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Number of Papers Included in these Proceedings per Country
 (The country of the first author was the one taken into account for these statistics)

Country	# Papers	%
Total	114	100,00
United States	16	14,04
Japan	15	13,16
Latvia	10	8,77
Brazil	8	7,02
Czech Republic	8	7,02
China	4	3,51
Ecuador	4	3,51
Italy	4	3,51
Russian Federation	4	3,51
Taiwan	4	3,51
Austria	3	2,63
Canada	3	2,63
India	3	2,63
Turkey	3	2,63
Bulgaria	2	1,75
Colombia	2	1,75
Peru	2	1,75
South Africa	2	1,75
South Korea	2	1,75
Germany	1	0,88
Hungary	1	0,88
Iraq	1	0,88
Israel	1	0,88
Lebanon	1	0,88
Libya	1	0,88
Pakistan	1	0,88
Paraguay	1	0,88
Poland	1	0,88
Portugal	1	0,88
Saudi Arabia	1	0,88
Serbia	1	0,88
Slovakia	1	0,88
Slovenia	1	0,88
United Arab Emirates	1	0,88

Foreword

Our purpose in the 22nd World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI 2018) is to provide, in these increasingly related areas, a **multi-disciplinary forum, to foster interdisciplinary communication** among the participants, and to support the sharing process of diverse perspectives of the same transdisciplinary concepts and principles.

Systemics, Cybernetics and Informatics (SCI) are being increasingly related to each other in almost every scientific discipline and human activity. Their common transdisciplinarity characterizes and communicates them, generating strong relations among them and with other disciplines. They work together to create a whole new way of thinking and practice. This phenomenon persuaded the Organizing Committee to structure WMSCI 2018 as a multi-conference where participants may focus on one area, or on one discipline, while allowing them the possibility of attending conferences from other areas or disciplines. This systemic approach stimulates cross-fertilization among different disciplines, inspiring scholars, originating new hypothesis, supporting production of innovations and generating analogies; which is, after all, one of the very basic principles of the systems' movement and a fundamental aim in cybernetics.

WMSCI 2018 was organized and sponsored by the International Institute of Informatics and Systemics (IIS, www.iis.org), member of the International Federation of Systems Research (IFSR). The IIS is a **multi-disciplinary organization for inter-disciplinary communication and integration**, which includes about 4000 members. Consequently, a main purpose of the IIS is to foster knowledge integration processes, interdisciplinary communication, and integration of academic activities. Based on 1) the transdisciplinarity of the systemic approach, along with its essential characteristic of emphasizing *relationships* and *integrating* processes, and 2) the multi-disciplinary support of cybernetics' and informatics' concepts, notions, theories, technologies, and tools, the IIS has been organizing multi-disciplinary conferences as a platform for fostering inter-disciplinary communication and knowledge integration processes.

Multi-disciplinary conferences are organized by the IIS as support for **both intra- and inter-disciplinary** communication. Processes of intra-disciplinary communication are mainly achieved via traditional paper presentations in corresponding disciplines, while conversational sessions, regarding trans- and inter-disciplinary topics, are among the means used for inter-disciplinary communication. Intra- and inter-disciplinary communications might generate *co-regulative cybernetic loops*, via negative feedback, and *synergic* relationships, via positive feedback loops, in which both kinds of communications could increase their respective effectiveness. Figure 1 shows at least two cybernetic loops if intra- and inter-disciplinary are adequately related. A necessary condition for the effectiveness of Inter-disciplinary communication is an adequate level of **variety** regarding the participating disciplines. *Analogical thinking and learning processes* of disciplinarians depend on it; which in turn are potential sources of the creative tension required for cross-fertilization among disciplines and the generations of new hypothesis. An extended presentation regarding this issue can be found at www.iis.org/MainPurpose.

