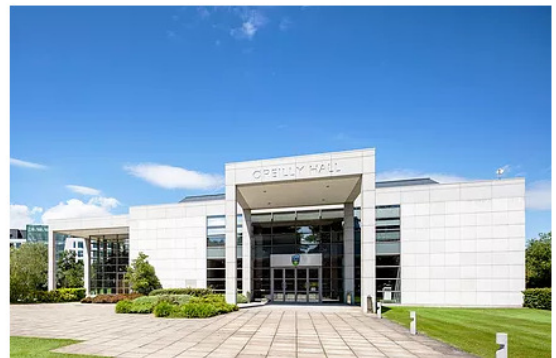
Dublin is Ireland's capital city and was founded by the Vikings in 841. The city is steeped in history and buzzing with energy. Medieval, Georgian and modern architecture provides a backdrop to a friendly cosmopolitan city.

Dublin is a thriving centre for culture and is home to a great musical and literary tradition, its native sons include Shaw, Yeats, Joyce, Wilde and Beckett.

The city's attractions include castles, museums, art galleries, pubs and cafes. Within half an hour of the city are mountain walks, stately homes and gardens, numerous golf courses, sandy beaches and fishing villages.

A bustling city with a population of over 1.7 million and home to over 100 different nationalities all of whom contribute to the fabric of Dublin. While it has a genuine cosmopolitan feel, Dublin has still managed to retain its own distinct culture which is expressed in a love of literature, drama, traditional music and sport. The quintessential Dublin Pub provides the focal point of Dublin's social life, illuminating the vibrant hues of Dubliners and their culture. Conversation flows freely unleashing the unique atmosphere that defines the city.

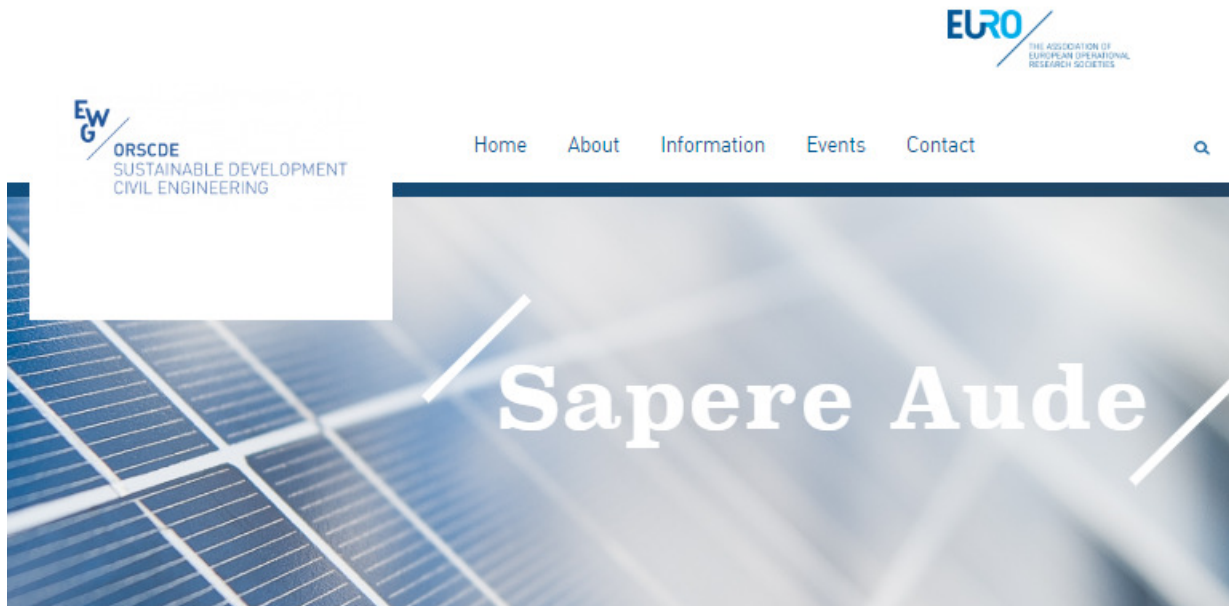
Dublin is one of the oldest cities in Europe and with ancient churches, grand buildings and fine museums, cultural riches abound. From the ancient to the avant-garde, from history, architecture, literature, art and archaeology to the performing arts Dublin has it, with the real advantage to the visitor being that everything is contained within a small area.



## New website for EWG ORSDCE

We are pleased to announce the launch of our new website that aims to create a user-friendly browsing experience for our trusted and valued members and the scientific community. The new website of EURO Working Group on Sustainable Development and Civil Engineering can be accessed using this link:

<https://www.euro-online.org/websites/orsdce/>



### Home

EWG ORSDCE, the EURO Working Group on Sustainable Development and Civil Engineering is a working group the main purpose of which is to provide a platform for communication among researchers who developing optimization techniques and practitioners interested in applying in the fields of Sustainable Development and Civil Engineering.

The decision to establish the EURO Working Group on OR in Sustainable Development and Civil Engineering was taken after long international collaboration between researchers from several European countries (Lithuania, Germany, Poland, United Kingdom, Belgium, Denmark, Latvia, Estonia, Czech Republic, Slovenia). The working group was established at EURO XXIII (Bonn, 2009).

EWG ORSDCE is the Working Group of EURO, the Association of European Operational Research Societies, officially sanctioned and financially supported by EURO.

The application of OR methods in issues of sustainable development and civil engineering is important in striving to resolve the conflicts between the various competing goals in pursuit of economic prosperity, environmental quality, social equity and technological efficiency.

Emphasizing the aforementioned issues, the working group raises the following objectives:

- to develop and apply the multi-criteria decision-making methods in the fields of sustainable development and civil engineering;
- to promote the innovations based on application of multi-criteria decision-making methods in construction industry;
- to facilitate the collaborations between European researchers working in field of OR in civil engineering and sustainable development;
- to ensure the continuity and progress of work and to transfer for scientific communities the ideas of multi-criteria decision aiding, the results of work, thoughts and important discussions of group members by means of annual meetings and conferences.

If you have an information on event you want to share, any suggestions, a question you want to put to the community, please contact the coordinator.

### Hot List

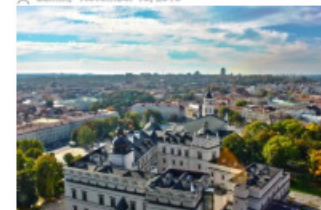
#### EURO 2019, Dublin

admin, - November 13, 2018



#### 17th Colloquium & 7th meeting of ORSDCE, 15 May 2019, Vilnius

admin, - November 13, 2018





If you are a member of the working group, but your name is not yet on the list of members, please register here: <https://www.euro-online.org/websites/orsdce/register/>

## Register

---

### Create your account on Euro Online MultiSite

**Username:**

(Must be at least 4 characters, letters and numbers only.)

**Email Address:**

We send your registration email to this address. (Double-check your email address before continuing.)

**First Name:**

(Must be input.)

**Last Name:**

(Must be input.)

**Institution:**

**Country:**

**Interests:**

**Personal website:**


The following information are for internal use and will not be shared.

**City**

**Address**

**Zipcode**

**Confirm you are human:**

 I'm not a robot   
reCAPTCHA  
Privacy \* Terms

**Signup**

To become a member of EURO Working group on Sustainable Development and Civil Engineering, please register and send the filled [form](#) to Coordinator. The form you can upload from the website.

## ***A novel method for multi-criteria decision-making problems - a combined compromise solution (CoCoSo)***

*Morteza Yazdani, Pascale Zarate, Edmundas Kazimieras Zavadskas, Zenonas Turskis*

A very important role in minimizing the vulnerability of project environments has an accurate definition of a problem and multiple conflicting criteria. Decision-makers, both scientists and experienced users, instead of making decisions based on only intuition and own experience, required to explicitly evaluate numerous criteria and consider various rules, so leading to more informed and better decisions.

The article presents a new method of *Combined Compromise Solution (CoCoSo)*. The suggested approach based on an integrated simple additive weighting and exponentially weighted product model. It can be a compendium of compromise solutions.

The following steps are validated:

1. The initial decision-making matrix is determined as shown below:

$$x_{ij} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix}; \quad i = 1, 2, \dots, m; \quad j = 1, 2, \dots, n. \quad (1)$$

2. The normalisation of criteria values is accomplished based on compromise normalisation equation (see Zeleny, 1973):

$$r_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}; \quad \text{for benefit criterion,} \quad (2)$$

$$r_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}, \quad \text{for cost criterion.} \quad (3)$$

3. The total of the weighted comparability sequence and the whole of the power weight of comparability sequences for each alternative sum of the weighted comparability sequence and also an amount of the power weight of comparability sequences for each alternative as  $S_i$  and  $P_i$ , respectively:

$$S_i = \sum_{j=1}^n (w_j r_{ij}), \quad (4)$$

$$P_i = \sum_{j=1}^n (r_{ij})^{w_j}, \quad (5)$$

The  $S_i$  value is achieved based on grey relational generation approach. The  $P_i$  value is achieved according to the WASPAS multiplicative attitude.

4. Relative weights of the alternatives using the following aggregation strategies computed. In this step, three appraisal score strategies are used to generate relative weights of other options, which are derived using Formulas (6)–(8):

$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^m (P_i + S_i)}, \quad (6)$$

$$k_{ib} = \frac{S_i}{\min_i S_i} + \frac{P_i}{\min_i P_i}, \quad (7)$$

$$k_{ic} = \frac{\lambda (S_i) + (1 - \lambda) (P_i)}{(\lambda \max_i S_i + (1 - \lambda) \max_i P_i)}; \quad 0 \leq \lambda \leq 1. \quad (8)$$

The Equation (6) expresses the arithmetic mean of sums of WSM and WPM scores, while Equation (7) expresses a sum of relative scores of WSM and WPM compared to the best. Equation (8) releases the balanced compromise of WSM and WPM models scores. In Equation (8),  $\lambda$  (usually  $\lambda=0.5$ ) is chosen by decision-makers. However, the flexibility and stability of the proposed CoCoSo can rely on other values.

5. The final ranking of the alternatives is determined based on  $k_i$  values (as more significant as better):

$$k_i = (k_{ia} k_{ib} k_{ic})^{\frac{1}{3}} + \frac{1}{3} (k_{ia} + k_{ib} + k_{ic}). \quad (9)$$

The paper proposed a new strategy to solve an MCDM problem through some specific modification to the main structure. Calculation of normalised criteria values, weighted comparability sequence, and the exponential weight of comparability sequences for each alternative identified. Then, three aggregator strategies are established to form a complete measure. Generating of the relevant and adjusted aggregator to reach optimal rank index has been presented. An equation can correlate those three rank indexes ultimately, and alternative priorities are obtained. The stability of the CoCoSo algorithm is approved by comparative analysis. The similarity of the results is very high with other MCDM approaches. The algorithm can compete with favourite tools like COPRAS, MOORA, and VIKOR as well. The authors suggest extending this algorithm by ordinary fuzzy sets, interval values, neutrosophic and intuitionistic fuzzy sets. Implementing and applying this new-born technique not only increases the accuracy of the decision-making system, but also aids company policies, accredits the global objectives, and delivers the beneficial consequences to the management control.

