

# Integrating education with consumer behaviour relevant to energy efficiency and climate change at the Universities of Russia, Sri Lanka and Bangladesh (BECK)

## MODULE SPECIFICATION

Originating Institution, Department	Module Co-ordinator(s)
Vilnius Gediminas Technical University, Department of Construction Management and Real Estate	Prof. Arturas Kaklauskas Dr. Ieva Ubarte

## TITLE OF THE MODULE

Title of the module	Module code <sup>1</sup>
Multi-criteria Optimisation and Decision Support Systems	STVND17001

## PROGRAMME(S) IN WHICH TO BE OFFERED:

Civil Engineering

## LEVEL OF STUDIES<sup>2</sup>

First cycle (BSc/BA) <input type="checkbox"/>	Second cycle (MSc/MA) <input type="checkbox"/>	Third cycle (PhD) <input checked="" type="checkbox"/>
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## CREDITS AND LEARNING HOURS

Credit Value <sup>3</sup>	ECTS Value <sup>4</sup>	Indicative academic learning hours <sup>5</sup>	Length (in Semesters) <sup>6</sup>	Year in which to be offered
9	9	240	1	1 (PhD)

## ANNOTATION OF THE MODULE<sup>7</sup>

<sup>1</sup> To be indicated by the Institution

<sup>2</sup> According to the Framework of Qualifications for the European Higher Education Area, Annex 8: [http://www.aic.lv/ace/ace\\_disk/Bologna/Bergen\\_conf/Reports/EQFreport.pdf](http://www.aic.lv/ace/ace_disk/Bologna/Bergen_conf/Reports/EQFreport.pdf)

<sup>3</sup> Permissible credit values as set out in Institution's Academic Regulations

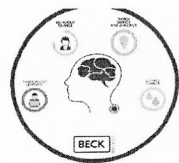
<sup>4</sup> European Credit Transfer System, 1 ECTS = 25-30 academic learning hours. Please refer to ECTS Users' Guide: [https://ec.europa.eu/education/ects/users-guide/docs/ects-users-guide\\_en.pdf](https://ec.europa.eu/education/ects/users-guide/docs/ects-users-guide_en.pdf)

<sup>5</sup> 1 academic learning hour is equal to 45 minutes

<sup>6</sup> Indicate 0.5, 1, 1.5 or 2

<sup>7</sup> Please provide brief summary of the module, up to 200 words





In Multiple-criteria decision analysis foundations, concepts and definitions: a typology, representations and definitions, generating nondominated solutions, determination of criteria values and weights, solving MCDM problems, MCDM methods, Decision-making paradox.

Integration of multiple criteria decision making methods with recommender, advisory, expert, data and text mining methods. Combination of multiple criteria decision making systems with recommender, advisory, expert, data and text mining systems.

Intelligent Decision Support Systems: Intelligent User Interface; Integration of Artificial Intelligent and DBMS Technologies; Recommender, Advisory and Expert Systems and their Integration with Decision Support Systems; Text Analytics and Mining based DSSs; Data Mining as an Important Component of Intelligent Decision Support Systems; Integration of Data Analytics and Decision Support Systems; Integration of Remote Sensing into a Decision Support Systems; Biometrics-based Decision Support Systems; Voice Recognition Decision Support Systems; Speech Recognition and Understanding Decision Support Systems; Adaptive Biometrics-based Decision Support Systems; Ambient Intelligence and the Internet of a Things-based Decision Support Systems; Sensory Decision Support Systems; Robotic Decision Support Systems. Intelligent Decision Support Systems in climate change.

### AIM OF THE MODULE<sup>8</sup>

To acquaint doctoral students with the theory of multi-objective selection and decision support systems (SPS) and their practical application in climate change and other fields

### MOOC LEARNING AND TEACHING STRATEGIES

The MOOC course has to contribute to an opening up of education to the benefit of both learners and the society at large while reflecting values such as equity, quality and diversity. The common features of the course are:

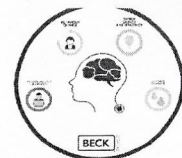
- Openness to learners: open entry (no formal pre-requisites), freedom to study at the time, place and pace of your choice, flexible pathways, fit for a wide variety of lifelong learners;
- Digital openness: courses available online;
- Learner-centred approach: courses aid students to construct their own learning from a rich environment, and to share and communicate it with others;
- Independent learning: a MOOC provides high quality materials to enable the progress of an independent learner through self-study;
- Media-supported interaction: course materials make best use of online affordances (interactivity, communication, collaboration) as well as rich media (video and audio) to engage students with their learning.
- Recognition options: successful course completion will be recognised as indicating worthwhile educational achievement.
- Quality focus: focus on quality in the production and presentation of a MOOC.
- Spectrum of diversity: the course is inclusive and accessible to very diverse citizens.