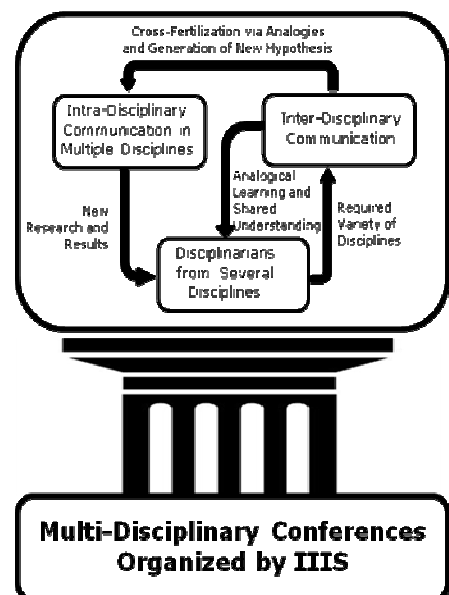


Figure 1

In the specific case of Systemics, Cybernetics and Informatics (SCI), the IIS is an organization dedicated to contribute to the development of the Systems Approach, Cybernetics, and Informatics potential, using both: knowledge and experience, thinking and action, theory and practice, for:

- a) The identification of synergistic relationships among Systemics, Cybernetics and Informatics, and between them and society.
- b) The promotion of contacts among the different academic areas, through the transdisciplinarity of the systems approach.
- c) The identification and implementation of communication channels among the different professions.
- d) The supply of communication links between the academic and professional worlds, as well as between them and the business world, both public and private, political and cultural.
- e) The stimulus for the creation of integrative arrangements at different levels of society, as well as at the family and personal levels.
- f) The promotion of trans-disciplinary research, both on theoretical issues and on applications to concrete problems.

These IIS objectives have oriented the organizational efforts of yearly WMSCI/ISAS/IMSCI/CISCI conferences since 1995.

On behalf of the Organizing Committee, I extend our heartfelt thanks to:

1. The 608 members of the different Program Committees, from 61 countries (including the PC members of the events organized in its context and jointly with WMSCI 2018). Almost all the members of the Program Committee are ***authors or co-authors sessions' best papers in previous conferences***, i.e. papers selected by the respective audience as the best paper of the session in which they were presented.
2. The 629 additional reviewers, from 80 countries, for their ***double-blind peer reviews***; and
3. The 201 reviewers, from 48 countries, for their efforts in making the ***non-blind peer reviews***. (Some reviewers supported both: non-blind and double-blind reviewing for different submissions).

The names and affiliation of both kinds of reviewers are listed in these proceedings. We extend our gratefulness to all of them. The scholarly quality of the authors and the reviewers is what define the quality of the conference and its respective proceedings. Consequently, our gratitude is to the members of the programs' committees, both kinds of reviewers and the collaborating authors.

A total of 1294 reviews made by 830 reviewers, from 83 countries, (who made at least one review) contributed to the quality achieved in WMSCI 2018. This means an average of 6.57 reviews per submission (197 submissions were received). ***Each registered author had access, via the conference web site, to the reviews that recommended the acceptance of their respective submissions***. Each registered author could also get information about: 1) the average of the

reviewers' evaluations according to 8 criteria, and the average of a global evaluation of his/her submission; and 2) the comments and the constructive feedback made by the reviewers, who recommended the acceptance of his/her submission, so the author would be able to improve the final version of the paper.

In the organizational process of WMSCI 2018, about 197 articles were submitted. These pre-conference proceedings include about 114 papers that were accepted for presentation from 34 countries (47 countries taking into account the presentations in collocated events). I extend our thanks to the invited sessions' organizers for collecting, reviewing, and selecting the papers that will be presented in their respective sessions. The submissions were reviewed as carefully as time permitted; it is expected that most of them will appear in a more polished and complete form in scientific journals.

This information about WMSCI 2018 is summarized in the following table, along with the other collocated events:

Conference	# of submissions received	# of reviewers that made at least one review	# of reviews made	Average of reviews per reviewer	Average of reviews per submission	# of papers included in the proceedings	% of submissions included in the proceedings
WMSCI 2018	197	830	1294	1.56	6.57	114	57,87%
IMSCI 2018	168	447	999	2.23	5.95	51	30,36%
WMSCI & IMSCI 2018	365	1277	2293	1.80	6.28	165	45,21%
CISCI 2018	155	611	1311	2.15	8.46	67	43,23%
TOTAL	520	1888	3604	1.91	6.93	232	44,62%

We also extend our gratitude to the invited sessions' organizers: Dr. Shigehiro Hashimoto, Dr. Natalja Lace, and Dr. Elina Gaile-Sarkane; as well as to the special track co-chairs and the co-editors of these proceedings, for the hard work, energy and eagerness they displayed preparing their respective sessions. We express our intense gratitude to Professor William Lesso (1931-2015) for his wise and timely, adequate and valuable tutoring, for his eternal energy, integrity, and continuous support and advice, as the Program Committee Chair of past conferences (since 1981), as well as for being a very caring old friend and intellectual father to many of us. We also extend our gratitude to Professor Belkis Sánchez, who brilliantly managed the organizing process.