**Read full text in article:**

Morteza Yazdani, Pascale Zarate, Edmundas Kazimieras Zavadskas, Zenonas Turskis, (2018) "A combined compromise solution (CoCoSo) method for multi-criteria decision-making problems", *Management Decision*, <https://doi.org/10.1108/MD-05-2017-0458>

## ***Journal Special Issues aimed at optimization of processes in engineering and management***

*Edmundas Kazimieras Zavadskas, Jurgita Antuchevičienė, Tatjana Vilutienė*

We are proud to announce that active members of EWG-ORS DCE published several successful Special Issues in different Clarivate Analytics Web of Science journals and currently some more issues are open for submissions in journals related to the research field of our Working Group.

As was mentioned in *Newsletter 7 and Newsletter 8 of EWG ORSDCE* (December, 2016 and December, 2017):

- The Special Issue “*Decision Making Methods and Applications in Civil Engineering*” in “*Mathematical Problems in Engineering*” journal was published in 2015.

See: <https://www.hindawi.com/journals/mpe/si/267648/>

- The Special Issue “*Mathematical Models for Dealing with Risk in Engineering*” in “*Mathematical Problems in Engineering*” journal was published in 2016.

See: <https://www.hindawi.com/journals/mpe/si/162542/>

- The Special Issue “*Managing Information Uncertainty and Complexity in Decision-Making*” in “*Complexity*” journal was published in 2017.

See: <https://www.hindawi.com/journals/complexity/si/513462/>

In 2018, three Special Issues, Guest Edited by members of EWG-ORS DCE from Vilnius Gediminas Technical University, have been published.



**sustainability**

- The most successive Special Issue that attracted the largest number of submissions, was Special Issue “***Sustainability in Construction Engineering***” in “*Sustainability*” journal  
Guest Editors: Edmundas Kazimieras Zavadskas; Jonas Šaparauskas; Jurgita Antuchevičienė

MDPI Publisher, Web of Science Core Collection, IF = 2.075

[http://www.mdpi.com/journal/sustainability/special\\_issues/Sustainability\\_Construction\\_Engineering](http://www.mdpi.com/journal/sustainability/special_issues/Sustainability_Construction_Engineering)

In this Special Issue, 28 selected and peer-reviewed papers contribute to sustainable construction by offering technological, economic, social and environmental benefits through a variety of methodologies and tools, including fundamental decision-making models and methods as well as advanced multi-criteria decision-making (MCDM) methods and techniques. The published papers are mainly concentrated in five areas: Sustainable architecture; construction/reconstruction technology and sustainable construction materials; construction economics, including investments, supply, contracting and costs calculation; infrastructure planning and assessment; project risk perception, analysis and assessment, with an emphasis on sustainability.

The Special Issue collects 23 research papers, 3 review papers, 1 case report paper and Editorial. The topics of the Special Issue gained attention all over the World. The paper from all four Continents have been submitted. Regarding the origin of papers, the papers from 14 countries have been published. Authors and co-authors from Lithuania contributed to 14 papers, those from Poland, 6 papers, those from Iran, 4 papers, and those from Korea, 3 papers. The authors from other countries contributed to 1 or 2 papers.

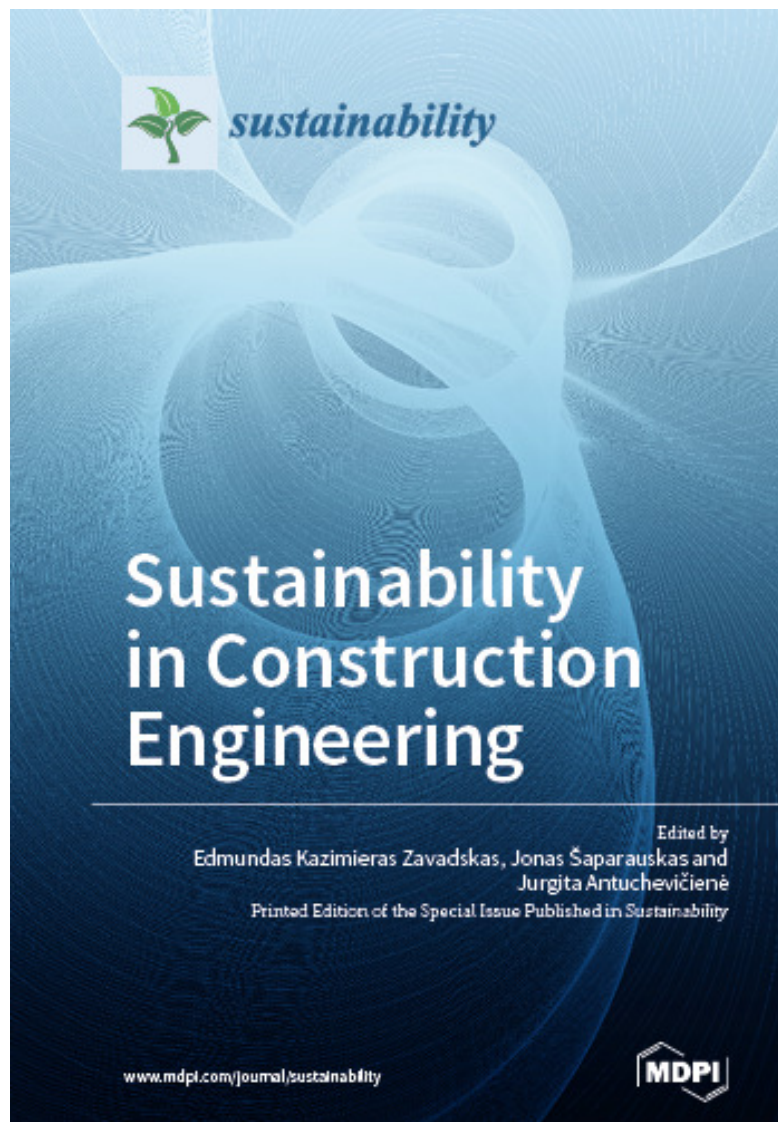
Multi-criteria decision-making (MCDM) methods and techniques proved to be very suitable for sustainability assessment. Almost one third of papers (8 papers from 28) applied MCDM methods, the others applied fundamental research methods.

A short description of the Issue is provided in Editorial. See:

<https://www.mdpi.com/2071-1050/10/7/2236>

A printed edition of this Special Issue is available here:

<https://www.mdpi.com/books/pdfview/book/754>



Two more Special Issues were published in "Symmetry" journal in 2018:



- Special Issue "**Civil Engineering and Symmetry**" in "Symmetry" journal (MDPI Publisher, Web of Science Core Collection, IF = 1.256)

[http://www.mdpi.com/journal/symmetry/special\\_issues/Civil\\_Engineering\\_Symmetry](http://www.mdpi.com/journal/symmetry/special_issues/Civil_Engineering_Symmetry)

*Guest Editors: Edmundas Kazimieras Zavadskas; Romualdas Baušys; Jurgita Antuchevičienė*

The topic of utmost importance in civil engineering is optimal solutions throughout the life cycle of the buildings, roads, bridges and other infrastructure objects. Operational research, management science, optimization methods provide a consistent and applicable groundwork for engineering decision making. Therefore, 8 articles were published on these topics and methodologies.



- Special Issue "**Solution Models based on Symmetric and Asymmetric Information**" in "Symmetry" journal (MDPI Publisher, Web of Science Core Collection, IF = 1.256)

[https://www.mdpi.com/journal/symmetry/special\\_issues/Solution\\_models\\_based\\_symmetric\\_a\\_symmetric\\_informinfor](https://www.mdpi.com/journal/symmetry/special_issues/Solution_models_based_symmetric_a_symmetric_informinfor)

*Guest Editors: Edmundas Kazimieras Zavadskas; Zenonas Turskis; Jurgita Antuchevičienė*

This Special Issue covers symmetry and asymmetry phenomena occurring in real-life problems. Symmetry and structural regularity are essential concepts in many natural and manmade objects and play a crucial role in problems solutions. While the complexity and risks inherent in problem solution models, along with different indicators of success and failure, may contribute to the difficulties in their performance evaluation and generally multiple solutions exist. The existence of information asymmetry also causes difficulties when achieving optimal solution. Therefore, various solution models have been proposed as integrated tools to find a balance between components of sustainable global development, i.e., to find symmetry axe with respect to goals, risks, and constraints to cope with the complicated problems. 9 papers related to theoretical or experimental research presenting engineering and other problem solution models dealing with symmetry and asymmetry of different types of information have been published in the Special Issue and are expected to gain interest of readers.

One more very successive Special Issue that gathered 16 papers is published in "Information" journal:



- Special Issue "**Multiple-Criteria Decision-Making (MCDM) Techniques for Business Processes Information Management**" in "Information" journal (MDPI Publisher, Emerging Sources Citation Index)

[https://www.mdpi.com/journal/information/special\\_issues/MCDM\\_Business\\_Processes](https://www.mdpi.com/journal/information/special_issues/MCDM_Business_Processes)

*Guest Editors: Edmundas Kazimieras Zavadskas; Jurgita Antuchevičienė; Prasenjit Chatterjee*

Information management is a common paradigm in modern decision-making. A wide range of decision-making techniques have been proposed in literature to model complex business processes.

In this Special Issue, 16 selected and peer-reviewed original research articles contribute to business information management in various today's real-world problems by proposing crisp or uncertain multiple-criteria decision-making (MCDM) models and techniques.

Although the announced topics of the special issue covered MADM and MODM theories, mainly MADM approaches have been suggested, and only a single research proposed MODM model. Therefore, multi-attribute decision-making techniques proved well applicable for business processes information management.

The most approaches suggested decision models under uncertainty, proposing extensions of decision-making methods in combination with fuzzy, rough, neutrosophic sets theory. Particular attention has been devoted to information aggregation operators, and even 65 percent of papers dealt with the item.

The application areas of proposed MCDM techniques mainly covered logistics and supply chains optimization, selection of goods or facilities, and personnel selection. A number of new approaches have been proposed that are expected to attract a large interest from community of researchers.

One more published special issue by MDPI Publisher, "Economies":



*economies*

- Special Issue "**Economic Growth as a Consequence of the Industry 4.0 Concept**" in "Economies" journal (MDPI Publisher, Emerging Sources Citation Index)

[http://www.mdpi.com/journal/economies/special\\_issues/industry4.0](http://www.mdpi.com/journal/economies/special_issues/industry4.0)

*Guest Editors: Petra Maresova, Jonas Šaparauskas, et al.*

To remain efficiency, it is essential for public and private sector to adopt new methodologies of public sector management, process management, manufacturing, and innovation. The impact of change is so crucial that it is referred to as the Fourth Industrial Revolution—Industry 4.0. Papers on the subject, which highlight the economic consequences, are published (6 papers).



