




Three Decades of OTO Conference Contributions to Organization Practices and Maintenance Technologies

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Abstract. History of operation and development of scientific conference “Organization and Technology of Maintenance” (OTO) during the three decades from regional scientific-professional conference to international scientific symposium is presented. The paper provides an overview of the number and structure of published papers, number of authors and their professional affiliation, sponsors and venues, and analyzes the structure of published papers. The conclusion points to the contributions of OTO papers to the practice of organization and maintenance technology in the region of Slavonia i.e. Central and Eastern Europe, and gives recommendations for better cooperation of scientific institutions with companies and public affairs institutions in the OTO area.

Keywords: Industry · Equipment maintaining · Organization of maintaining · Technologies of maintaining

1 Introductory Remarks

It has been 30 years since the first regional conference of OTO (Organization and Maintenance Technology) at which multidisciplinary issues of organization and technology of exploitation and maintenance of industrial equipment were discussed. Several generations of experts from industry and academia - in difficult socio-economic and political conditions - have invested extraordinary efforts and social enthusiasm in the organization of this conference and accompanying events; and, no state-political or professional body ordered that these activities be carried out, nor were they paid for that work, nor was any private non-transparent interest realized. So, it is time to give an assessment of the OTO rallies held over the past three decades.

1.1 Techno-Economic Characteristics of the Region’s Economy

Techno-economic characteristics of the economy of the region of Slavonia (see Fig. 1) summarize the following three excerpts, with graphs and tables, from our previous papers:

“In 1979, in the area of the Slavonia region, 184742 people were employed in the social sector, of which 85702 in industry. In following years, employment grew so that

in 1987, 221326 and 104890 workers were employed in industry [1]. This shows that the region of Slavonia was not an explicitly agricultural region (as was often assumed) but had a developed industrial production (metal processing, wood, textile, food, chemical, rubber, leather and foot-wear industry).” [1]; Fig. 2, 3, 4 and Table 1.



Fig. 1. Croatia region of Slavonia in 1983 (14 then municipalities).

In socialist Yugoslavia, economy was divided into the social and private sectors. Only the number of employees in social sector is shown in Fig. 2. This means that private craftsmen, farmers and free professions (approximately 30000 employees) are not included [1].

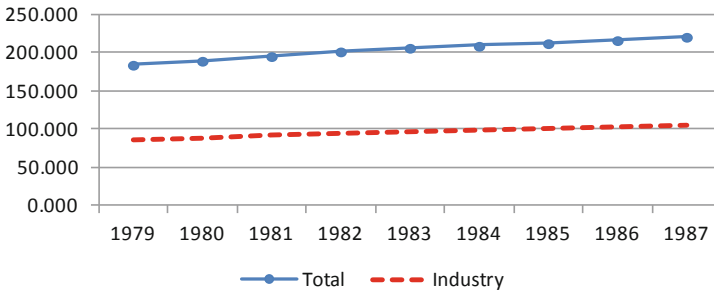


Fig. 2. Number of employees in social sector of economy and industry of Slavonia in period 1979–1987 [1].

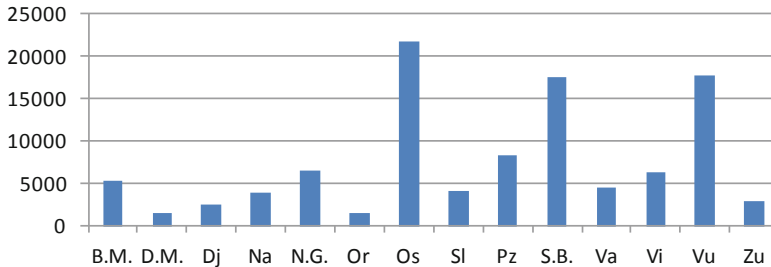


Fig. 3. Number of employees in industry of region Slavonia by municipalities in 1987 [1].