The delivery of the new certificated and recognized adaptive BECK MOOCs is enabled by the use of the innovative Simulated Big Data Interuniversity Networked Affective Educational Centre. Affective computing technologies and neuro decision matrices, big data and text analytics, and an adapted Yerkes–Dodson law are the foundation of the BECK system. Affective computing is the

<sup>8</sup> Aim of the module must correspond to the BECK Capacity Building Framework







study and development of systems and devices that can recognize, interpret, process and simulate human affects. The BECK system will interpret the emotional state of a student and adapt the learning process to that particular student by providing an appropriate response to relevant emotions and requirements.

Six major components have been identified for the development of the Simulated Big Data Interuniversity Networked Affective Educational Centre (the BECK Centre):

- 1) Adaptive MOOCs;
- 2) Computer learning systems;
- 3) Big Data Mining;
- 4) Affective Tutoring System;
- 5) Access to e-sources;
- 6) Moodle Virtual Learning Environment.

The computer learning system is understood as an object (with its components) for managing and investigating data, information, and expressed and unexpressed knowledge. It is a modelling system that accumulates data and information from various resources and then processes that data and information by means of various mathematical, logical and informational models.

The data mining will enable integrated analysis of the following data and information from multiple locations: weather, climate, dwelling envelope, utilities, occupancy, market data (government data, trade association data, financial data from major players, customer surveys), climate change, best practices, human influences, the behaviour of users, etc.

The Affective Tutoring System integrates the student self-assessment procedures with biometric (facial expression analysis) and intelligent techniques and technologies.

The centre will offer open-source videos, simulators (calculators and software), case studies from the best universities around the world to enhance the module.

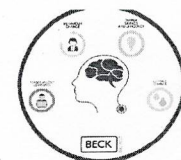
The following main features have been identified for the development of the Moodle Virtual Learning Environment: adaptable design, modern and easy to use interface, personalized dashboard, collaborative tools and activities (Assignments, Chat, Choice, Database, Feedback, Forum, Glossary, Lesson, Quiz, Survey, Wiki, Workshop), all-in-one calendar, convenient file management, simple and intuitive text editor, notifications, progress track, secure authentication and mass enrolment, multilingual capability, high interoperability, user role and permission management, etc.

MOOC is accessible for various target groups. Its activities aid participants to construct their own learning and communicate it to others. The activities, tasks and routes are designed in such a way that they can be performed at specific levels of difficulty or complexity, to accommodate the broad spectrum of participants' knowledge and skills that is expected. The course contains sufficient interactivity (learner to content, learner to learner and learner to teacher) to encourage active engagement. The feedback of the academic tutor is limited and scalable. The course provides learners with regular feedback through self-assessment activities, tests or peer feedback. The MOOC has possibilities to follow the score and progression.

The pedagogical model of the course is such that the efforts of all services do not increase significantly as the number of participants increases. All aspects of the course are delivered online. Learning outcomes are assessed using the balance of formative and summative assessment appropriate to the level of certification.







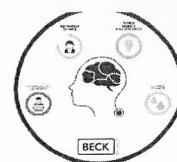
## INTENDED LEARNING OUTCOMES AND ASSESSMENT