Our gratitude to Professors Bela H. Banathy, Stafford Beer, George Klir, Karl Pribram, Paul A. Jensen, and Gheorghe Benga who dignified our past WMSCI conferences by being their Honorary Presidents. We also extend our gratitude to the following scholars, researchers, and professionals who accepted to deliver plenary workshops and/or to address the audience of the General Joint Plenary Sessions with keynote addresses.

Workshops and Conversational Sessions

Professor T. Grandon Gill, University of South Florida, USA, College of Business, Director of the Doctorate in Business Administration, Editor-in-Chief of Informing Science, Editor of the Journal of IT Education, Founding Editor of Journal of Information Technology Education.

Professor William Swart, East Carolina University, USA, FMR. Dean of Engineering and Technology at New Jersey Institute of Technology, Provost and Vice President for Academic Affairs at East Carolina University, Researcher and Consultant at NASA's Space Shuttle.

Plenary Keynote Speakers

Professor Shigehiro Hashimoto, Kogakuin University, Japan. Councilor and Dean, Faculty of Engineering, Former Associate to the University President. Doctor of Engineering and Doctor of Medicine. Biomedical Engineering.

Professor Matthew E. Edwards, Alabama A&M University, USA. Professor of Physics and Former Dean of the School of Arts and Sciences. Director of IHSEAR: Institute of Higher Science Education, Advancement and Research.

Professor Dr.-Ing. Albrecht Rothermel, Ulm University, Germany. Deputy Director of the Institute of Microelectronics. Former Editor of the IEEE JSSC, and TPC-Chair of the IEEE ICCE-B.

Dr. Russell Jay Hendel, Towson University, USA, Dept. of Mathematics. Researcher in Discrete Number Theory, the Theory of Pedagogy, Applications of Technology to Pedagogy, and the Interaction of Mathematics and the Arts.

Dr. Bernard Wallner, University of Vienna, Austria, Department of Anthropology, Co-leader of the working group Anthropological Economics & Demography.

Professor Ran Giladi, Ben-Gurion University of the Negev, Israel, Faculty of Engineering Sciences, Department of Communication Systems Engineering.

Professor Jan Detand, Ghent University, Belgium, Faculty of Engineering and Architecture, Industrial Engineering Design at Industrial Design Center.

Professor T. Grandon Gill, University of South Florida, USA, College of Business. Director of the Doctorate in Business Administration. Editor-in-Chief of Informing Science. Editor of the Journal of IT Education, Founding Editor of Journal of Information Technology Education.

Professor Dov Lichtenberg, Tel Aviv University, Israel, Former Dean of Medicine. Professor Emeritus since 2011. Post Doc in Chemical Biophysics at Caltech, USA.

Professor William Swart, East Carolina University, USA. FMR. Dean of Engineering and Technology at New Jersey Institute of Technology. Provost and Vice President for Academic Affairs at East Carolina University. Researcher and Consultant at NASA's Space Shuttle.

Dr. Mario Lamanna, Evoelectronics, Italy and Selex-SI, USA. Senior Scientist and Project Leader Projects in the fields of Defense and Security.

Professor Ariyoshi Kusumi, Chukyo University, Japan, School of International Liberal Studies, Environmental Science. Visiting Scientist at The Regional Environmental Center for Central and Eastern Europe in Hungary.

Dr. Kevin Foltz, Institute for Defense Analyses, USA, Information Technology and Systems Division. Independent Technical Analyst for the Department of Defense.

Dr. Jyothi Thalluri, University of South Australia, School of Pharmacy and Medical Sciences. 2015 Award Winner of Student Nominated Excellent Educator. Endeavour Executive Award Winner - Australian government.