*administrative  
sciences*

- Special Issue "**Rational Decision Making in Risk Management**" in "Administrative Sciences" journal (MDPI Publisher)

*Guest Editor: Jolanta Tamošaitienė*

This Special Issue published articles that offer economic, social, technical and environmental benefits from risk management solutions involving various decision-making methods, methodologies, models, algorithms and tools for rational decision making.

[https://www.mdpi.com/journal/admsci/special\\_issues/Rational\\_Decision\\_Making](https://www.mdpi.com/journal/admsci/special_issues/Rational_Decision_Making)

**More Special Issues on the subject very closely related to activities of our EURO Working Group are currently open for submissions.**

**Your original research or review articles are welcome:**



- Special Issue "**Multi-Objective and Multi-Attribute Optimisation for Sustainable Development Decision Aiding**" in "Sustainability" journal (MDPI Publisher, Web of Science Core Collection, IF = 2.075)

*Guest Editors: Edmundas Kazimieras Zavadskas; Jurgita Antuchevičienė; Samarjit Kar*

Deadline for manuscript submissions: **28 February 2019**

In this Special Issue, researchers from academia and industries are invited to submit papers that explore aspects of multi-objective or multi-attribute modelling and optimization in crisp or uncertain environment, and will elaborate on the state-of-the-art case studies in selected areas of application related to sustainable development decision aiding.

The particular topics can be found here:

[https://www.mdpi.com/journal/sustainability/special\\_issues/Multi-Objective\\_Multi-Attribute\\_Optimisation\\_Sustainable\\_Development\\_Decision\\_Aiding](https://www.mdpi.com/journal/sustainability/special_issues/Multi-Objective_Multi-Attribute_Optimisation_Sustainable_Development_Decision_Aiding)



- Special Issue "**A Healthy Built Environment for an Ageing Population**" in "Sustainability" journal (MDPI Publisher, Web of Science Core Collection, IF = 2.075)

*Guest Editors: Vida Maliene, Emma Mulliner, Mike Riley, Mantas Kazimieras Malys*

Deadline for manuscript submissions: **30 April 2019**

This Special Issue explores the scientific forum on a healthy built environment including social studies on ageing population needs, stakeholders preferences and opportunities, socio-economic challenges for sustainable housing and environment design, and technological solutions. Topics include, but are not limited to, the following: impact of the built environment on a public health and ageing; ageing population needs for a sustainable housing and communities; socio-economic challenges for delivery of healthy built environment; housing market for an ageing population; housing and environment design for an ageing population; construction technologies and housing adaptation for an ageing population; sustainability and healthy built environment; public health and built environment.

The particular topics can be found here:

[https://www.mdpi.com/journal/sustainability/special\\_issues/Ageing\\_Population\\_Sustainability](https://www.mdpi.com/journal/sustainability/special_issues/Ageing_Population_Sustainability)



- Special Issue "**Multi-Criteria Decision-Making Techniques for Improvement Sustainability Engineering Processes**" in "Symmetry" journal



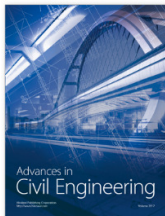
(MDPI Publisher, Web of Science Core Collection, IF = 1.256)

*Guest Editors: Edmundas Kazimieras Zavadskas, Dragan Pamučar, Željko Stević, Abbas Mardani*

Deadline for manuscript submissions: **15 July 2019**

This Special Issue aims to incorporate recent developments in the area of decision making in sustainable engineering processes. Topics include, but are not limited to, the following: MCDM optimization in sustainable engineering, environmental sustainability in engineering processes, sustainable multi-criteria production and logistics processes planning, integrated approach for modelling processes in engineering, new trends in the multi-criteria evaluation of sustainable processes, multi-criteria decision-making in strategic management based on sustainable criteria. The detailed information please read here:

[https://www.mdpi.com/journal/symmetry/special\\_issues/Sustainability\\_Engineering\\_Processes](https://www.mdpi.com/journal/symmetry/special_issues/Sustainability_Engineering_Processes)



- Special Issue „**Advanced BIM Applications in the Construction Industry**“ in Journal „*Advances in Civil Engineering*“ (HINDAWI Publisher, Web of Science Core Collection, IF = 0.827)

*Guest Editors: Tatjana Vilutiene, Mohammad R. Hosseini, Eugenio Pellicer, Edmundas K. Zavadskas*

Deadline for manuscript submissions: **1 February 2019**

This Special Issue from Journal Advances in Civil Engineering plan to extend the growing research stream by inviting manuscripts that investigate current BIM practices, advanced developments, and critical effects of BIM on collaborative design and construction. BIM effects will be discussed into three dimensions: technology, people, and processes. Submissions that address investigation of BIM applications for new construction and energy retrofitting, describe methodologies for BIM-enabled project performance assessment, present advanced collaborative approaches in BIM-enabled projects, and present strategies for the recognition of specific BIM related competences are encouraged.

The detailed information please read here:

<https://www.hindawi.com/journals/ace/si/327683/cfp/>

## International Recognition

Congratulations to the honoured member of EWG-ORSDC prof. Edmundas Kazimieras Zavadskas being among an elite group of scientists recognized for exceptional research performance demonstrated by production of multiple highly cited papers that rank in the top 1% by citations for field and year in Web of Science. The distinction he have earned derives from his peers, who have time and again acknowledged the influence of his research contributions in their publications and citations.

**Clarivate Analytics** Highly Cited Researchers

Executive Summary Cross-Field Methodology Resources ▾ FAQ

### Highly Cited Researchers 2018

This list recognizes world-class researchers selected for their exceptional research performance, demonstrated by production of multiple highly cited papers that rank in the top 1% by citations for field and year in *Web of Science*.

[Download Executive Summary](#)

Zavadskas Edmundas Kazimieras

Last Name ▾	First Name	Category	Primary Institution	Primary Region	Secondary affiliation	Profiles
Zavadskas	Edmundas Kazimieras	Cross-Field	Vilnius Gediminas Tech Univ	Lithuania		

**publons** BROWSE COMMUNITY FAQ

LOG IN REGISTER WEB OF SCIENCE

Home ▸ Researchers ▸ Edmundas Kazimieras Zavadskas



**Edmundas Kazimieras Zavadskas**

Highly cited Top peer reviewer

Research Institute of Smart Building Technologies, Vilnius Gediminas Technical University  
ResearcherID: Q-6048-2018

VERIFIED REVIEWS  
**218**

Highly Cited Researcher in the field of Cross-Field - 2018

<https://publons.com/awards/2018/esi/?name=Edmundas+Kazimieras+Zavadskas&esi=13>

Top Reviewer for Multidisciplinary - September 2018

<https://publons.com/awards/2018/esi/?name=Edmundas+Kazimieras+Zavadskas&esi=22>

Top Reviewer for Computer Science - September 2018

<https://publons.com/awards/2018/esi/?name=Edmundas+Kazimieras+Zavadskas&esi=13>

Top Reviewer for Environment/Ecology - September 2018

<https://publons.com/awards/2018/esi/?name=Edmundas+Kazimieras+Zavadskas&esi=17>

## Highly Cited Papers

Data from *Essential Science Indicators*

Date of data search 2018-12-20

---

The highly cited paper means that paper received enough citations to place it in the top 1% of the academic field on a highly cited threshold for the field and publication year.

---

### Highly Cited July/August 2018 2018 (in the field of Environment/Ecology)

Hatefi, S. M., & Tamošaitienė, J. (2018). Construction projects assessment based on the sustainable development criteria by an integrated fuzzy AHP and improved GRA model. *Sustainability*, 10(4), 991.

**Times Cited: 6 (from Web of Science Core Collection)**

**Short summary.** Due to the increasing population and earth pollution, managing construction and infrastructure projects with less damage to the environment and less pollution is very important. Sustainable development aims at reducing damage to the environment, making projects economical, and increasing comfort and social justice. This study proposes fuzzy analytic hierarchy process (AHP) and improved grey relational analysis (GRA) to assess construction projects based on the sustainable development criteria. For doing so, sustainable development criteria are first identified in economic, social, and environmental dimensions using literature review, and are then customized for urban construction projects using experts' opinions. After designing questionnaires and collecting data, fuzzy AHP is used for determining the importance of sustainable development criteria and their subcriteria. Then, improved GRA is employed for assessing six recreational, commercial, and official centers in Isfahan regarding the weights of criteria and subcriteria. The proposed fuzzy AHP-improved GRA help us to prioritize construction projects based on the sustainable development criteria. Finally, the results of employing improved GRA determine Negin Chaharbagh recreational and commercial complex as the best project.

---

### Highly Cited July/August 2018 2018 (in the field of Engineering)

Ghorabae, M. K., Amiri, M., Zavadskas, E. K., & Antucheviciene, J. (2018). A new hybrid fuzzy MCDM approach for evaluation of construction equipment with sustainability considerations. *Archives of Civil and Mechanical Engineering*, 18(1), 32-49.

**Times Cited: 7 (from Web of Science Core Collection)**

**Short summary.** Because of the possible harmful effects of construction equipment on the environment, evaluation of them can be considered as a helpful activity to move toward the sustainability in construction. This evaluation process could involve some alternatives and some criteria in a discrete decision space. In this study, a new hybrid multi-criteria decision-making (MCDM) approach is proposed to deal with this evaluation process in the fuzzy environment. We present fuzzy extensions of the SWARA (Step-wise Weight Assessment Ratio Analysis) and CRITIC (CRiteria Importance Through Intercriteria Correlation) methods for determining subjective and objective weights of criteria. Based on these extended methods and the fuzzy EDAS (Evaluation based on Distance from Average Solution) method, a new hybrid approach is proposed. In this approach, the subjective and objective criteria weights are combined to determine more justified weights for criteria. The proposed approach is applied to a case study of construction equipment evaluation with sustainability considerations. To examine the result of evaluation, a sensitivity analysis is performed based on varying criteria weights. A comparison is also made between the results of the proposed approach and some existing MCDM methods. These analyses show the stability and validity of the results and efficiency of the proposed approach.

---

**Highly Cited July/August 2018 2018 (in the field of Economics & Business)**

Trinkūnienė, E., Podvezko, V., Zavadskas, E. K., Jokšienė, I., Vinogradova, I., & Trinkūnas, V. (2017). Evaluation of quality assurance in contractor contracts by multi-attribute decision-making methods. *Economic research-Ekonomska istraživanja*, 30(1), 1152-1180.