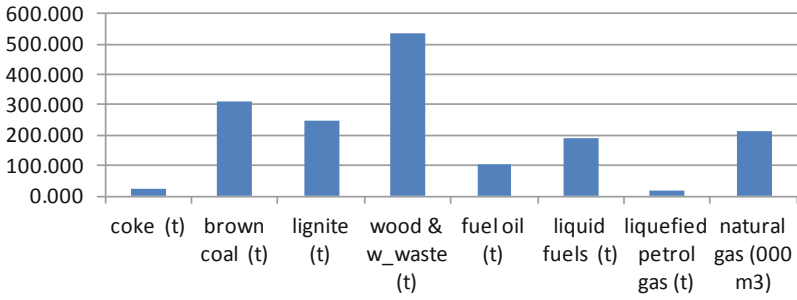


Fig. 4. Structure of substitutable energy consumption in Slavonia industry in 1984 [2].

In the area of Slavonia region in 1984, 25217 t coke, 159 t hard coal, 309318 t brown coal, 249072 t lignite, 532785 t wood and wood waste, 102669 t fuel oil, 88000 t liquid fuels, 16952 t liquefied petroleum gas and 213.5 million m³ natural gas were consumed (see Fig. 3 and 4) [2, 3]. The region had a dozen large energy consumers that were high on the list of energy consumers in Croatia (see Table 1).

Table 1. Slavonian industrial capacities on the ranking list of the largest energy consumers in Croatia (1981–1983) [2].

On	Company name	Headquarters	Rank in Cro
1	Kombinat Belišće	Belišće	5
2	Tvornica šećera IPK Osijek	Osijek	6
3	Kombinat Borovo	Borovo	11
4	Tvornica cementa	Našice	13
5	Tvornica šećera PPK Županja	Županja	15
6	Tvornica šećera PIK Belje	B. Manastir	17
7	SOUR Đuro Đaković	Sl. Brod	21
8	DIK Đurđenovac	Đurđenovac	26
9	Slavonija DI	Sl. Brod	28

In those decades, 12 large industrial-agricultural companies with developed agricultural production and food industry operated in the region (see Table 2).

Table 2. Industrial-agricultures companies in Slavonia region (1983) [1].

On	Company name	Headquarters
1	Agro-kombinat Jasinje	Slavonski Brod
2	IPK Osijek	Osijek

(continued)

Table 2. (continued)

On	Company name	Headquarters
3	PIK Belje	Darda
4	PIK Đakovo	Đakovo
5	PIK Nova Gradiška	Nova Gradiška
6	PPK Slavonska Orahovica	Slavonska Orahovica
7	PPK Kutjevo	Slavonska Požega
8	PIK Đuro Salaj	Valpovo
9	PIK Vinkovci	Vinkovci
10	PIK Vukovar	Vukovar
11	PPK Županja	Županja

Eleven large industrial and agricultural companies in Slavonia in those years were on ranking list of 140 largest companies in Yugoslavia (see Table 3).

Table 3. Slavonian companies on ranking list of largest companies in industry, mining, agriculture, forestry and construction in Yugoslavia - according to total income [4, 5].

Company	Headquarter	Ranking position		Number of employees
		1983	1989	1989
1. Kombinat Borovo	Vukovar	16	35	21.557
2. IPK Osijek	Osijek	33	22	16.520
3. PIK Belje	Darda	57	–	8.710
4. SOUR “Đuro Đaković”	Sl. Brod	76	–	16.619
5. PIK Vinkovci	Vinkovci	87	102	4.338
6. Kombinat Belišće	Belišće	121	...	5.038
7. Elektroslavonija	Osijek	–	89	2.500
8. Saponia	Osijek	–	104	2.839
9. PPK Đuro Salaj	Valpovo	–	126	2.473
10. PIK Đakovo	Đakovo	–	131	3.579
11. PPK Kutjevo	Kutjevo	–	135	2.669

Unfortunately - after the democratic social changes in the 1990's in the Slavonian region (as well as in the whole Republic of Croatia) three (for the region) objective difficulties significantly reduced the potential of industry: a) war aggression on the Republic of Croatia caused great human and material losses and broken social relations which has set back economic and social development; b) the concept and implementation of privatization in the Republic of Croatia during the same period also made huge losses

in the financial and social capital of the region - for which incorrect implementation there is a very significant part of the responsibility of local politicians; and c) the processes of globalization have changed the economic environment which, with large food imports into the country, has done additional damage to development. It should be added that during this period there were a number of subjective weaknesses of local politics and science. [6] Thus, dozens of industrial companies in the region disappeared, and in hundreds of companies, production - as well as the number of employees - was decimated. According to Statistical reports, in 2008 there were 525 industrial companies in the Slavonia region, employing 42,183 workers [7].