Professor Oleg I. Redkin, Saint Petersburg State University, Russia, Faculty of African and Asian Studies. Head of Arabic Studies.

Professor Olga Bernikova, Saint Petersburg State University, Russia, Research Laboratory for Analysis and Modeling of Social Process. Member of the Editorial board of the journal "Islam in the Modern World".

Professor Margit Scholl, Technical University of Wildau [FH], Germany, Faculty of Economics, Computer Science, Law, Business, and Administrative Informatics, Received a research prize from TH Wildau.

Dr. Pawel Poszytek, Foundation for the Development of the Education System, Poland. General Director, Member of working groups of the European Commission and the Ministry of National Education of Poland.

Professor Alfredo Soeiro, University of Porto, Portugal, Department of Civil Engineering. Pro-Rector of University of Porto. Founder of EUCEN, RECLA and AUPEC. Vice president of EUCEN and SEFI, President of IACEE, AUPEC and of SEFI. Secretary General of AECEF and of IACEE Council.

Professor Cécile Gardies, National Higher School of Agricultural Education Training, France. Director of the IDC collection (Information-Documentation-Communication) to the Cépadués editions. Co-director of the Agora Collection Research Editions Educagri.

Professor Laurent Fauré, National Higher School of Agricultural Education Training, France. Head of Education and Pedagogy Department. Associate Professor in Agricultural Equipment Education.

Dr. Sylvia Mirry, University of Bologna, Italy, Faculty of Sciences, Department of Computer Science and Engineering. Former Visiting Researcher at University of Toronto, Ontario, Canada.

Bruce Leybourne, MS. Institute for Advance Studies on Climate Change (IASCC), USA, Research Director and Principal Investigator, MS in Geology from University of Southern Mississippi, USA, Former Navy tenure at the U.S. Naval Oceanographic Office, NASA's Stennis Space Center.

Professor Sami Shaban, United Arab Emirates University, College of Medicine and Health Sciences, Medical Education Department Medical Informatics.

Professor Akira Ishii, Tottori University, Japan, Department of Applied Mathematics and Physics. Council member of Complex Systems Society.

Drs. Nozomi Okano, Tottori University, Japan, Ph.D candidate. Department of Applied Mathematics and Physics. University President of NKDesign.

Ashley Dean, MA, Leeds Beckett University, UK. Senior Lecturer in Animation, Design and Broadcast Media. Research in experimental film making, animation and more formal classroom teaching.

Drs. Lars König, M.SC, University of Münster, Germany. Doctoral Student in the DFG-funded Research Training Group. Research Assistant at the Institute for Psychology in Education.

Profesora Gabriela Vilanova, Universidad Nacional de la Patagonia Austral, Argentina. Directora del Grupo de Investigación: Innovación en Procesos de Enseñanza y Aprendizaje en Ambientes Virtuales de Aprendizaje.

Professor E. Bolaños-Rodríguez, Universidad Autónoma del Estado de Hidalgo, México. Escuela Superior de Tizayuca. Electroquímica, Ciencias Ambientales, Pedagogía, Computación, Tecnologías de la Información y las Comunicaciones (TIC), Metodología de la Investigación.

Professor Jorge Ruben Varas, Universidad Nacional de la Patagonia Austral, Argentina. Ergonomía y Psicología del Trabajo . Co-Director de Proyectos de Investigación relacionados a Educación en Entornos Virtuales de Aprendizaje.

Professor David González Ortega, Universidad de Valladolid, España, Departamento de Teoría de la Señal y Comunicaciones e Ingeniería Telemática en la E.T.S. de Ingenieros de Telecomunicación. Grupo de Telemática e Imagen (GTI) en los campos de Redes Neuronales, Visión Artificial, y Sensores Fisiológicos.

Invited Sessions Organizers

Professor Shigehiro Hashimoto, Kogakuin University, Japan. Councilor and Dean, Faculty of Engineering, Former Associate to the University President. Doctor of Engineering and Doctor of Medicine. Biomedical Engineering.

Professor Dr. oec Natalja Lace, Riga Technical University, Faculty of Engineering, Economy and Management. Head of Department of Corporate Finance and Economics.

Professor Dr. oec Elina Gaile-Sarkane, Dean of the Faculty of Engineering, Economy and Management.