**Times Cited: 11 (from Web of Science Core Collection)**

**Short summary.** The goal of this paper is to compare quality assurance in different contractor contracts by means of multi-attribute decision-making (MADM) and to select the best option. For this investigation, the authors have developed the complex of quality evaluation criteria. During experimental evaluation, the significance of criteria was determined and the expert evaluation of template construction contracts was performed. The complex comparison of contractor contracts was carried out by means of the following MADM methods: Simple Additive Weighting (SAW), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Complex Proportional Assessment (COPRAS) as well as the new Evaluation Based on Distance from Average Solution (EDAS). MADM. method. To determine the weights of criteria, with due consideration of uncertainty of expert evaluation, the Fuzzy Analytic Hierarchy Process (FAHP) method was applied. Evaluation of the data structure was performed by methods for the determination of objective weights: an entropy method and new criteria impact loss (CILOS) and integrated determination of objective criteria weights (IDOCRIW) methods. Expert subjective and objective weights were combined into aggregate weights. Based on the investigation performed, the authors make conclusions regarding possibilities for improving quality assurance in contractor contracts.

**Highly Cited July/August 2018 (in the field of Environment/Ecology)**

Zavadskas, E., Antucheviciene, J., Vilutiene, T., & Adeli, H. (2018). Sustainable decision-making in civil engineering, construction and building technology. *Sustainability*, 10(1), 14. <https://doi.org/10.3390/su10010014>

**Times Cited: 12 (from Web of Science Core Collection)**

**Short summary.** Sustainable decision-making in civil engineering, construction and building technology can be supported by fundamental scientific achievements and multiple-criteria decision-making (MCDM) theories. The current paper aims at overviewing the state of the art in terms of published papers related to theoretical methods that are applied to support sustainable evaluation and selection processes in civil engineering. The review is limited solely to papers referred to in the Clarivate Analytic Web of Science core collection database. As the focus is on multiple-criteria decision-making, it aims at reviewing how the papers on MCDM developments and applications have been distributed by period of publishing, by author countries and institutions, and by journals. Detailed analysis of 2015–2017 journal articles from two Web of Science categories (engineering civil and construction building technology) is presented. The articles are grouped by research domains, problems analyzed and the decision-making approaches used. The findings of the current review paper show that MCDM applications have been constantly growing and particularly increased in the last three years, confirming the great potential and prospects of applying MCDM methods for sustainable decision-making in civil engineering, construction and building technology.

**Highly Cited July/August 2018 2018 (in the field of Economics & Business)**

Keshavarz Ghorabae, M., Amiri, M., Zavadskas, E. K., & Antucheviciene, J. (2017). Supplier evaluation and selection in fuzzy environments: a review of MADM approaches. *Economic research-Ekonomska istraživanja*, 30(1), 1073-1118.

**Times Cited: 22 (from Web of Science Core Collection)**

**Short summary.** In past years, the multi-attribute decision-making (MADM) approaches have been extensively applied by researchers to the supplier evaluation and selection problem. Many of these studies were performed in an uncertain environment described by fuzzy sets. This study provides a review of applications of MADM approaches for evaluation and selection of suppliers in a fuzzy environment. To this aim, a total of 339 publications were examined, including papers in peer-reviewed journals and reputable conferences and also some book chapters over the period of 2001 to 2016. These publications were extracted from many online databases and classified in some categories and subcategories according to the MADM approaches, and then they were analysed based on the frequency of approaches, number of citations, year of publication, country of origin and publishing journals. The results of this study show that the AHP and TOPSIS methods are the most popular approaches. Moreover, China and Taiwan are the top countries in terms of number of publications and number of citations, respectively. The top three journals with highest number of publications were: Expert Systems with Applications, International Journal of Production Research and The International Journal of Advanced Manufacturing Technology.

---

### **Highly Cited July/August 2018 2018 (in the field of Economics & Business)**

Zavadskas, E. K., Govindan, K., Antucheviciene, J., & Turskis, Z. (2016). Hybrid multiple criteria decision-making methods: A review of applications for sustainability issues. *Economic research-Ekonomska istraživanja*, 29(1), 857-887.

**Times Cited: 33 (from Web of Science Core Collection)**

**Short summary.** Formal decision-making methods can be used to help improve the overall sustainability of industries and organisations. Recently, there has been a great proliferation of works aggregating sustainability criteria by using diverse multiple criteria decision-making (MCDM) techniques. A number of review papers summarising these techniques have been published. During the past few years, new approaches for hybrid MCDM (HMCDM) methods have been developed, but they have not yet been completely reviewed. This article aims to fill this gap and to summarise publications related to the application of HMCDM. The current study is limited solely to papers available in the Thomson Reuters Web of Science Core Collection database. The main findings report that HMCDM methods have been increasingly applied for supporting decisions in different domains of sustainability. The most frequently used methods emphasise the advantages of hybrid approaches over individual methods, and we conclude that they can assist decision-makers in handling information such as stakeholders' preferences, interconnected or contradictory criteria, and uncertain environments. The main contribution of this work is identifying hybrid approaches as improvements for decision-making related to sustainability issues, while also promoting future application of the approaches.

---

### **Highly Cited July/August 2018 (in the field of Engineering)**

Zavadskas, E. K., Antucheviciene, J., Turskis, Z., & Adeli, H. (2016). Hybrid multiple-criteria decision-making methods: A review of applications in engineering. *Scientia Iranica. Transaction A, Civil Engineering*, 23(1), 1. doi: 10.24200/sci.2016.2093

**Times Cited: 36 (from Web of Science Core Collection)**

**Short summary.** To support evaluation and selection processes in engineering, formal decision-making methods can be used. A great number of works applying diverse Multiple-Criteria Decision-Making (MCDM) techniques for engineering problems have been published recently. A new approach of hybrid MCDM methods has been developed, rapidly, during the past few years. The current paper aims at filling the gap and summarizing publications related to applications of hybrid MCDM for engineering. The study is limited solely to papers referred in Thomson Reuters Web of Science Core Collection academic database. It aims to review how the papers have been distributed by period of publishing and by country; multiple-criteria decision-making methods

have been used, most frequently, in developing hybrid approaches and in domains the methods have been applied for. For a more detailed analysis of applications, journal articles from engineering research area were grouped by research domains and further by analyzed issues. Findings of the current review paper confirm that hybrid MCDM approaches, due to their abilities in integrating different techniques, can assist in handling miscellaneous information taking into account stakeholders' preferences when making decisions in engineering.

---

### **Highly Cited July/August 2018 2018 (in the field of Engineering)**

Mardani, A., Zavadskas, E. K., Khalifah, Z., Zakuan, N., Jusoh, A., Nor, K. M., & Khoshnoudi, M. (2017). A review of multi-criteria decision-making applications to solve energy management problems: Two decades from 1995 to 2015. *Renewable and Sustainable Energy Reviews*, 71, 216-256.

**Times Cited: 37 (from Web of Science Core Collection)**

**Short summary.** Energy management problems associated with rapid institutional, political, technical, ecological, social and economic development have been of critical concern to both national and local governments worldwide for many decades; thus, addressing such issues is a global priority. The main objective of this study is to provide a review on the application and use of decision making approaches in regard to energy management problems. This paper selected and reviewed 196 published papers, from 1995 to 2015 in 72 important journals related to energy management, which chosen from the "Web of Science" database and in this regard, the systematic and meta-analysis method which called "PRISMA" has been proposed. All published papers were categorized into 13 different fields: environmental impact assessment, waste management, sustainability assessment, renewable energy, energy sustainability, land management, green management topics, water resources management, climate change, strategic environmental assessment, construction and environmental management and other energy management areas. Furthermore, papers were categorized based on the authors, publication year, nationality of authors, region, technique and application, number of criteria, research purpose, gap and contribution, solution and modeling, results and findings. Hybrid MCDM and fuzzy MCDM in the integrated methods were ranked as the first methods in use. Finally, environmental impact assessment was ranked as the first area that applied decision making approaches. Results of this study acknowledge that decision making approaches can help decision makers and stakeholders in solving some problems under uncertainties situations in environmental decision making and these approaches have seen increasing interest among previous researchers to use these approaches in various steps of environmental decision making process.

---

### **Highly Cited July/August 2018 2018 (in the field of Engineering)**

Yazdani, M., Chatterjee, P., Zavadskas, E. K., & Zolfani, S. H. (2017). Integrated QFD-MCDM framework for green supplier selection. *Journal of Cleaner Production*, 142, 3728-3740.

**Times Cited: 40 (from Web of Science Core Collection)**

**Short summary.** Supplier evaluation and selection is a significant strategic decision for reducing operating costs and improving organizational competitiveness to develop business opportunities. Moreover, with increasing concern towards environmental protection and sustainable development, it becomes important to pay more attention to environmental requirements and evaluating the potential suppliers by incorporating green factors into the selection process. Thus, the aim of this paper is to put forward an integrated approach for green supplier selection by considering various environmental performance requirements and criteria. The proposed approach addresses the inter-relationships between the customer requirements (CRs) with the aid of decision-making trial and evaluation laboratory (DEMATEL) method while constructing a relationship structure. Quality function deployment (QFD) model is used to establish a central

relationship matrix in order to identify degree of relationship between each pair of supplier selection criteria and CRs. Finally, complex proportional assessment (COPRAS) applied to prioritize and rank the alternative suppliers. A case study is presented to reveal the potentiality and aptness of the proposed methodology.

---

#### **Highly Cited July/August 2018 2018 (in the field of Engineering)**

Ghorabae, M. K., Zavadskas, E. K., Amiri, M., & Esmaeili, A. (2016). Multi-criteria evaluation of green suppliers using an extended WASPAS method with interval type-2 fuzzy sets. *Journal of Cleaner Production*, 137, 213-229.

**Times Cited: 42 (from Web of Science Core Collection)**

**Short summary.** The main goal of green supply chain management (GSCM) is to reduce the negative environmental impacts in all activities and stages of a supply chain. Evaluation of suppliers in a supply chain according to environmental criteria can help us to achieve this goal of GSCM. Since this evaluation usually comprises some alternatives and some criteria, green supplier selection (GSS) could be considered as a multi criteria decision-making (MCDM) problem. To handle the uncertainty of information in an MCDM problem, the theory of fuzzy sets is an effective tool. Interval type-2 fuzzy sets (IT2FSs), which are characterized by an interval membership function, is very flexible to model the uncertainty of the MCDM problems. In this study, a new integrated approach based on Weighted Aggregated Sum Product Assessment (WASPAS) method, is proposed to deal with multi-criteria group decision-making problems with IT2FSs. This approach is based on the operators of IT2FSs, some modifications in the classical WASPAS method and a new procedure for calculation of criteria weights. In the procedure of calculation of criteria weights, we combine the subjective weights expressed by decision-makers with objective weights resulted from an entropy method to obtain more realistic weights. To show the applicability of the proposed approach in the real-world MCDM problems, a green supplier selection problem is used. We perform a sensitivity analysis with different weights of criteria and different values of method's parameters to show the stability of the proposed approach. This analysis shows that combining the subjective and objective weights can help to increase the stability of the proposed approach with different weights of criteria. A comparison is also made between the results of the proposed approach and some existing methods for validating the proposed approach. This analysis shows that the proposed approach is efficient and well consistent with the other methods.