1.2 Establishment of the Association of Industrial Equipment Maintainers of Slavonia and Baranja

Developed industrial capacities and mechanized agricultural production have conditioned development of strong equipment maintenance services with numerous professional staff in a number of engineering and technological professions. Consequently, experts founded their professional organization – Association of Maintenance Osijek (industrial equipment in Slavonia), which was founded in Osijek on October 27, 1983.

The Association brought together hundreds of engineers and experts of other profiles from thirty cities and municipalities of the region, who at that time had a professional need to exchange experiences, expand their knowledge of new technologies, develop specific solutions in operation and maintenance of industrial equipment. At that time, members of the Association participated in a series of seminars, lectures and visits to large industrial complexes, both in the Slavonia region and in Croatia, as well as in other republics of Yugoslavia. Also - a number of experts participated in their work at professional meetings in Croatia. The Association was programmatically oriented towards manufacturing companies in industry, agriculture and construction, as well as the transport sector. Exchange of experiences and processes of continuous education (today it would be called lifelong learning) were basic tasks of Association. Thus, a number of technical exhibitions, study visits, courses, forums and round tables were organized during the operation. In the late 1980s, need to hold a regular annual regional meeting on organization and technology of equipment maintenance was articulated. Namely, developed industrial production in the region, capacities with high energy consumption, and introduction of new technologies and crisis of the socialist business model (which indicated need for stronger market respect) imposed a number of new organizational and technological problems, among others, in sector of exploitation and maintenance of industrial equipment [8]. At the beginning of 1990 - on the initiative of prof. dr. sc. Branimir Kovačić (Faculty of Electrical Engineering Osijek) the Association started by organizing regional professional-scientific meetings on topic of maintenance of industrial equipment. That's how it was on April 20, 1990 the first scientific colloquium on topic "Organization of Maintenance in New Conditions" was held at the Faculty of Electrical Engineering in Osijek [9].

2 Conference on Organization and Maintenance Technology

Due to the aggression against the Republic of Croatia and the bombing of Osijek in 1991, the conference was not held, and next two conferences were also held during the war on 12 December, 1992 and March 12, 1993 in Osijek under the title “Maintenance of Industrial Equipment” (In the fall of 1993, the scientific colloquium “Informatization of Maintenance” was also held in Osijek). The next two conferences were held: March 4, 1994. (“Maintenance Organization and Technology”) in the city of Đakovo and January 27, 1995 (“Management and Maintenance Organization”) in the city of Našice. The seventh conference was held on February 16, 1996 in Slavonski Brod under the title “Organization and technology of maintenance - OTO 96.” and since then all subsequent conferences are held under that title, and OTO (abbreviation from the Cro name “Organization and technology of maintenance”) becomes the brand of the conference [9]. In the past 30 years OTO conferences have been held in 11 cities in the Slavonian region and in Kutina (Croatian city outside territory of the Slavonia) Table 4.

Table 4. Cities and number of OTO conferences held [8–38].

1	Osijek	14
2	Požega	3
3	Đakovo	2
4	Kutina	2
5	Vinkovci	2
6	Županja	2
7	Donji Miholjac	1
8	Kneževo	1
9	Našice	1
10	Slavonski Brod	1
11	Virovitica	1
12	Vukovar	1

2.1 Number of Papers and Structure of Authors

In 30 years 1321 authors have presented at OTO conferences (and published in proceedings) a total of 630 papers [10–40]. In the first years of conferences (which were during the war) number of papers is smaller (about 10), but in later years it grows (20 per conference) and from 2020 to over 40 papers (see Fig. 5).

The analysis of the number of authors and published papers shows:

- In the first two decades (1990–2010) there were the most papers with one author (224), followed papers by two authors (61), with three authors (33), with four authors (6) and by with five author (4);

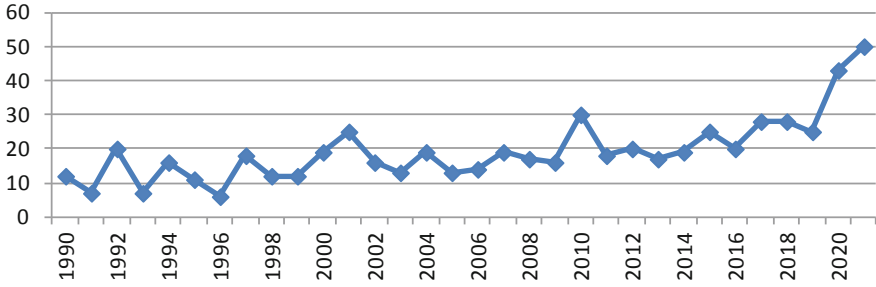


Fig. 5. Number of papers in OTO proceedings from 1990 to 2021 [10–40].

