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Proceedings

30th International Scientific Conference / 2019



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University of Zagreb

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The 30th Central European Conference on Information and Intelligent Systems is held under the patronage of the President of the Republic of Croatia Kolinda Grabar Kitarović and Ministry of Science and Education.

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PREFACE

These Proceedings contain full text conference papers presented at the Central European Conference on Information and Intelligent Systems (CECIIS), held in Varaždin, Croatia, October 2-4, 2019. Proceedings are available in print and digital formats.

CECIIS has been held for 30 years. The conference and the accompanying events are certainly the most significant annual scientific event organized by the Faculty of Organization and Informatics, University of Zagreb.

Its international participants, program committee members and the reviewers enabled CECIIS to become one of the most important conferences in the area of applied information science in Central Europe. It is our great pleasure to say that this year's international co-editor is professor Dieter Hertweck (Reutlingen University, Faculty of Computer Science and Herman Hollerith Research Centre, Germany).

The special topic of CECIIS 2019 Conference - Digital Transformation – Shaping the Future, was designed to provide our participants with an opportunity to research and discuss the advantages and possibilities of contemporary digital technologies and their impact on society.

The Proceedings of CECIIS 2019 contain 42 scientific papers, peer-reviewed by two independent reviewers and accepted by the international Program Committee within the following sections:

Computer Games, Data and Knowledge Bases, Education and Learning Analytics, Emerging Trends in ICT, ICT Entrepreneurship and Innovation, Intelligent Information Systems, Quality of Software and Services, Software Engineering, Strategic Planning and Decision Making.

Altogether 55 papers have been submitted to the CECIIS 2019 Conference. The review process that has been done with the wholehearted dedication of 74 reviewers (38 reviewers from Croatia and 46 from abroad) resulted with 42 accepted papers.

After the conference, the selected papers will be further reviewed by two independent international reviewers with the possibility of being extended and included in the Journal of Organizational and Information Sciences (JIOS), the international scientific journal published by the Faculty of Organization and Informatics.

Within its poster and presentation section, CECIIS 2019 gathered students from Croatia, USA (Cincinnati and Pittsburgh) and Albania (Tirana and Shkoder). The posters were presented during the conference and the abstracts are published within the CECIIS webpage.

The special value of this year's conference is featured by outstanding invited lecturers, researchers who have left a deep mark in the scientific and professional areas of their interest. Within the CECIIS 2019, the following three invited lectures were presented:

Prof. Dr. Wolf Rauch, "30 years of Information Science – a success story!" - Professor Rauch is a full professor at the Institute of Information Science and Information Systems at Karl-Franzens-University Graz since 1987. After obtaining the PhD in Wien, he worked for several years with the research institute in Frankfurt am Main (GID) and at the universities in Regensburg, Saarbrücken, Berlin and Klagenfurt. He was Dean and Rector at the Karl-Franzens-University Graz and the president of Austrian Rectors Conference in 1999. Prof. Rauch has been cooperating with FOI staff within different national and international scientific projects and was awarded "Friend of the Faculty of Organization and Informatics" in 2009.

Prof. Dr. Sirje Virkus, "Digital transformation in the higher education environment" - Professor Virkus is a professor of Information Science and the Head of the Study Area of Information Sciences at the School of Digital Technologies of Tallinn University. She holds a PhD in Information and Communication Studies from the Manchester Metropolitan University. She has been working in the area of information sciences at Tallinn University since 1985. Her research interests are focused on the development of information-related competencies, ICT innovation in education and internationalisation. She has written more than 170 research publications. She is a member of editorial boards of several high quality scientific journals and conference programme committees.

Prof. Dr. Dr. h.c. Günter Müller, "Digital transformation: better world or crisis of trust?" – Prof. Müller is a professor (em) of computer science at the University of Freiburg acting as a senior adviser since 2017. He received his

PhD in Data Base Systems and worked as a post-doc with IBM in Almaden in the famous System R project. In 1985, he was nominated by IBM Corporation as Director for Telecommunication systems, Europe. For his work in digital networks and security he received an honorary doctorate from the Technical University of Darmstadt, the medal of honour from the Vienna University of Economics and Business, the Ehrenkreuz from the Austrian president and was awarded a recognition "Friend of the Faculty of Organization and Informatics in Varaždin". He was deeply involved in contributing and setting up programs in German, European and industrial development and research area in information security.