---

#### **Highly Cited July/August 2018 2018 (in the field of Engineering)**

Mardani, A., Zavadskas, E. K., Streimikiene, D., Jusoh, A., & Khoshnoudi, M. (2017). A comprehensive review of data envelopment analysis (DEA) approach in energy efficiency. *Renewable and Sustainable Energy Reviews*, 70, 1298-1322.

**Times Cited: 45 (from Web of Science Core Collection)**

**Short summary.** The main aim of this review article is to review of DEA models in regarding to energy efficiency. This paper reviewed and summarized the different models of DEA that have been applied around the world to development of energy efficiency problems. Consequently, a review of 144 published scholarly papers appearing in 45 high-ranking journals between 2006 and 2015 have been obtained to achieve a comprehensive review of DEA application in energy efficiency. Accordingly, the selected articles have been categorized based on year of publication; author (s) nationalities, scope of study, time duration, application area, study purpose, results and outcomes. Results of this review paper indicated that DEA showed great promise to be a good evaluative tool for future analysis on energy efficiency issues, where the production function between the inputs and outputs was virtually absent or extremely difficult to acquire.

---

#### **Highly Cited July/August 2018 2018 (in the field of Computer Science)**

Zavadskas, E. K., Mardani, A., Turskis, Z., Jusoh, A., & Nor, K. M. (2016). Development of TOPSIS method to solve complicated decision-making problems—An overview on developments from 2000 to 2015. *International Journal of Information Technology & Decision Making*, 15(03), 645-682.

**Times Cited: 51 (from Web of Science Core Collection)**

**Short summary.** In recent years several previous scholars made attempts to develop, extend, propose and apply Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) for solving problems in decision making issues. Indeed, there are questions, how TOPSIS can help for solving these problems? Or does TOPSIS solved decision making problems in the real world? Therefore, this study shows the recent developments of TOPSIS approach which are presented by previous scholars. To achieve this objective, there are 105 reviewed papers which developed, extended, proposed and presented TOPSIS approach for solving DM problems. The results of the study indicated that 49 scholars have extended or developed TOPSIS technique and 56 scholars have proposed or presented new modifications for problems solution related to TOPSIS technique from 2000 to 2015. In addition, results of this study indicated that, previous studies have modifications related to this technique in 2011 more than other years.

---

#### **Highly Cited July/August 2018 (in the field of Environment/Ecology)**

Mardani, A., Zavadskas, E., Govindan, K., Amat Senin, A., & Jusoh, A. (2016). VIKOR technique: A systematic review of the state of the art literature on methodologies and applications. *Sustainability*, 8(1), 37.

**Times Cited: 53 (from Web of Science Core Collection)**

**Short summary.** The main objective of this paper is to present a systematic review of the VlseKriterijuska Optimizacija I Komoromisno Resenje (VIKOR) method in several application areas such as sustainability and renewable energy. This study reviewed a total of 176 papers, published in 2004 to 2015, from 83 high-ranking journals; most of which were related to Operational Research, Management Sciences, decision making, sustainability and renewable energy and were extracted from the "Web of Science and Scopus" databases. Papers were classified into 15 main application areas. Furthermore, papers were categorized based on the nationalities of authors, dates of publications, techniques and methods, type of studies, the names of the journals and studies purposes. The results of this study indicated that more papers on VIKOR technique were published in 2013 than in any other year. In addition, 13 papers were published about sustainability and renewable energy fields. Furthermore, VIKOR and fuzzy VIKOR methods, had the first rank in use. Additionally, the Journal of Expert Systems with Applications was the most significant journal in this study, with 27 publications on the topic. Finally, Taiwan had the first rank from 22 nationalities which used VIKOR technique.

---

#### **Highly Cited July/August 2018 2018 (in the field of Engineering)**

Zavadskas, E. K., Antucheviciene, J., Hajiagha, R., Hossein, S., & Hashemi, S. S. (2015). The interval-valued intuitionistic fuzzy MULTIMOORA method for group decision making in engineering. *Mathematical Problems in Engineering*, 2015.

**Times Cited: 54 (from Web of Science Core Collection)**

**Short summary.** Multiple criteria decision making methods have received different extensions under the uncertain environment in recent years. The aim of the current research is to extend the application of the MULTIMOORA method (Multiobjective Optimization by Ratio Analysis plus Full Multiplicative Form) for group decision making in the uncertain environment. Taking into account the advantages of IVIFS (interval-valued intuitionistic fuzzy sets) in handling the problem of uncertainty, the development of the interval-valued intuitionistic fuzzy MULTIMOORA (IVIF-



MULTIMOORA) method for group decision making is considered in the paper. Two numerical examples of real-world civil engineering problems are presented, and ranking of the alternatives based on the suggested method is described. The results are then compared to the rankings yielded by some other methods of decision making with IVIF information. The comparison has shown the conformity of the proposed IVIF-MULTIMOORA method with other approaches. The proposed algorithm is favorable because of the abilities of IVIFS to be used for imagination of uncertainty and the MULTIMOORA method to consider three different viewpoints in analyzing engineering decision alternatives.

---

#### **Highly Cited July/August 2018 2018 (in the field of Engineering)**

Liou, J. J., Tamošaitienė, J., Zavadskas, E. K., & Tzeng, G. H. (2016). New hybrid COPRAS-G MADM Model for improving and selecting suppliers in green supply chain management. *International Journal of Production Research*, 54(1), 114-134.

**Times Cited: 69 (from Web of Science Core Collection)**

**Short summary.** Greening the supply chain is an increasingly important concern for many business enterprises and a challenge for logistics management. Critical functions within green supply chain management are internal improvements and selection of green suppliers. This study proposes a novel, hybrid model that addresses dependent relationships between various criteria and the vague information coming from decision-makers. The Decision-making Trial and Evaluation Laboratory (DEMATEL) technique structures the relationships among criteria, thereby constructing an influential network relationship map (INRM). Meanwhile the DEMATEL-based, analytical network process (ANP) method aids in obtaining influential weights of the criteria. Decision-makers may hold diverse opinions and preferences due to incomplete information, differences in knowledge or simply conflicts that are inherent between various departments. This can make it difficult to judge the performance of alternatives. One remedy is to apply a modified Complex PROportional ASsessment of alternatives with Grey relations. Next, this is applied to improve each criterion for integration of the performance values obtained in closing the aspiration level from different expert opinions based on INRM. An empirical example using data from a Taiwanese electronics company is provided to demonstrate our proposed method. The results can provide firms with a knowledge-based understanding of the source of some problems, thus reducing the performance gaps and closing the aspiration levels. Finally, there is a discussion on certain managerial implications.

---

#### **Highly Cited July/August 2018 2018 (in the field of Computer Science)**

Zavadskas, E. K., Kaklauskas, A., Turskis, Z., & Tamošaitienė, J. (2009). Multi-attribute decision-making model by applying grey numbers. *Informatika*, 20(2), 305-320.

**Times Cited: 138 (from Web of Science Core Collection)**

**Short summary.** Multi-attribute analysis is a useful tool in many economical, managerial, constructional, etc, problems. The accuracy of performance measures in COPRAS (The multi-attribute COMplex PROportional ASsessment of alternatives) method is usually assumed to be accurate. This method assumes direct and proportional dependence of the Weight and utility degree of investigated versions on a system of attributes adequately describing the alternatives and on values and weights of the attributes. However, there is usually some uncertainty involved in all multi-attribute model inputs. The objective of this research is to demonstrate flow simulation can be used to reflect fuzzy inputs, which allows more complete interpretation of model results. A case study is used to reflect fuzzy the concept of general contractor choice of on the basis of multiple attributes of efficiency with fuzzy inputs applying CwOPRAS-G method. The research has concluded that the COPRAS-G method is appropriate to use.

---

**Highly Cited July/August 2018 2018 (in the field of Economics & Business)**

Zavadskas, E. K., Turskis, Z., & Kildienė, S. (2014). State of art surveys of overviews on MCDM/MADM methods. *Technological and economic development of economy*, 20(1), 165-179.

**Times Cited: 146 (from Web of Science Core Collection)**

**Short summary.** Decision-making is primarily a process that involves different actors: people, groups of people, institutions and the state. As a discipline, multi-criteria decision-making has a relatively short history. Since 1950s and 1960s, when foundations of modern multi-criteria decision-making methods have been laid, many researches devoted their time to development of new multi-criteria decision-making models and techniques. In the past decades, researches and development in the field have accelerated and seem to continue growing exponentially. Despite the intensive development worldwide, few attempts have been made to systematically present the theoretical bases and developments of multi-criteria decision-making methods. However, the methodological choices and framework for assessment of decisions are still under discussion. The article describes the situation with reviews of MCDM/MADM methods. Furthermore, there is a need for research to study the strengths and weaknesses of different decision-making methods.

---

**Highly Cited July/August 2018 2018 (in the field of Engineering)**

Zavadskas, E. K., Turskis, Z., & Tamošaitienė, J. (2010). Risk assessment of construction projects. *Journal of civil engineering and management*, 16(1), 33-46.

**Times Cited: 184 (from Web of Science Core Collection)**

**Short summary.** The paper presents risk assessment of construction projects. The assessment is based on the multi-attribute decision-making methods. The risk evaluation attributes are selected taking into consideration the interests and goals of the stakeholders as well as factors that have influence on the construction process efficiency and real estate value. Ranking of objects and determination of their optimality are determined by applying TOPSIS grey and COPRAS-G methods with attributes values determined at intervals. A background and a description of the proposed model are provided and key findings of the analysis are presented.

---

**Highly Cited July/August 2018 2018 (in the field of Engineering)**

Zavadskas, E. K., Kaklauskas, A., Turskis, Z., & Tamošaitienė, J. (2008). Selection of the effective dwelling house walls by applying attributes values determined at intervals. *Journal of Civil Engineering and Management*, 14(2), 85-93.

**Times Cited: 191 (from Web of Science Core Collection)**

**Short summary.** The higher life quality standards, the changes of habits and new well-being requirements have led to all increase in the demand for housing. Decision-making problems in construction management often involve it complex decision-making process in which multiple requirements and conditions have to be taken into consideration simultaneously. However, not every attribute used in multidimensional scaling is equally and precisely weighted in the real world. Thus quantitative and qualitative assessments are often required to deal with uncertainty, subjective and imprecise data. The accuracy of performance measures in common multi-attribute methods is usually assumed to be accurate. Grey theory is a new technique for performing prediction, relational analysis and decision-making in many areas. This paper considers the application of grey relations methodology for defining the utility of an alternative and is proposed as a method of multiple criteria complex proportional assessment of alternatives with grey relations (COPRAS-G). In this model parameters of the alternatives are determined by the grey relational grade and are expressed in intervals. A case study of assessing external walls of four alternatives was used to demonstrate the applicability and the effectiveness of the proposed

approach. The results Show that this method can be implemented as an effective decision aid in multi-attribute selection.