- Since 2012, the number of authors per paper has grown significantly; this is mostly result of more complex research on specific technical issues that are published, although it should not be excluded “friendly” addition of some “authors” (according to this author at least 15% of papers) who thus get the necessary points for re/election in scientific and teaching positions (see Fig. 6 and 7).

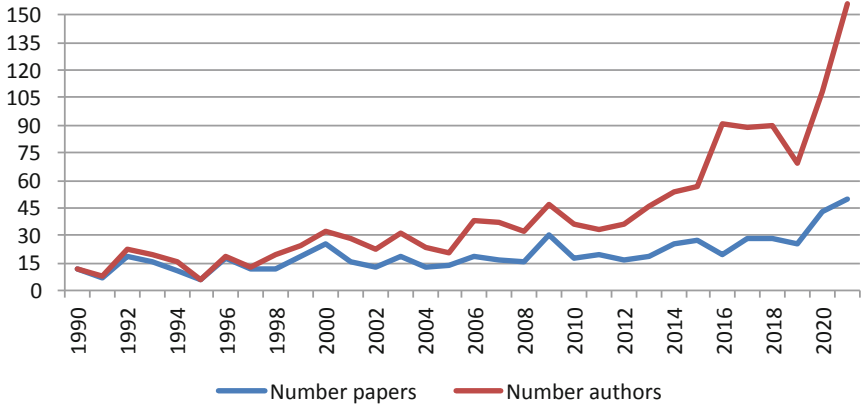


Fig. 6. Number of authors and number of papers in OTO proceedings 1990–2021 [8–38].

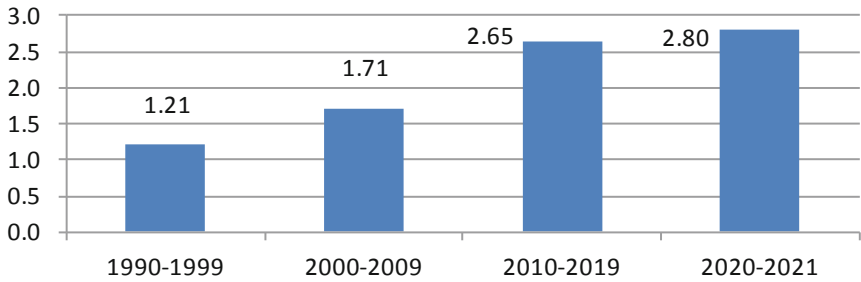


Fig. 7. Average number of authors per published paper in OTO proceedings 1990–2021 [10–40].

Analysis by author profession shows that most of authors are in field of electrical engineering (power engineering, electromechanical engineering, computer science, and telecommunications; 31%), and mechanical engineering (26%), followed authors in economics (16%), agronomy (11%) and construction (11%) and others (law, sociology etc. 4.0%), see Fig. 8.

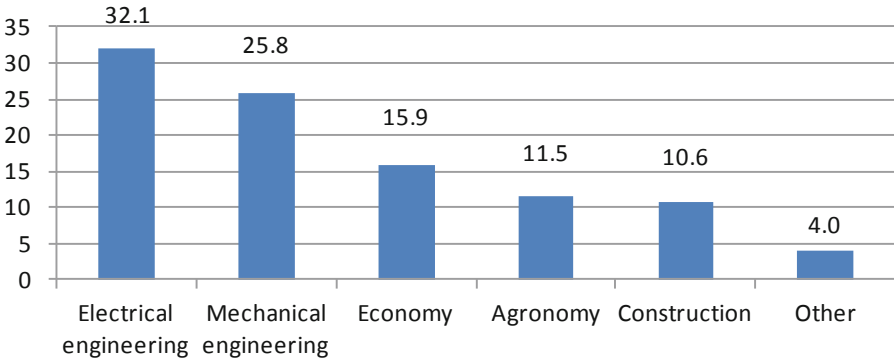


Fig. 8. Authors of papers at OTO conference 1990–2021 by professions (%) (Total = 100) [10–40].