We would like also to extend our gratefulness to Professor Gradon Gill and Dr. Jeremy Horne for their continuous advice and support in the conferences they participated in, along the last 12 years as well as in the conferences they were not able to participate in. In both cases: their advices and the kind of care they provided us with are highly valued and appreciated.

Many thanks to Drs. Sushil Archarya, Esther Zaretsky, and to professors Michael Savoie, Hsing-Wei Chu, Mohammad Siddique, Friedrich Welsch, Thierry Lefevre, José Vicente Carrasquero, Angel Oropeza, and José Ferrer, for chairing and supporting the organization of conferences and/or special events or tracks in the context of, or collocated with, WMSCI 2018. We also wish to thank all the authors for the quality of their papers, the Program Committee members and the additional reviewers for their time and their contributions in the respective reviewing processes.

Our gratefulness is also extended to the organizations that provided scientific, academic, professional, or corporate co-sponsorships in this conference and/of previous ones. The following are among these organizations:



Special Thanks to Dr. Jeremy Horne, Dr. Harvey Hyman, and Ms. Molly Youngblood Geiger (Google Partners Community Ambassador) for their efforts in helping us with the identification of above shown co-sponsors.

We extend our gratitude as well to María Sánchez, Juan Manuel Pineda, Marcela Briceño, Desireé Yonali Gamboa, and Freddy Callaos for their knowledgeable effort in supporting the organizational process, producing the hard copy and CD versions of the proceedings, developing and maintaining the software that support the interactions of the authors with the reviewing process and the Organizing Committee, as well as for their support in the help desk and in the promotional process and advising role in the promotion of the conference.

Professor Nagib C. Callaos, Ph. D.
WMSCI 2018 General Chair
www.iiis.org/Nagib-Callaos

WMSCI 2018
The 22nd World Multi-Conference on Systemics, Cybernetics and Informatics
Special Track on Design and Modeling in Science, Education, and Technology: DeMset 2018
Special Track on Knowledge and Cognitive Science and Technologies: KCST 2018
Special Track on Academic Globalization and Inter-Cultural Communication: AGIC 2018

VOLUME III

CONTENTS

Contents

i

Innovation and Technology Transfer in Emerging Economies - Invited Session
Organizer: Elina Gaile-Sarkane and Inga Lapina (Latvia)

Cevers, Aldis; Rudzitis, Normunds (Latvia): "Promotion of Economic and Border Security: BOMCA Experience"

1

Hilkevics, Sergejs; Hilkevica, Galina (Latvia): "The Information System for US Stock Market: Fundamental and Technical Analysis"

6

Locovs, Jevgenijs; Gaile-Sarkane, Elīna; Suija-Markova, Inese; Rostoka, Zane; Rubina, Liene (Latvia): "Enterprise Agility – Modern Term or Future Trend for Successful Company Development?"

13

Mjakuškina, Svetlana; Lapina, Inga (Latvia): "Product Conformity Assessment within the Integrated Management System: Manufacturing Compliance and Customer Safety"

19

Straujuma, Anita; Gaile-Sarkane, Elina; Ozolins, Modris; Ozolina-Ozola, Iveta (Latvia): "Alumni Knowledge Management Metrics for the Advancement of Industry University Collaboration"

25

Relating Research, Practice and/or Knowledge Integration: RPKI 2018

Cave, Chessica (USA): "Creating a Multimodal Lecture"

31

Chae, Haeng-Suk (South Korea): "An Investigation of Evaluating Position on Textile-Based Keypad of Smart Wear"

35

Ciampi, Francesco (Italy): "Closing the Gap Between Scientific Research and Management Consulting"

38

Lichtenberg, Dov; Pinchuk, Ilya (Israel): "Quantitation of Oxidative Stress on the Basis of the Level of a Single Biomarker is Questionable. Try to Base it on the Lag Preceding Serum Lipid Peroxidation Ex-Vivo"