---

### **Highly Cited July/August 2018 2018 (in the field of Engineering)**

Mardani, A., Jusoh, A., & Zavadskas, E. K. (2015). Fuzzy multiple criteria decision-making techniques and applications–Two decades review from 1994 to 2014. *Expert systems with Applications*, 42(8), 4126-4148.

**Times Cited: 235 (from Web of Science Core Collection)**

**Short summary.** MCDM is considered as a complex decision-making tool involving both quantitative and qualitative factors. In recent years, several fuzzy FMCDM tools have been suggested to choosing the optimal probably options. The purpose of this paper is to review systematically the applications and methodologies of the fuzzy multi decision-making (FMCDM) techniques. This study reviewed a total of 403 papers published from 1994 to 2014 in more than 150 peer reviewed journals (extracted from online databases such as ScienceDirect, Springer, Emerald, Wiley, ProQuest, and Taylor & Francis). According to experts' opinions, these papers were grouped into four main fields: engineering, management and business, science, and technology. Furthermore, these papers were categorized based on authors, publication date, country of origin, methods, tools, and type of research (FMCDM utilizing research, FMCDM developing research, and FMCDM proposing research). The results of this study indicated that, in 2013, scholars have published papers more than other years. In addition, hybrid fuzzy MCDM in the integrated method and fuzzy AHP in the individual section were ranked as the first and second methods in use. Additionally, Taiwan was ranked as the first country that contributed to this survey, and engineering was ranked as the first field that has applied fuzzy DM tools and techniques.

---

### **Highly Cited July/August 2018 2018 (in the field of Economics & Business)**

Zavadskas, E. K., & Turskis, Z. (2011). Multiple criteria decision making (MCDM) methods in economics: an overview. *Technological and economic development of economy*, 17(2), 397-427.

**Times Cited: 268 (from Web of Science Core Collection)**

**Short summary.** The main research activities in economics during the last five years have significantly increased. The main research fields are operation research and sustainable development. The philosophy of decision making in economics is to assess and select the most preferable solution, implement it and to gain the biggest profit. Preferences are used in a lot of problem situations both in individual and organizational decision making processes. A number of effective decision making methods that support decisions under conditions of multiple criteria have appeared in the last decade. This paper presents a panorama of decision making methods in economics and summarizes the most important results and applications over the last five years. This paper considers decision making in light of the recent developments of multiple criteria decision making methods (because classical methods are overviewed in a lot of earlier publications). Authors of different approaches, pioneering studies and works are presented in short.

---

## ***New scientific papers***

***The list presents papers co-authored by the members of EWG-ORSDC and published in 2018 only in journals with IF.***

Amoozad Mahdiraji Hannan; Beheshti Moein; Razavi Hajiagha Seyed Hossein; Zavadskas Edmundas Kazimieras. A fuzzy binary bi objective transportation model: Iranian steel supply network. *Transport*. Vilnius: VGTU Press. ISSN 1648-4142. vol. 33, iss. 3 (2018), p. 810-820.

Cavallaro Fausto; Zavadskas Edmundas Kazimieras; Štreimikienė Dalia. Concentrated solar power (CSP) hybridized systems. Ranking based on an intuitionistic fuzzy multi-criteria algorithm. *Journal of cleaner production*. Oxford: Elsevier Ltd.. ISSN 0959-6526. Vol. 179 (2018), p. 407-416.

Čereška Audrius; Podvieszko Askoldas; Zavadskas Edmundas Kazimieras. Assessment of different metals screw joint parameters by using multiple criteria analysis methods. *Metals*. Basel: MDPI AG. ISSN 2075-4701. vol. 8, iss. 5 (2018), p. 1-16.

Čereška Audrius; Zavadskas Edmundas Kazimieras; Bučinskas Vytautas; Podvezko Valentinas; Šutinys Ernestas. Analysis of steel wire rope diagnostic data applying multi-criteria methods. *Applied sciences*. Basel: MDPI AG. ISSN 2076-3417. Vol. 8, iss. 2 (2018), p. 1-22.

Chatterjee Kajal; Pamucar Dragan; Zavadskas Edmundas Kazimieras. Evaluating the performance of suppliers based on using the R'AMATEL-MAIRCA method for green supply chain implementation in electronics industry. *Journal of cleaner production*. London: Elsevier Ltd.. ISSN 0959-6526. Vol. 184 (2018), p. 101-129.

Chatterjee Kajal; Zavadskas Edmundas Kazimieras; Tamošaitienė Jolanta; Adhikary Krishnendu; Kar Samarjit. A hybrid MCDM technique for risk management in construction projects. *Symmetry*. Special issue: Civil engineering and symmetry. Basel: MDPI. Vol. 10, iss. 2 (2018), p. 1-30.

Dahooei Jalil Heidary; Zavadskas Edmundas Kazimieras; Vanaki Amir Salar; Firoozfar Hamid Reza; Keshavarz-Ghorabae Mehdi. An evaluation model of business intelligence for enterprise systems with new extension of CODAS (CODAS-IVIF). *E&M Economics and Management = E&M Ekonomie a management*. Liberec: Technical University of Liberec. ISSN 1212-3609. vol. 21, iss. 3 (2018), p. 171-187. [M.kr.:02T; 03S] [Aut.lankų sk.: 1.214]

Dahooie Jalil Heidary; Zavadskas Edmundas Kazimieras; Abolhasani Mahdi; Vanaki Amirsalar; Turskis Zenonas. A novel approach for evaluation of projects using an interval-valued fuzzy Additive Ratio Assessment (ARAS) method: a case study of oil and gas well drilling projects. *Symmetry*. Basel: MDPI AG. ISSN 2073-8994. Vol. 10, iss. 2 (2018), p. 1-32.

Durdyev Serdar; Zavadskas Edmundas Kazimieras; Thurnell Derek; Banaitis Audrius; Ihtiyar Ali. Sustainable construction industry in Cambodia: awareness, drivers and barriers. *Sustainability*. Basel: MDPI AG. ISSN 2071-1050. Vol. 10, iss. 2 (2018), p. 1-19.

Hashemi Hassan; Mousavi Seyed Meysam; Zavadskas Edmundas Kazimieras; Chalekaee Alireza; Turskis Zenonas. A new group decision model based on grey-intuitionistic Fuzzy-ELECTRE and VIKOR for contractor assessment problem. *Sustainability*. Basel: MDPI. ISSN 2071-1050. vol. 10, iss. 5 (2018), p. 1-19.

Hosseini M. Reza; Martek Igor; Chileshe Nicholas; Zavadskas Edmundas Kazimieras; Arashpour Mehrdad. Assessing the influence of virtuality on the effectiveness of engineering project networks: "Big five theory" perspective. *Journal of construction engineering and management*. Reston: ASCE. ISSN 0733-9364. Vol. 144, iss. 7 (2018), p. 1-12.

Hosseini M. Reza; Martek Igor; Zavadskas Edmundas Kazimieras; Aibinu Ajibade A; Arashpour Mehrdad; Chileshe Nicholas. Critical evaluation of off-site construction research: a Scientometric

analysis : review. Automation in construction. Amsterdam: Elsevier Science BV. ISSN 0926-5805. Vol. 87 (2018), p. 235-247.

Kaklauskas Artūras; Herrera-Viedma Enrique; Echenique Vladimir; Zavadskas Edmundas Kazimieras; Ubartė Ieva; Mostert Andre; Podvezko Valentinas; Binkytė Arūnė; Podviezko Askoldas. Multiple criteria analysis of environmental sustainability and quality of life in post-Soviet states. Ecological indicators. Amsterdam: Elsevier Science BV. ISSN 1470-160X. Vol. 89 (2018), p. 781-807.

Kaklauskas Artūras; Zavadskas Edmundas Kazimieras; Banaitis Audrius; Meidutė-Kavaliauskienė Ieva; Liberman Amir; Dzitac Simona; Ubartė Ieva; Binkytė Arūnė; Čerkauskas Justas; Kuzminskė Agnė; Naumčik Andrej. A neuro-advertising property video recommendation system. Technological forecasting and social change. New York: Elsevier Science INC. ISSN 0040-1625. Vol. 131 (2018), p. 78-93.

Kaklauskas Artūras; Zavadskas Edmundas Kazimieras; Radzevičienė Asta; Ubartė Ieva; Podviezko Askoldas; Podvezko Valentinas; Kuzminskė Agnė; Banaitis Audrius; Binkytė Arūnė; Bučinskas Vytautas. Quality of city life multiple criteria analysis. Cities. Oxford: Elsevier. ISSN 0264-2751. 72, Part A (2018), p. 82-93.

Kapse Chanduraj Pious; Kumar Anil; Dash Manoj Kumar; Zavadskas Edmundas Kazimieras; Luthra Sunil. Developing textile entrepreneurial inclination model by integrating experts mining and ISM-MICMAC. International journal of production research. Oxon: Taylor & Francis Ltd. ISSN 0020-7543. vol. 56, iss. 14 (2018), p. 4709-4728.

Karabasevic Darjan; Zavadskas Edmundas Kazimieras; Stanujkic Dragisa; Popovic Gabrijela; Brzakovic Miodrag. An approach to personnel selection in the IT industry based on the EDAS method. Transformations in business and economics. Kaunas: Vilniaus universiteto Kauno fakultetas. ISSN 1648-4460. Vol. 17, iss. 2 (2018), p. 55-65.

Keshavarz Ghorabae Mehdi; Amiri Maghsoud; Zavadskas Edmundas Kazimieras; Antuchevičienė Jurgita. A new hybrid fuzzy MCDM approach for evaluation of construction equipment with sustainability considerations. Archives of Civil and Mechanical Engineering. Wroclaw: Elsevier B.V.. ISSN 1644-9665. Vol. 18, iss. 1 (2018), p. 32-49.

Keshavarz-Ghorabae Mehdi; Amiri Maghsoud; Zavadskas Edmundas Kazimieras; Turskis Zenonas; Antuchevičienė Jurgita. Simultaneous evaluation of criteria and alternatives (SECA) for multi-criteria decision-making. Informatica. Vilnius: Vilniaus universiteto Matematikos ir informatikos institutas. ISSN 0868-4952. vol. 29, no. 2 (2018), p. 265-280.

Keshavarz-Ghorabae Mehdi; Amiri Maghsoud; Zavadskas Edmundas Kazimieras; Turskis Zenonas; Antuchevičienė Jurgita. Ranking of bridge design alternatives: a TOPSIS-FADR method. Baltic journal of road and bridge engineering. Riga: Riga Technical University. ISSN 1822-427X. vol. 13, iss. 3 (2018), p. 209-237.

Keshavarz-Ghorabae Mehdi; Amiri Maghsoud; Zavadskas Edmundas Kazimieras; Turskis Zenonas; Antuchevičienė Jurgita. An extended step-wise weight assessment ratio analysis with symmetric interval Type-2 fuzzy sets for determining the subjective weights of criteria in Multi-Criteria Decision-Making problems. Symmetry. Basel: MDPI AG. vol. 10, iss. 4 (2018), p. 1-15.