CECIIS 2019 included the following parallel events:

- DOCTORAL STUDENT SECTION - 11th International Doctoral Seminar 2019
- 3rd Workshop on Data Analysis
- DIGITRANS Fast Forward workshop
- Computer Games - professional achievements (professional track in Croatian)
- project presentations: e-Schools, STEM Revolution in Community, HigherDecision, CRISS, DIGITRANS, ABCitiEs, Meria, IRI Hyper, KyrMedu, LAMBDA, AMED, EIT Health, Twinning Open Data Operational, DIP-2future, IoTIF and Educode.
- CECIIS 2019 conference sponsors' events (Infodom, Oracle, Dignet Software).

The 30th CECIIS Conference was held under the patronage of the President of the Republic of Croatia, Kolinda Grabar Kitarović and the Ministry of Science and Education of the Republic of Croatia. The CECIIS Conference was financially supported by sponsors: Infodom, Dignet Software, Oracle, Varaždin County and the City of Varaždin.

We would like to express our utmost gratitude to the invited speakers, authors, reviewers, session chairs, participants, organizers of parallel events, as well as Program and Organizing Committee members for their contributions. We acknowledge that the organizational and supporting assistance and hosting of the Faculty of Organization and Informatics was crucial for the overall success of the Conference. Finally, we are most grateful to all our industrial partners and sponsors for their support.

Finally, we hope that inside these covers you will find relevant and interesting papers in the field of information and intelligent systems and we look forward to your participation in one of many CECIIS conferences to come.

September, 2019

On the behalf of the Program and Organizing Committees

Vjeran Strahonja, Dieter Hertweck and Valentina Kirinić
Editors

30 years of the Central European Conference on Information and Intelligent Systems (CECIIS)

Scientific research is a prerequisite for quality education at universities, and the Central European Conference on Information and Intelligent Systems - CECIIS is one of the main pillar of scientific research activities at the Faculty of Organization and Informatics, University of Zagreb (FOI).

The main indicators of the excellence of scientific research work of a research institution are the published scientific papers of teachers and associates and the scientific projects. Since the possibilities for publishing scientific papers in scientific journals and within scientific events are unlimited, the fact that FOI has its own scientific journal JIOS and conference CECIIS whose Proceedings are referenced in significant databases gives a special value and ensures the recognition of the Faculty in the scientific community.

The international scientific conference - CECIIS is often an opportunity for early stage researchers and doctoral students to gain their first international experience, and they have often used this possibility of direct and informal communication to create opportunities for new collaborations.

From the early beginnings to the present, the main aim of CECIIS is to foster the cooperation among researchers involved in the development and application of methods and techniques in the field of information and intelligent systems.

This year marks the 30th anniversary of the conference. The first conference was organized by the Faculty in Varaždin on November 22-23, 1989, under the title "Information Systems in Office Business (Yugoslav Symposium)" Varaždin¹. At this symposium, 40 papers were presented. Office business automation was a hot topic at the time, and the conference took place just months after a group of professors and associates from FOI participated in a conference of similar title and profile held in Munich. The title *symposium* was used until 1997, and since 1998 the title *conference* has been used, which is more in line with the profile, format and content of this scientific event. The official language of the first symposium was Croatian and later Slovenian, English and German were also used as official languages. From the ninth symposium onwards the official language is English.

For about twenty years, the conference has been taking place in late September or early October. This time of autumn in Varaždin is marked by the Varaždin Baroque Evenings - the most significant cultural manifestation in the city of Varaždin, and, as professor Aurer observed, by the harvest season in the surrounding vineyards which is favourable for the organization of the conference excursion.

The basic concept of the conference has not changed over the years, suggesting that it was well designed at the very beginning. Although the CECIIS conference covers a wide range of topics in the field of information and communication sciences, especially related to information and software systems, which also corresponds to the title of the Faculty of Organization and Informatics, each conference has some special emphasis and a topic chosen by the Program Committee. The main topic is determined by the choice of keynote speakers which are, as a rule, scientists and experts with a worldwide reputation in their field.