41

Moldoveanu, Mirela; Grenier, Naomi (Canada): "How do Research Designs Contribute to Research-Based Knowledge Integration in Canada's Education Sector?"	45
Peichev, Denislav; Angova, Stela; Milenkova, Valentina; Peicheva, Dobrinka; Marinov, Mario (Bulgaria): "Knowledge-Based Management and Media and Information Ecology Skills"	50
Placencia Medina, Maritza; Pando Álvarez, Rosa; Mechan Méndez, Víctor; Quintana Salinas, Margot Rosario; Silva-Valencia, Javier; Carreño Escobedo, Jorge Raúl; Mendoza Rojas, Hubert James; Ascacivar Placencia, Yanelli Karen (Peru): "Preparing Teachers for Medical Education Using ICT: Achievements and Challenges of an Educational Intervention in a National University in Perú"	54
Puravangara, Sethu Madhavan (United Arab Emirates): "Delays and Failures in Projects: Using Soft Systems and Action Research Methods to Explore Integration Issues in Research and Practice"	60
Soeiro, Alfredo (Portugal): "Integrating Research, Practice and Knowledge: CALOHEE Project as Case Study of Civil Engineering"	66
Turuntaev, Ilya S.; Danilov, Vladimir G. (Russian Federation): "The Problem of Automatic Answer Checking and Some other Issues in Math Educational Systems Development"	71
Human Information Systems	
Soltes, Dusan (Slovakia): "The GDPR: A Real Revolution in the Protection of Personal Data"	77
Tintin, Romel *; Altamirano, Patricio *; Chávez, Carmen *; Tintin, Liliana ** (* Ecuador, ** South Korea): "Could e-Government Development Reduce Corruption in South America?"	80
Information and Communication Technologies	
Ahmad, Tabrez (India): "Challenges of Cyber Crimes in India: A Critical Analysis"	86
Civelek, Turhan; Vidinli, I. Bahattin (Turkey): "Resection of Benign Tumor in Tibia with a High Speed Burr by Haptic Devices in Virtual Reality Environments"	92
Kamaludeen, Mirza; Ismaeel, Salam; Scarfo, Carm; Tabari, Soussan (Canada): "Digital Condition Index (DCI): A Classification Science and Method for Building Digital Readiness"	98
Kamaludeen, Mirza; Ismaeel, Salam; Petrocelli, Franca; Scarfo, Carm; Tabari, Soussan (Canada): "Broadband Enabled Fabric for Public Libraries in Canada"	103
Lo, Yen-Hsi *; Lo, Yen-Fen *; Chiang, Po-Yun *; Hsiao, Jung ** (* Taiwan, ** USA): "Key Factors in the Success of Self - Directed Learning of Military Personnel - Taking Smartphone as an Example"	109

Interdisciplinary Research, Education, and Communication (IDREC 2018)

- Aguiar, Lucas Barbosa de; Lima, Marina Morato Stival; Rehem, Tania Cristina Morais Santa Barbara; Funghetto, Silvana Schwerz; Volpe, Cris Renata Grou (Brazil): "Factors Related to Medication Errors in a Brazilian Hospital" 113
- Awami, Salah (Libya): "Investigation of Libyan Public Health Surveillance Systems: Health Informatics Perspective" 119
- Ho, Sophia Shi-Huei; Chen, Robin June-Cheng; Weng, Shin Hsin-Wei (Taiwan): "A Study of Application of Transaction Cost and Relational Capital Perspectives on Relationship between Institutional Governance and Institutional Performance ~ Comparison between Taiwan and Mainland China HEIs" 124
- Huang, Mingshu; Yee, Christopher R.; Sukhatme, Vikas P.; Narain, Niven R.; Akmaev, Viatcheslav R.; Vemulapalli, Vijetha (USA): "Identification of Novel Risk Factors for Hospital Admission after Colonoscopy Exam by Analyzing Population Wide Data with Artificial Intelligence Technology bAIcis®" 130
- Kang, Sukjin; Lee, Seungryul (South Korea): "Ethnography with Intercultural Competence and Visual Thinking for Real Life Problem Solving" 134
- Leclerc-Sherling, Christine (USA): "Treating Social Systems with Organizational Assessment: De-Stigmatizing Employees and Promoting Systemic Results" 138
- Němec, Vladimír; Hyršlová, Jaroslava; Mrázek, Petr; Novák, Martin; Endrizalová, Eva; Zharkova, Victoria (Czech Republic): "The Quality System of Air Transport Pilots Training at the University of Pardubice" 144
- Soušek, Radovan *; Šustr, Martin *; Fuchs, Pavel *; Endrizalová, Eva *; Novák, Martin *; Müllerová, Jana ** (* Czech Republic, ** Slovakia): "Evaluation of Risks in Air Transport" 149
- Velázquez-Araque, Luis; Álvarez Macías, Desireé; Aguilar Sierra, Josué; Tulcán Álvarez, Alejandro; Cárdenas, José (Ecuador): "A Preliminary Study of Pelletized Ecuadorian Rice Husk for its Use as a Source of Renewable Energy" 154
- Wallner, Bernard; Fieder, Martin (Austria): "Sexual Dimorphism in Volunteerism and Job Position" 159