It should be emphasized here that over 98% of authors have a university degree, or that over 65% of the first authors have the academic degree of master or doctor of science. In multi-author papers, more than 50% of these author teams are interdisciplinary.

Looking at the domicile institution of the authors - most authors are in group of technical faculties (TF), followed: authors from faculties of social sciences and colleges (SFHS), large companies in business sector (LBS), public institutions and local government (LSG), small enterprises (SME) and others (unemployed professionals and students), see Fig. 9.

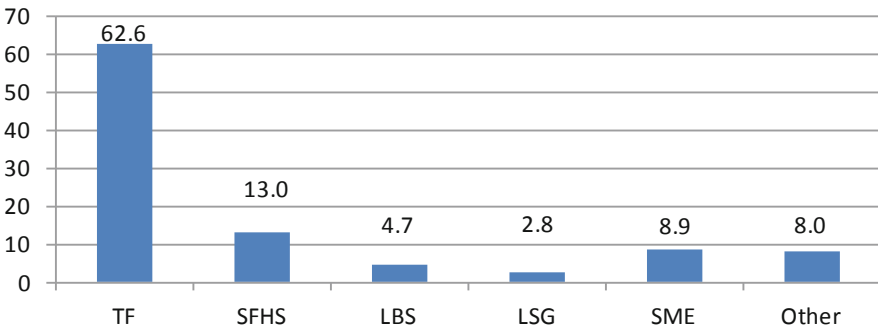


Fig. 9. Authors of papers in OTO proceedings 1990–2021 by employment institutions [10–40].

According to place of residence of (first) author (in team work) in first 20 years, the most represented authors are from Osijek (225), followed by: Slavonski Brod (25), Požega (17), Zagreb (16), Kutina (12), others cities in the region of Slavonia (9), other cities in Croatia (28). There were few papers from abroad (13). Figure 10 shows the number of authors by decades according to country of residence in the period 1990–2021.

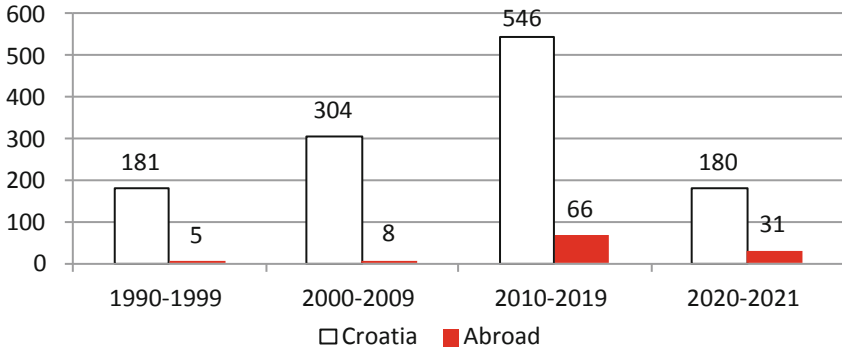


Fig. 10. Authors of papers in OTO proceedings 1990–2021 by country of residence [10–40].

Most authors outside Croatia are from Serbia (71), Bosnia and Herzegovina (17), Slovenia (8), and a smaller number of papers are from Austria, Germany, Hungary, Kosovo, Poland, Spain, and Turkey.

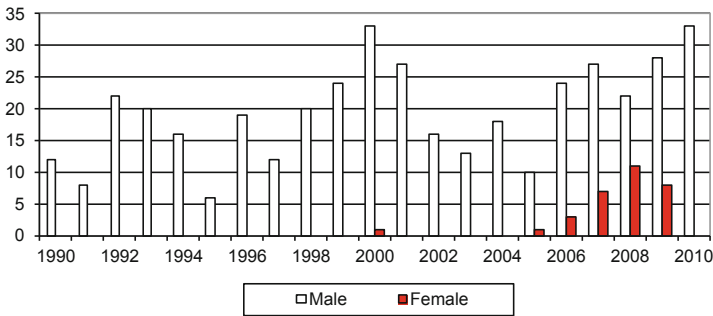


Fig. 11. Number of authors in OTO proceedings 1990–2010 by gender [7].