Keshavarz-Ghorabae Mehdi; Amiri Maghsoud; Zavadskas Edmundas Kazimieras; Turskis Zenonas; Antuchevičienė Jurgita. A comparative analysis of the rank reversal phenomenon in the EDAS and TOPSIS methods. Economic computation and economic cybernetics studies and research. Bucharest: Academy of Economic Studies. ISSN 0424-267X. vol. 52, iss. 3 (2018), p. 121-134.

Krishankumar Raghunathan; Ravichandran Kattur Soundarapandi; Premaladha Jayaraman; Kar Samarjit; Zavadskas Edmundas Kazimieras; Antuchevičienė Jurgita. A decision framework under

a linguistic hesitant fuzzy set for solving multi-criteria group decision making problems. *Sustainability*. Basel: MDPI. ISSN 2071-1050. vol. 10, iss. 8 (2018), p. 1-21.

Krylovas Aleksandras; Kosareva Natalja; Zavadskas Edmundas Kazimieras. WEBIRA - comparative analysis of weight balancing method. *International Journal of Computers, Communications & Control (IJCCC)*. Agora: Agora University Editing House. ISSN 1841-9836. 12, 2 (2017), p. 238-253.

Krylovas Aleksandras; Kosareva Natalja; Zavadskas Edmundas Kazimieras. Scheme for statistical analysis of some parametric normalization classes. *International journal of computers, communications & control (IJCCC)*. Oradia: Agora University. ISSN 1841-9836. vol. 13, iss. 6 (2018), p. 972-987.

Kumar Anil; Kaviani Mohamad Amin; Bottani Eleonora; Dash Manoj Kumar; Zavadskas Edmundas Kazimieras. Investigating the role of social media in polio prevention in India: a Delphi-DEMATEL approach. *Kybernetes*. Bingley: Emerald Publishing Limited. ISSN 0368-492X. Vol. 47, iss. 5 (2018), p. 1053-1072.

Mahdiraji Hannan Amoozad; Arzaghi Sepas; Stauskis Gintaras; Zavadskas Edmundas Kazimieras. A hybrid fuzzy BWM-COPRAS method for analyzing key factors of sustainable architecture. *Sustainability*. Basel: MDPI AG. Vol. 10, iss. 5 (2018), p. 1-26.

Mahdiraji Hannan Amoozad; Razavi Hajiagha Seyed Hossein; Hashemi Shide Sadat; Zavadskas Edmundas Kazimieras. Bi-objective mean-variance method based on Chebyshev inequality bounds for multi-objective stochastic problems. *RAIRO-operations research*. Les Ulis: EDP Sciences. ISSN 0399-0559. vol. 52, no. 4 (2018), p. 1201-1217.

Mardani Abbas; Nilashi Mehrbakhsh; Zavadskas Edmundas Kazimieras; Awang Siti Rahmah; Zare Habib; Jamal Noriza Mohd. Decision making methods based on fuzzy aggregation operators: three decades review from 1986 to 2017. *International journal of information technology & decision making*. Singapore: World Scientific Publishing Company. ISSN 0219-6220. Vol. 17, iss. 2 (2018), p. 391-466.

Martek Igor; Hosseini M. Reza; Shrestha Asheem; Zavadskas Edmundas Kazimieras; Seaton Stewart. The sustainability narrative in contemporary architecture: falling short of building a sustainable future. *Sustainability*. Basel: MDPI AG. ISSN 2071-1050. Vol. 10, iss. 4 (2018), p. 1-18.

Mombeini Hossein; Yazdani-Chamzini Abdolreza; Štreimikienė Dalia; Zavadskas Edmundas Kazimieras. New fuzzy logic approach for the capability assessment of renewable energy technologies: Case of Iran. *Energy & Environment*. London: SAGE Publications. ISSN 0958-305X. vol. 29, iss. 4 (2018), p. 511-532.

Nilashi Mehrbakhsh; Cavallaro Fausto; Mardani Abbas; Zavadskas Edmundas Kazimieras; Samad Sarminah; Ibrahim Othman. Measuring country sustainability performance using ensembles of neuro-fuzzy technique. *Sustainability*. Basel: MDPI AG. vol. 10, iss. 8 (2018), p. 1694-1702.

Pamučar Dragan; Stević Željko; Zavadskas Edmundas Kazimieras. Integration of interval rough AHP and interval rough MABAC methods for evaluating university web pages. *Applied soft computing*. Amsterdam: Elsevier Science. ISSN 1568-4946. Vol. 67 (2018), p. 141-163.

Radovic Dunja; Stević Željko; Pamučar Dragan; Zavadskas Edmundas Kazimieras; Badi Ibrahim; Antuchevičienė Jurgita; Turskis Zenonas. Measuring performance in transportation companies in developing countries: a novel rough ARAS model. *Symmetry*. Basel: MDPI AG. vol. 10, iss. 10 (2018), p. 1-24.

Shen Kao-Yi; Zavadskas Edmundas Kazimieras; Tzeng Gwo-Hshiung. Updated discussions on 'Hybrid multiple criteria decision-making methods: a review of applications for sustainability

issues'. Economic research-ekonomska istrazivanja. Oxon: Taylor & Francis Ltd. ISSN 1331-677X. vol. 31, iss. 1 (2018), p. 1437-1452.

Šikšnelytė Indrė; Zavadskas Edmundas Kazimieras; Štreimikienė Dalia; Sharma Deepak. An overview of multi-criteria decision-making methods in dealing with sustainable energy development issues. Energies. Basel: MDPI AG. ISSN 1996-1073. vol. 11, no 10 (2018), [p. 1-21].

Stević Željko; Pamučar Dragan; Subotić Marko; Antuchevičienė Jurgita; Zavadskas Edmundas Kazimieras. The location selection for roundabout construction using Rough BWM-Rough WASPAS approach based on a new rough hamy aggregator. Sustainability. Basel: MDPI. vol. 10, iss. 8 (2018), p. 1-27.

Stević Željko; Vasiljevic Marko; Zavadskas Edmundas Kazimieras; Sremac Sinisa; Turskis Zenonas. Selection of carpenter manufacturer using fuzzy EDAS method. Inžinerinė ekonomika = Engineering economics. Kaunas: Technologija. ISSN 1392-2785. vol. 29, iss. 3 (2018), p. 281-290.

Štreimikienė Dalia; Šikšnelytė Indrė; Zavadskas Edmundas Kazimieras; Cavallaro Fausto. The impact of greening tax systems on sustainable energy development in the Baltic States. Energies. Basel: MDPI AG. ISSN 1996-1073. vol. 11, iss. 5 (2018), p. 1-29.

Vinogradova Irina; Podvezko Valentinas; Zavadskas Edmundas Kazimieras. The recalculation of the weights of criteria in MCDM methods using the bayes approach. Symmetry. Basel: MDPI AG. vol. 10, iss. 6 (2018), p. 1-18.

Yapici Pehlivan Nimet; Şahin Aynur; Zavadskas Edmundas Kazimieras; Turskis Zenonas. A comparative study of integrated FMCDM methods for evaluation of organizational strategy development. Journal of business economics and management. Vilnius: VGTU Press. ISSN 1611-1699. vol. 19, iss. 2 (2018), p. 360-381.

Yazdani Morteza; Chatterjee Prasenjit; Zavadskas Edmundas Kazimieras; Štreimikienė Dalia. A novel integrated decision-making approach for the evaluation and selection of renewable energy technologies. Clean Technologies and Environmental Policy. Niujorkas: Springer. ISSN 1618-954X. Vol. 20, Iss. 2 (2018), p. 403-420.

Zavadskas Edmundas Kazimieras; Antuchevičienė Jurgita; Vilutienė Tatjana; Adeli Hojjat. Sustainable decision-making in civil engineering, construction and building technology. Sustainability. Basel: MDPI AG. ISSN 2071-1050. Vol. 10, iss. 1 (2018), p. 1-21.

Zavadskas Edmundas Kazimieras; Kaklauskas Artūras; Kalibatas Darius; Turskis Zenonas; Krutinis Mindaugas; Bartkienė Lina. Applying the TOPSIS-F method to assess air pollution in Vilnius. Environmental engineering and management journal. Iasi: "Gheorghe Asachi" Technical University of Iasi. ISSN 1582-9596. vol. 17, iss. 9 (2018), p. 2041-2050. [

Zavadskas Edmundas Kazimieras; Nunić Zdravko; Stjepanović Željko; Prentkovskis Olegas. A Novel Rough Range of Value Method (R-ROV) for selecting Automatically Guided Vehicles (AGVs). Studies in informatics and control. Bucharest: National Institute for Research & Development in Informatics. ISSN 1220-1766. vol. 27, iss. 4 (2018), p. 385-394.

Zavadskas Edmundas Kazimieras; Stević Željko; Tanackov Ilija; Prentkovskis Olegas. A novel multicriteria approach – Rough Step-wise Weight Assessment Ratio Analysis method (R-SWARA) and its application in logistics. Studies in informatics and control. Bucharest: National Institute for Research & Development in Informatics. ISSN 1220-1766. Vol. 27, no. 1 (2018), p. 97-106.

Zolfani Sarfaraz Hashemkhani; Yazdani Morteza; Zavadskas Edmundas Kazimieras. An extended stepwise weight assessment ratio analysis (SWARA) method for improving criteria prioritization process. Soft computing. Berlin: Springer. ISSN 1432-7643. vol. 22, iss. 22 (2018), p. 7399-7405.

Peterlin Judita; Dimovski Vlado; Tvaronavičienė Manuela; Grah Barbara; Kaklauskas Artūras. The strategic process of developing social aspects of sustainability through the vision reflection in

business education. *Technological and Economic Development of Economy*. Vilnius: VGTU Press. ISSN 2029-4913. vol. 24, iss. 4 (2018), p. 1718-1736.

Trinkūnas Vaidotas; Tupėnaitė Laura; Raslanas Saulius; Siniak Nikolai; Kaklauskas Artūras; Gudauskas Renaldas; Naimavičienė Jurga; Binkytė Arūnė; Prialgauskas Darius; Tunčikienė Živilė. Sustainable development of real estate: decision support model and recommendations for the period of crisis. *International journal of strategic property management*. Vilnius: VGTU Press. ISSN 1648-715X. vol. 22, iss. 4 (2018), p. 252-264.

Tupėnaitė Laura; Kaklauskas Artūras; Lill Irene; Geipele Ineta; Naimavičienė Jurga; Kanapeckienė Loreta; Kauskale Linda. Sustainability assessment of the new residential projects in the Baltic States: a multiple criteria approach. *Sustainability*. Basel: MDPI AG. ISSN 2071-1050. Vol. 10, iss. 5 (2018), p. 1-21.