Design and Modeling Methods and Methodologies

- Hirz, Mario (Austria): "An Approach Supporting Integrated Modeling and Design of Complex Mechatronics Products by the Example of Automotive Applications" 161
- Zammataro, Andrea (Italy): "Designing Representations, Affecting Reality: A Meta-Model Proposal to Address the Question of Design Epistemology from the Perspective of Cognitive Science" 167

Educational Research, Design, and Modeling

Ilunga, Masengo (South Africa): "Institutional Models of Open and Distance Learning: Comparison between Open University of the United Kingdom and University of South Africa" 172

Cognitive Science

Lu, Lucia Y. (USA): "Digital Photos Invite Multisensory Learning in Literacy" 178

Academic Globalization

Thompson, Laura (USA): "Globalization and its Impact on Individual Identity and Immersion" 181

Inter-Cultural Communication

Thompson, Laura (USA): "Leading Roles that Stage Reality" 184

Design and Modeling Methods and Methodologies

Eilouti, Buthayna (Saudi Arabia): "Systematic Concept Derivation and Translation in Engineering Design" 188

Complexity: Complex Sciences and Systems

Shakhmurov, Veli; Shahmurov, Rishad (Turkey): "The Dynamics of a Cancer Tumor Growth Model with Multiphase Structure" 194

Interdisciplinary Research, Education, and Communication (IDREC 2018)

Gomes, Carlos Francisco Simões; Ribeiro, Priscilla Cristina Cabral; Freire, Kyane Alves de Matos (Brazil): "Bibliometric Research in Warehouse Management System from 2006 to 2016" 200

Matos Hernández, Eneida Catalina; Cruz Rizo, Lorna (Ecuador): "Research in Higher Education Institutions as a Substantive Process: The Endogenous Challenge" 205

Sahmurova, Aida; Yazıcı, Pınar; Sezgin, Pelin (Turkey): "Determination of the Effects of Environmental Factors on Attention Deficit and Hyperactivity Disorder" 211

Invited Papers

Ahmad, Tabrez (India): "Technology Convergence and Cybersecurity: A Critical Analysis of Techno-Legal Challenges in India and USA (Invited Paper)" 217

Ciampi, Francesco (Italy): "The Possible Evolution of Management Consultant's Knowledge Creation Roles (Invited Paper)" 224

Hashimoto, Shigehiro (Japan): "Cross Cultural Seminar Inspires Multidisciplinary Learning: From Biomedical Engineering to Gerontechnology (Invited Paper)" 229

Leclerc-Sherling, Christine (USA): "An Interdisciplinary Approach of Resilience and Posttraumatic Growth Applied to Individuals, Groups, and Institutions. (Invited Paper)"	235
Leybourne, Bruce (USA): "Why Inter-Disciplinary Research, Education, & Communication (IDREC) are Necessary in the Advancement of Science Educational Perspectives from Geophysics & Climate Research (Invited Paper)"	238
Placencia Medina, Maritza; Silva-Valencia, Javier; Pando Álvarez, Rosa; Mechán Méndez, Víctor; Quintana Salinas, Margot Rosario; Carreño Escobedo, Jorge Raúl; Carrasco Escobedo, Elias Juan; Ascacivar Placencia, Yanelli Karen (Peru): "Evaluation by Competences in a Clinical Environment of a Public University in Peru (Invited Paper)"	248
Authors Index	253



Pages 1-252 are not included in this book preview.

To view the papers, please, click the “Home” button at the top of this page, and then, click the “Papers” link for this volume.