<i>Learning Outcomes of the module<sup>9</sup></i>	<i>Methods of studies</i>	<i>Assessment methods of student achievements<sup>10</sup></i>	<i>Assessments criteria of students achievements by assessment levels</i>
O1. Will understand the different interests of stakeholders in achieving energy efficient buildings.	Blended learning, integrated affective tutoring and affective computing methods. The Integrated Method include the computer learning systems, big data mining, affective tutoring system, access to e-sources (open-source videos, simulators (calculators and software), case studies from the best universities around the world), self-study in Moodle virtual environment (educational material including Video – audio material, Text material; Interaction in forums for building learning community; Exercises with integrated feedback mechanism); Live events (video conferencing)	<input checked="" type="checkbox"/> Problematic questions <input checked="" type="checkbox"/> Intelligent tests <input type="checkbox"/> Regular tests <input checked="" type="checkbox"/> Problematic tasks <input type="checkbox"/> Projects <input checked="" type="checkbox"/> Peer evaluation <input type="checkbox"/> Automated feedback <input type="checkbox"/> Final evaluation <input checked="" type="checkbox"/> Other: assessment of a written group essay	<i>Threshold achievement level</i> Knows the concepts, theories and perspectives of different stakeholders with regard to the green built environment, energy efficiency and climate change, but is not able to explain and apply in wider context
			<i>Typical achievement level</i> Able to explain and apply the concepts, theories and perspectives of different stakeholders with regard to the green built environment, energy efficiency and climate change.
			<i>Excellent achievement level</i> Able to explain and apply the concepts, theories and perspectives of different stakeholders with regard to the green built environment, energy efficiency and climate change in wider context
		<input checked="" type="checkbox"/> Problematic questions	<i>Threshold achievement level</i>

<sup>9</sup> Learning outcomes are specified in three categories – as **knowledge, skills and competence**. This signals that qualifications – in different combinations – capture a broad scope of learning outcomes, including theoretical knowledge, practical and technical skills, and social competences where the ability to work with others will be crucial. Please refer to Cedefop (2017). Defining, writing and applying learning outcomes: a European handbook. Luxembourg: Publications Office of the European Union. [https://www.cedefop.europa.eu/files/4156\\_en.pdf](https://www.cedefop.europa.eu/files/4156_en.pdf). Learning outcomes of the module must correspond to the BECK Capacity Building Framework.

<sup>10</sup> Please select from the list. Additional assessment methods may be added.

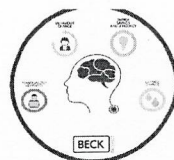




<p>O2. Be able to argue their points of view and justify the decisions made.</p>	<p>Blended learning, integrated affective tutoring and affective computing methods.</p>	<p> <input type="checkbox"/> Intelligent tests  <input type="checkbox"/> Regular tests  <input checked="" type="checkbox"/> Problematic tasks  <input type="checkbox"/> Projects  <input type="checkbox"/> Peer evaluation  <input checked="" type="checkbox"/> Automated feedback  <input type="checkbox"/> Final evaluation  <input type="checkbox"/> Other:         </p>	<p>Able to research and make decisions in the development of context-relevant solutions for the green built environment in relation to energy efficiency and climate change by using modern ICT technologies at a basic level</p> <p><i>Typical achievement level</i> Able to research and make decisions in the development of context-relevant solutions for the green built environment in relation to energy efficiency and climate change by using modern ICT</p> <p><i>Excellent achievement level</i> Able to research and make decisions in the development of context-relevant solutions for the green built environment in relation to energy efficiency and climate change by using modern ICT at an advanced level</p>
<p>O3. Have gained near real-life experience in decision-making, communication and teamworking.</p>	<p>Interactive group work in developing context-relevant solutions.</p>	<p> <input checked="" type="checkbox"/> Problematic questions  <input type="checkbox"/> Intelligent tests  <input type="checkbox"/> Regular tests  <input checked="" type="checkbox"/> Problematic tasks  <input type="checkbox"/> Projects  <input checked="" type="checkbox"/> Peer evaluation  <input type="checkbox"/> Automated feedback  <input type="checkbox"/> Final evaluation  <input checked="" type="checkbox"/> Other: activity assessment         </p>	<p><i>Threshold achievement level</i> Has basic skills to develop, communicate, manage and negotiate context-relevant solutions for the green built environment in relation to energy efficiency and climate change.</p> <p><i>Typical achievement level</i> Has intermediate skills to develop, communicate, manage and negotiate context-relevant solutions for the green built environment in relation to energy efficiency and climate change.</p> <p><i>Excellent achievement level</i> Has advanced skills to develop, communicate, manage and negotiate context-relevant solutions for the green built environment in relation to energy efficiency and climate change.</p>







			environment in relation to energy efficiency and climate change.
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### MODULE MARK CALCULATION<sup>11</sup>:

Assessment components (in chronological order of submission/examination date)				
Type of assessment <sup>12</sup>	Weighting, %	Duration (if exam)	Word count (if essay or similar):	Component pass required <sup>13</sup>
Mark for individual work	30%			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Mark for test of 20 questions, the correct answer is equal to 0.5 points	70%			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
<b>Total:</b>	100%			

### SYLLABUS OUTLINE

No.	Topic <sup>14</sup>	Number of hours <sup>15</sup>
1.	Basics, concepts and definitions of multicriteria decision analysis (MCDM): typology, representations and definitions, non-dominant decision making, determination of criteria values and significance, MCDM problem solving, MCDM methods, decision making paradox.	25
2.	Quantitative methods (TOPSIS, SAW, VIKOR, LINMAP, COPRAS)	25
3.	Comparative preference methods (ELECTRE, PROMETHEE, UTA)	15
4.	Verbal analysis solution methods (ZAPOS, CIKL, SNOD)	15
5.	Methods of Gambling Theory (LEVI 3.0)	15
6.	Integration of multi-criteria decision-making methods with reference, consulting, expert, data and text analysis methods	30
7.	Intelligent decision support systems	20
8.	Intelligent decision support systems in climate change	20
9.	Practical examples of decision support systems: stock exchange, auctions, investments	25
10.	Practical examples of decision support systems: real estate, construction, healthcare, transport, textiles, banks, investment	25

<sup>11</sup> Please list all components, sum must be equal to 100%. Note that successful course completion should be recognised as indicating worthwhile educational achievement.

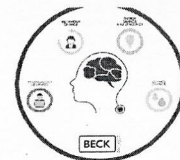
<sup>12</sup> Please indicate in chronological order of submission date each assessment component by type, e.g. examination, home work, coursework, project

<sup>13</sup> Indicate Yes to specify the assessment component(s) to be passed in order to pass the module

<sup>14</sup> Please add as many topics as needed

<sup>15</sup> Includes self-learning, on-line conferences and consultations





11.	Practical examples of decision support systems: international decision support systems, city, expert, building management, ethics.	25
<b>Total:</b>		<b>240</b>

## LEARNING MATERIALS<sup>16</sup>

### Core materials (up to 5 references):

1. Kaklauskas, A. Biometric and intelligent decision making support. Monograph. Heidelberg: Springer International Publishing, 2015. 220 p. (Intelligent Systems Reference Library, Vol. 81).
2. Kaklauskas, A., Zavadskas, E. K., Bardauskienė, D., Dargis, R. (Redaktoriai). Darnus nekilnojamojo turto vystymas / Vilniaus Gedimino technikos universitetas. Vilnius : Technika, 2012. 879 p.
3. A. Kaklauskas, E. K. Zavadskas (Editors). Multiple Criteria Analysis of the Life Cycle of the Built Environment: monograph. Vilnius: Technika, 2015. 448 p.
4. Kaklauskas, A., Zavadskas, E. K. Intelektinė ir biometrinė sprendimų parama: monografija / Vilnius: Technika, 2010. 372 p.
5. Kaklauskas, A., Zavadskas, E. K. Биометрическая и интеллектуальная поддержка решений: монография / Артурас Каклаускас, Эдмундас-Казимерас Завадскас. 2-е дополненное издание. Vilnius: Technika, 2013. 411 p.

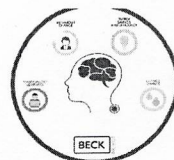
### Supplementary materials (up to 10 references):