¹ The data is taken from the text by professor Boris Aurer (em.) written in the monograph "50 Years of the Faculty of Organization and Informatics, University of Zagreb 1962 - 2012" (FOI Varaždin, 2012, ed. Diana Šimić)

An overview of the number of invited speakers, papers by topics, number of authors and sponsors between 2005 and 2018 is shown in the following table:

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Keynote Speeches	4	1	1	9		3	3	2	1	1	3	3	2	2	24
Education for Information Society	6	10	7	13	9	16	12	15	5	8	7	9			117
Information and Communication Technologies	9	7	11	6	3	18	11	12	14	11	4	5			111
Information Systems Security	3	11	7	9	7	4	6	8	4	1	2				62
Data and Knowledge Bases	6	5	8	4	3	11	6	10	4	5	2	4	4	2	74
Intelligent Information Systems	2	4	3	4	2	10	6	7	4	6	4	4	7	4	67
Information Systems in Management and Decision Support	19	9	4	9	5										36
Intelligent Transport Systems	9	3	2	8	4	3	1	4		1	1				36
Software Engineering		1	3	6	4	6	4	6	7	5	7	1	3	1	54
ICT Management		3	5	10	7										25
Strategic Planning of Information Systems	4	1	2	4	1										12
Intelligent Systems Techniques and Methods		4	6	5	3										18
Quality and Metrics in ICT		4		5											9
Information Systems in Manufacturing	3	3	1	1											8
Multimedia Systems	1	2	2		1										6
Workflow Modelling			1												1
Semantic Web and Ontologies					1										1
Economics and Information Systems										7	6	7			20
Computer Games														4	4
Education and Learning Analytics													9	6	15
Emerging Trends in ICT													3	6	9
ICT Entrepreneurship and Innovation													4	1	5
Quality of Software and Services											1	1	4	1	7
Strategic Planning and Decision Making													4	3	7
Other relevant papers				6											6
Student Papers					1	1	14	12	5	5	12	12	13	20	95
No of authors	126	151	125	172	105	140	98	94	85	91	70	71	93	68	1489
No of sponsors	20	21	10	9	5	10	10	14	18	19	11	12	7	4	170

The conference is governed by the international Program Committee that brings decisions about the content and monitors the scientific level. The technical tasks are managed and performed by the Organizing Committee. Since the beginning of the conference, all papers presented at the conference have been reviewed by at least two reviewers, one being from abroad.

The connection between the Conference and the scientific journal “Journal of Information and Organizational Science”, also published by FOI, is reflected in the fact that the Conference Program Committee proposes the papers with significant scientific contributions to be extended and published in the journal. Clearly, the editorial board of the Journal brings the final the decision based on the peer review results.

During the last fifteen years CECIIS Conference was hosting different parallel conferences, workshops, roundtables, exhibitions, presentation of projects and project meetings, challenges for students, conference sponsors' events and other similar activities.

Here are the most significant:

- Informatopolis - Open Day of Contemporary Public Administration, more than 100 participants (2005)
- Teaching and Learning Skills, Workshop (2005); "International Projects: Developing a Risk Management and Dissemination Plan, Workshop (2006)
- Development of educational materials for e-education, workshop, (2006)
- Online communication and e-education, workshop, (2006)
- E-learning, one-day symposium (2007)
- Activities towards ICT professionalism, workshop (2008)
- Competences of ICT professionals, roundtable (2008)
- Web-based survey methods, workshop (2009)
- Project Management Education and Research in Croatia, Round Table (2010)
- FOI security, two-day symposium (2011)
- CROSIM - Croatian Society Simulation Modeling, Round Table (2011)
- FOI Security (FSec) Symposium, three-day symposium (2012 to 2015)
- Mathematics and the ICT, two-day workshop (2012)
- Mobile and embedded development (f-moed) Symposium, (2012 to 2015)
- 10th International Doctoral Seminar IDS (2015)
- The Round Table on Quality in Informatics (2015)
- Poster and presentation section for students (since 2011)
- e-Schools Day - presentations and workshops of the project "e-Schools: Establishing a System for Developing Digitally Mature Schools (pilot project)" (2,16, 2017, 2018)
- Workshop on Data Analysis (2017, 2018)
- Computer Games - Professional Development (2018)
- Digital Transformation of Educational Institutions (2018)
- 4th Meeting of Business Informatics Departments - Influence of Digital Transformation (2018)

In conclusion, CECIIS is an established, distinctive and valued conference, with a defined profile. Like most similar conferences, it had its crises, but its continuity over the past 30 years proves its quality and reputation, especially now when many big conferences are getting bigger and many small conferences are disappearing.

Finally, the conferences are made by people.

Celebrating the 30th anniversary of CECIIS Conference is the best time to thank all the participants, especially those who are returning for years and to all invited speakers. Every successful conference is based on the work and dedication of its organizers, so we kindly thank to our past and acting members of the Program and Organizing Committees, and to all those who provided technical and administrative support, our numerous volunteers and students.

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