It is especially important to point out gender structure of papers authors: in the first 15 years in OTO proceedings, except four female authors, all authors are male. Only since 2006 have papers of female authors been present - as shown in Fig. 11. Looking at the total number of authors in the first 20 years of the OTO conferences female authors was 10% (see Fig. 12). Since 2011, female authors have been regularly represented at OTO in increased number compared to previous period (see Fig. 13 and 14).

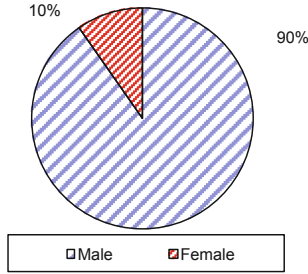


Fig. 12. Percent of authors in OTO proceedings 1990–2010 by gender [7].

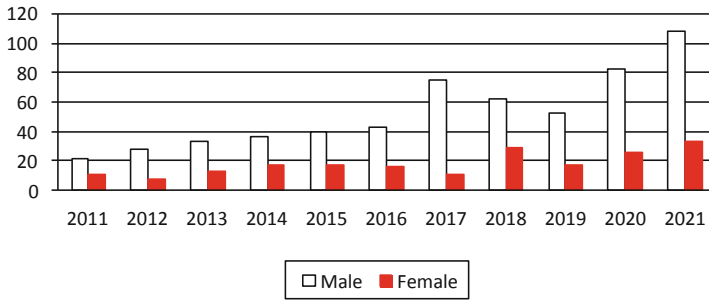


Fig. 13. Number of authors in OTO proceedings 2011–2021 by gender [31–40].

Increased representation of female authors is a result of changes in material production technology and increased share of tertiary sector (services and education) in the structure of economy and society and strong development of informatics and computing - in which sectors a significant percentage of women professionals - as well as representation of women in construction, electrical engineering and mechanical engineering.

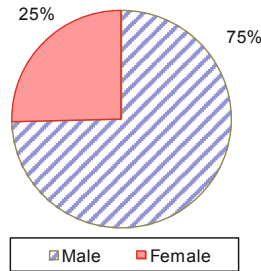


Fig. 14. Percent of authors in OTO proceedings 2011–2021 by gender [31–40].

3 Thematic Framework of Published Papers

The analysis of the thematic framework of published papers at OTO conferences [10–40] was made for two periods; a) 1990–2010 and b) 2011–2021, and in each of the period on two levels:

1. Thematic framework of papers; the papers are grouped into three groups: (1) “Maintenance organization”, (2) “Maintenance processes and procedures” and (3) “Maintenance technologies”;
2. Analysis of papers according to area of purpose; There are five sets of intended use of paper: (1) “In principle models”, (2) “Intended use for industry”, (3) “Intended use for agriculture”, (4) “Intended use for construction”, and (5) “Intended use for the non-economic sector”.

3.1 Period 1990–2010

According to the thematic framework, most papers were published in the group “Maintenance processes and procedures” (MPP), followed by thematic groups “Maintenance organization” (MOR) and “Maintenance technologies” (MTH), see Fig. 15.

The analysis of works by purpose shows that most works were published in group “Principle models” (Pri_mo), followed by: “Purpose industry” (P_ind), “Purpose agriculture” (P_agr), “Purpose construction” (P_con) and “Purpose non-economic sector” (P_nes), see Fig. 16.

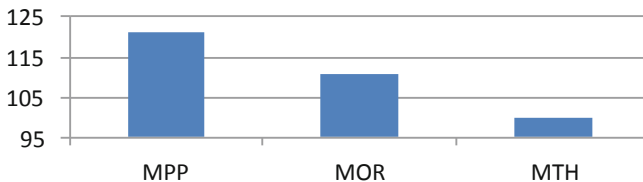


Fig. 15. Thematic framework of papers in OTO proceedings 1990–2010 [9].