Tupėnaitė Laura; Kaklauskas Artūras; Voitov Igor; Trinkūnas Vaidotas; Siniak Nikolai; Gudauskas Renaldas; Naimavičienė Jurga; Kanapeckienė Loreta. Multiple criteria assessment of apartment building performance for refurbishment purposes. *International journal of strategic property management*. Vilnius: VGTU Press. ISSN 1648-715X. vol. 22, iss. 4 (2018), p. 236-251.

Kaklauskas Artūras; Dzemyda Gintautas; Tupėnaitė Laura; Voitau Ihar; Kurasova Olga; Naimavičienė Jurga; Rassokha Yauheni; Kanapeckienė Loreta. Artificial neural network-based decision support system for development of an energy-efficient built environment. *Energies*. Basel: MDPI. vol. 11, iss. 8 (2018), p. 1-20.

Kaklauskas Artūras; Banaitis Audrius; Ferreira Fernando A. F.; Ferreira Joao J. M.; Amaratunga Dilanthi; Lepkova Natalija; Ubartė Ieva; Banaitienė Nerija. An evaluation system for university-industry partnership sustainability: enhancing options for entrepreneurial universities. *Sustainability*. Basel: MDPI AG. ISSN 2071-1050. Vol. 10, iss. 1 (2018), p. 1-17.

Durdyev Serdar; Ihtiyar Ali; Banaitis Audrius; Thurnell Derek. The construction client satisfaction model: a PLS-SEM approach. *Journal of civil engineering and management*. Vilnius: Technika. ISSN 1392-3730. Vol. 24, iss. 1 (2018), p. 31-42.

Marques Sara C.R.; Ferreira Fernando A. F.; Meidutė-Kavaliauskienė Ieva; Banaitis Audrius. Classifying urban residential areas based on their exposure to crime: a constructivist approach. *Sustainable cities and society*. Amsterdam: Elsevier Science BV. ISSN 2210-6707. Vol. 39 (2018), p. 418-429.

Trojanek Maria; Marcin Anholcer; Banaitis Audrius; Trojanek Radoslaw. A generalised model of ground lease pricing. *Sustainability*. MDPI AG: Basel. vol. 10, iss. 9 (2018), p. 1-21.

Vilutienė Tatjana; Ignatavičius Česlovas. Towards sustainable renovation: key performance indicators for quality monitoring. *Sustainability*. Basel: MDPI AG. ISSN 2071-1050. Vol. 10, iss. 6 (2018), p. 1-16.

2018 - Ustinovičius Leonas; Popov Vladimir; Čepurnaitė Jovita; Vilutienė Tatjana; Samofalov Michail; Miedziałowski Czesław. BIM-based process management model for building design and refurbishment. *Archives of civil and mechanical engineering*. Wrocław: Elsevier B.V.. ISSN 1644-9665. vol. 18, iss. 4 (2018), p. 1136-1149.

Valančius Kęstutis; Vilutienė Tatjana; Rogoża Artur. Analysis of the payback of primary energy and CO2 emissions in relation to the increase of thermal resistance of a building. *Energy and buildings*. Lausanne: Elsevier B.V.. ISSN 0378-7788. vol. 179 (2018), p. 39-48.

Montalbán-Domingo, L., García-Segura, T., Sanz, M. A., & Pellicer, E. (2018). Social sustainability criteria in public-work procurement: An international perspective. *Journal of Cleaner Production*, 198, 1355-1371.



- Castillo, T., Alarcón, L. F., & Pellicer, E. (2018). Influence of organizational characteristics on construction project performance using corporate social networks. *Journal of Management in Engineering*, 34(4), 1-9.
- Sierra, L. A., Yepes, V., & Pellicer, E. (2018). A review of multi-criteria assessment of the social sustainability of infrastructures. *Journal of Cleaner Production*, 187, 496-513.
- Castillo, T., Alarcón, L. F., & Pellicer, E. (2018). Finding Differences among Construction Companies Management Practices and Their Relation to Project Performance. *Journal of Management in Engineering*, 34(3), 1-13.
- Jordan-Palomar, I., Tzortzopoulos, P., García-Valldecabres, J., & Pellicer, E. (2018). Protocol to Manage Heritage-Building Interventions Using Heritage Building Information Modelling (HBIM). *Sustainability*, 10(4), 908.
- Sierra, L. A., Yepes, V., García-Segura, T., & Pellicer, E. (2018). Bayesian network method for decision-making about the social sustainability of infrastructure projects. *Journal of Cleaner Production*, 176, 521-534.
- Ortiz, J. I., Pellicer, E., & Molenaar, K. R. (2018). Management of time and cost contingencies in construction projects: a contractor perspective. *Journal of Civil Engineering and Management*, 24(3), 254-264.
- Maliene, V., Dixon-Gough, R., & Malys, N. (2018). Dispersion of relative importance values contributes to the ranking uncertainty: Sensitivity analysis of Multiple Criteria Decision-Making methods. *Applied Soft Computing*, 67, 286-298.
- Dičiūnaitė-Rauktienė, R., Gurskienė, V., Burinskienė, M., & Maliene, V. (2018). The usage and perception of pedestrian zones in Lithuanian cities: Multiple criteria and comparative analysis. *Sustainability*, 10(3), 818.
- Bielinskas, V., Burinskienė, M., & Podvieszko, A. (2018). Choice of abandoned territories conversion scenario according to MCDA methods. *Journal of Civil Engineering and Management*, 24(1), 79-92.
- Ghasemi, F., Sari, M. H. M., Yousefi, V., Falsafi, R., & Tamošaitienė, J. (2018). Project Portfolio Risk Identification and Analysis, Considering Project Risk Interactions and Using Bayesian Networks. *Sustainability*, 10(5), 1609.
- Hatefi, S. M., & Tamošaitienė, J. (2018). Construction projects assessment based on the sustainable development criteria by an integrated fuzzy AHP and improved GRA model. *Sustainability*, 10(4), 991.
- Asadi, P., Zeidi, J. R., Mojibi, T., Yazdani-Chamzini, A., & Tamošaitienė, J. (2018). Project risk evaluation by using a new fuzzy model based on Elena guideline. *Journal of Civil Engineering and Management*, 24(4), 284-300.
- Leśniak, A., Kubek, D., Plebankiewicz, E., Zima, K., & Belniak, S. (2018). Fuzzy AHP Application for Supporting Contractors' Bidding Decision. *Symmetry*, 10(11), 642.
- Radziszewska-Zielina, E., Kania, E., & Śladowski, G. (2018). Problems of the Selection of Construction Technology for Structures in the Centres of Urban Agglomerations. *Archives of Civil Engineering*, 64(1), 55-71.

See full list on <https://www.euro-online.org/websites/orsdce/articles-published/>

## PhD Dissertations defended during 2018

### Big data analytics recommender system for housing health and safety 2018

Arūnė Binkytė

**Scientific supervisor:** Prof. Dr. Habil. Artūras Kaklauskas

**Research object.** This dissertation focuses on the management of safe and healthy housing in micro, meso and macro environment in order to keep it safe and healthy, according to the needs of stakeholder groups.

**Aim and Tasks of the Work.** The aim of the dissertation is to develop an integrated big data analytics recommender system for housing health and safety that will allow to manage safe and healthy house for the stakeholder groups.

In order to reach the research aim, the following tasks have been set out:

1. To analyse the research results from various countries on the importance of the big data assessment and management of safe and healthy housing and to identify what makes up the assessment of the life cycle of safe and healthy housing.
2. To analyse micro, meso and macro environment factors that affect safe and healthy housing, to prove the benefits of the integrated big data analytics recommender system for housing health and safety, to determine on the methods for big data analytics of safe and healthy housing and to decide on the assessment methodology.
3. To assess micro, meso and macro factors, to validate the reliability of this assessment by means of sensitivity analysis, and to examine practical scenarios.
4. To build the analytics recommender systems which complexly analyse safe and healthy housing.
5. To build the integrated big data analytics recommender system for housing health and safety and to prepare the databases and model bases required by this system.

**Research methodology.** The scientific research adopted multiple criteria methods (COPRAS, INVAR, safe and healthy housing analytics, multiple criteria object utility degree optimisation) and produced another multiple criteria method, called CREST. The methods proposed for the criteria weight assignment are either expert judgement or the integrated criteria weight assignment. The benefits of the analytics recommender system were proved by means of LOGIT, a big data statistical analysis method. All recommender systems are based on collaborative filtering.

**Defended Statements.**

1. Using created innovative multi criteria decision support CREST method could be determine the level of crisis temperature, trends in the Lithuanian construction and real estate market and provided recommendations.
2. The integrated BDHOSS is a collection of established mathematical models and methods vital when complex management issues have to be addressed, and offers quantitative and qualitative issue analysis that may help with stakeholder decisions.

**Approval of the thesis.** The key research findings were announced in nine research articles: four in scientific journals listed in Clarivate Analytics' Web of Science, one in the scientific journal "Science – future of Lithuania", two in peer-reviewed international conferences proceedings, and two in other international and national conference proceedings. The dissertation's research findings were also presented at four scientific conferences in Lithuania and abroad.

**Practical value.** The main practical benefit of these research results is faster and more accurate assessment of safe and healthy housing, and timely recommendations on ways to eliminate or mitigate adverse outcomes. Another aim is lower labour costs by facilitating a smooth decision making process related to housing health and safety issues.

The research findings were put to practice during the following projects: "Creating the national certification model for healthy housing", a contract research project; "Students Achieving Valuable Energy Savings" (SAVES), a project within the Intelligent Energy – Europe (IEE) programme; and "Greening the Business: Green Business Management Trainings" (GreenB; 2015-1-FR01-KA204-015377) and "The iProfessional" (iPro; 540097-LLP-1-2013-1-BG-ERASMUS-EQR), two ERASMUS+ projects. The systems developed by this PhD candidate were adopted and used for the Erasmus+ teaching process.

*Editor's comments*

Dear EWG-ORSDCE members, dear friends,

Next year all members of EWG-ORSDCE are welcome to participate in the forthcoming 17th Colloquium „Sustainable decisions in Built Environment“, and 7th meeting of EURO working group OR in Sustainable Development and Civil Engineering that will be held on 15th of May, 2019 in Vilnius, Lithuania. In addition, you are invited to the 30th EURO Conference that will be held on 23-26 June 2019 in Dublin, Ireland. 2018 EURO Working Group "OR in Sustainable Development and Civil Engineering (ORSDCE)" will organize the invited session in the field "OR for Sustainable Development". The papers presented in this session are welcome for publishing in scientific journals: Technological and Economic Development of Economy, Journal of Civil Engineering and Management, Journal of Business Economics and Management, International Journal of Strategic Property Management, and Engineering Structures and Technologies.

On behalf of the Editorial Board of EWG-ORSDCE Newsletter  
Tatjana Vilutienė

EWG-ORSDCE Newsletter Editorial Board: Edmundas Kazimieras Zavadskas, Tatjana Vilutienė