1. A. Ishizaka, P. Nemery. Multi-criteria Decision Analysis: Methods and Software. John Wiley & Sons. 2013. 296 p. ISBN-13: 978-1119974079, ISBN-10: 1119974070
2. V. Belton, T. Stewart. Multiple Criteria Decision Analysis: An Integrated Approach. 2013. 372 p. ISBN-13: 978-1461355823, ISBN-10: 1461355826
3. E. Ballesterio, C. Romero. Multiple Criteria Decision Making and its Applications to Economic Problems. Springer Science. Springer. 2010. 160 p. ISBN-10: 1441950532, ISBN-13: 978-1441950536
4. G. H. Tzeng, J. J. Huang. Fuzzy Multiple Objective Decision Making. CRC Press. Taylor & Francis Group. 2013. 308 p. ISBN-13: 978-1466554610, ISBN-10: 1466554614
5. V. L. Sauter. Decision Support Systems for Business Intelligence. John Wiley & Sons. 2011. 453 p.
6. R. Sharda, D. Delen, E. Turban. Business Intelligence and Analytics: Systems for Decision Support (10th Edition). Pearson/Prentice Hall. 2015.
7. E. Turban, R. E Sharda, D. Delen. Decision Support and Business Intelligence Systems (9th Edition). Prentice Hall. 2010.
8. D. Power. Decision Support, Analytics, and Business Intelligence, Second Edition (Information Systems). Business Expert Press. 2013. 150 p.
9. S. D. Eksioglu, M.M.H. Seref, W.L.Winston. Developing Spreadsheet-Based Decision Support Systems. Dynamic Ideas. 2011.

<sup>16</sup> Courses should provide high quality materials to enable an independent learner to progress through self-study. Materials should make best use of online affordances (interactivity, communication, collaboration) as well as rich media (video and audio) to engage students with their learning.







10. G. H. Tzeng, J. J. Huang. Multiple Attribute Decision Making: Methods and Applications. CRC Press. Taylor & Francis Group. 2011. 308 p.

**On-line resources<sup>17</sup>:**

PhD students can use different computer learning systems developed by module's author in conjunction with his colleagues appeared in reviewed publications containing the Web of Science Core Collection citation index:

1. An affect-based, multimodal, video recommendation system (Kaklauskas et al. 2016)
2. Multiple-Criteria Analysis of Life Cycle of Energy-Efficient Built Environment (Kaklauskas et al. 2013)
3. Passive house model for quantitative and qualitative analyses and its intelligent system (Kaklauskas et al. 2012)
4. Recommended biometric stress management system (Kaklauskas et al. 2011)
5. Planning Alternative Building Life Cycle Processes and Multi-criteria Analysis Decision-making Support System SPS (Zavadskas et al. 2005)
6. Planning Alternative, Information Grounded Building Renewal and Multi-criteria Analyses SPS (Kaklauskas et al. 2005a)
7. Multi-criteria Analyses of Innovations SPS (Kaklauskas, Zavadskas 2007)
8. Pledged Intelligent Environment SPS (Kaklauskas et al. 2010b)
9. Crisis Management in the Construction and Real Estate Sector SPS (Kaklauskas et al. 2011)
10. Negotiations System (Urbanaviciene et al. 2009)
11. Energetics Systems Multi-criterion SPS (Sliogerienė et al. 2009)
12. Facilities management Analysis SPS (Lepkova et al. 2008)

<http://iti.vgtu.lt/tempus/>

<http://smartvideo.dev.vgtu.lt/site/login>

<http://iti3.vgtu.lt/ilearning/zemelapis.aspx>

<http://iti.vgtu.lt/realestate/>

<http://iti3.vgtu.lt/savas/simpletable.aspx?sistemid=469>

<http://iti3.vgtu.lt/savas/simpletable.aspx?sistemid=1467>

<http://iti3.vgtu.lt/savas/simpletable.aspx?sistemid=1468>

<http://iti3.vgtu.lt/savas/simpletable.aspx?sistemid=1476>

<http://iti3.vgtu.lt/savas/simpletable.aspx?sistemid=1460>

<http://iti3.vgtu.lt/savas/simpletable.aspx?sistemid=390>

<http://iti3.vgtu.lt/savas/simpletable.aspx?sistemid=391>

**Other materials:**

Lecture materials available at the BECK Simulated Big Data Interuniversity Networked Affective Educational Centre.

**REQUIRED IT RESOURCES<sup>18</sup>**

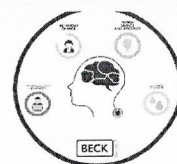
No.	Software, manufacturer
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<sup>17</sup> Please provide links

<sup>18</sup> Please add as many software as needed for the course







1.	MS Excel
2.	Adobe Acrobat reader

Date of completion of this version of Module Specification:

Date of approval by the Academic Support Center

Vaidotas Trinkūnas

2020 06 22