AUTHORS INDEX

VOLUME III

Aguiar, Lucas Barbosa de	113	Ho, Sophia Shi-Huei	124
Aguilar Sierra, Josué	154	Hsiao, Jung	109
Ahmad, Tabrez	86; 217	Huang, Mingshu	130
Akmaev, Viatcheslav R.	130	Hyršlová, Jaroslava	144
Altamirano, Patricio	80	Ilunga, Masengo	172
Álvarez Macías, Desireé	154	Ismaeel, Salam	98; 103
Angova, Stela	50	Kamaludeen, Mirza	98; 103
Ascacivar Placencia, Yanelli Karen	54; 248	Kang, Sukjin	134
Awami, Salah	119	Lapina, Inga	19
Cárdenas, José	154	Leclerc-Sherling, Christine	138; 235
Carrasco Escobedo, Elias Juan	248	Lee, Seungryul	134
Carreño Escobedo, Jorge Raúl	54; 248	Leybourne, Bruce	238
Cave, Chessica	31	Lichtenberg, Dov	41
Cevers, Aldis	1	Lima, Marina Morato Stival	113
Chae, Haeng-Suk	35	Lo, Yen-Fen	109
Chávez, Carmen	80	Lo, Yen-Hsi	109
Chen, Robin June-Cheng	124	Locovs, Jevgenijs	13
Chiang, Po-Yun	109	Lu, Lucia Y.	178
Ciampi, Francesco	38; 224	Marinov, Mario	50
Civelek, Turhan	92	Matos Hernández, Eneida Catalina	205
Cruz Rizo, Lorna	205	Mechan Méndez, Víctor	54; 248
Danilov, Vladimir G.	71	Mendoza Rojas, Hubert James	54
Eilouti, Buthayna	188	Milenkova, Valentina	50
Endrizalová, Eva	144; 149	Mjakuškina, Svetlana	19
Fieder, Martin	159	Moldoveanu, Mirela	45
Freire, Kyane Alves de Matos	200	Mrázek, Petr	144
Fuchs, Pavel	149	Müllerová, Jana	149
Funghetto, Silvana Schwerz	113	Narain, Niven R.	130
Gaile-Sarkane, Elina	25	Němec, Vladimír	144
Gaile-Sarkane, Elīna	13	Novák, Martin	144; 149
Gomes, Carlos Francisco Simões	200	Ozolins, Modris	25
Grenier, Naomi	45	Ozolins, Modris	25
Hashimoto, Shigehiro	229	Pando Álvarez, Rosa	54; 248
Hilkevica, Galina	6	Peichev, Denislav	50
Hilkevics, Sergejs	6	Peicheva, Dobrinka	50
Hirz, Mario	161	Petrocelli, Franca	103

Pinchuk, Ilya	41
Placencia Medina, Maritza	54; 248
Puravangara, Sethu Madhavan	60
Quintana Salinas, Margot Rosario	54; 248
Rehem, Tania Cristina Morais	113
Santa Barbara	
Ribeiro, Priscilla Cristina Cabral	200
Rostoka, Zane	13
Rubina, Liene	13
Rudzitis, Normunds	1
Sahmurova, Aida	211
Scarfo, Carm	98; 103
Sezgin, Pelin	211
Shahmurov, Rishad	194
Shakhmurov, Veli	194
Silva-Valencia, Javier	54; 248
Soeiro, Alfredo	66
Soltes, Dusan	77
Soušek, Radovan	149
Straujuma, Anita	25
Suija-Markova, Inese	13
Sukhatme, Vikas P.	130
Šustr, Martin	149
Tabari, Soussan	98; 103
Thompson, Laura	181; 184
Tintin, Liliana	80
Tintin, Romel	80
Tulcán Álvarez, Alejandro	154
Turuntaev, Ilya S.	71
Velázquez-Araque, Luis	154
Vemulapalli, Vijetha	130
Vidinli, I. Bahattin	92
Volpe, Cris Renata Grou	113
Wallner, Bernard	159
Weng, Shin Hsin-Wei	124
Yazıcı, Pınar	211
Yee, Christopher R.	130
Zammataro, Andrea	167
Zharkova, Victoria	144