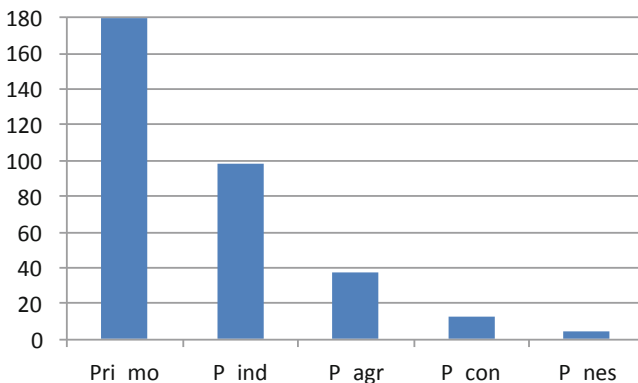


Fig. 16. Papers in OTO proceedings 1990–2010 according to purpose [9].

In thematic group “Maintenance organization” according purpose most papers consider Economic aspects of maintenance (Ecn), followed by: Macro (Mac) and Micro (Mic) models on maintenance organization (Orm), Informatics in maintenance (Info) and Safety at work (SaW), see Fig. 17.

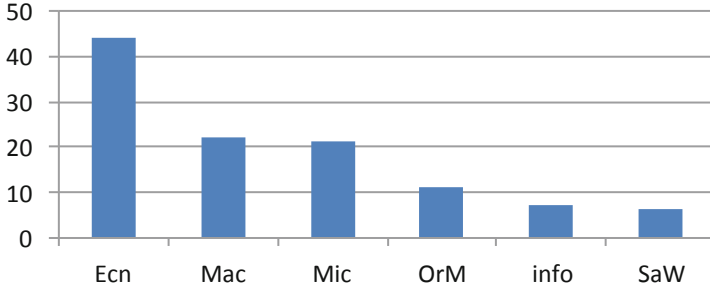


Fig. 17. Papers in OTO proceedings 1990–2010 according to field of papers purpose [9].

In thematic group “Maintenance processes and procedures” most papers are from field of mechanical engineering (Mc_eng), followed by: electrical engineering (El_eng), informatics (Info), models (mod), agriculture (Agr), industry (Ind) and construction (Con), see Fig. 18.

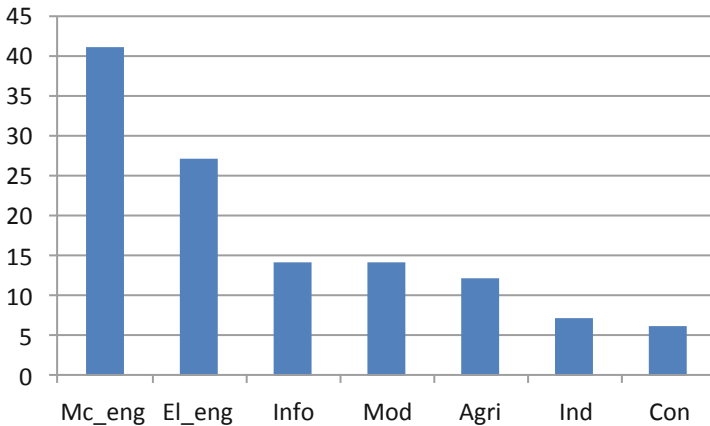


Fig. 18. Papers in field “Processes and maintenance procedures” in OTO proceedings 1990–2010 [9].

In thematic group “Maintenance Technologies” most papers are in field of mechaical engineering (M_eng_t), followed by: electrical engineering (El_en_t), informatics (Info_t), Chemistry (Che_t), food industry (Food_t), and construction (Con_t), see Fig. 19.

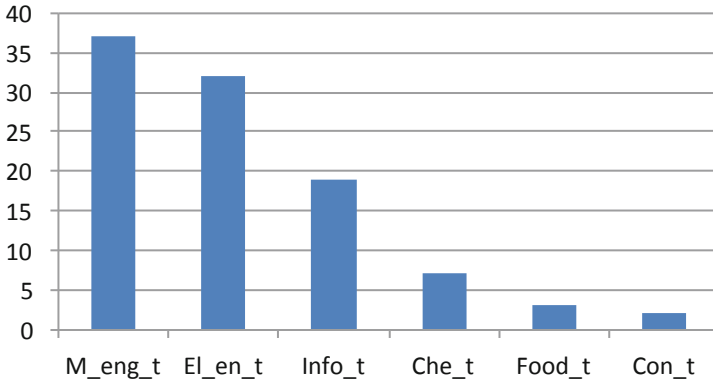


Fig. 19. Papers in “Maintenance Technologies” in OTO proceedings 1990–2010 by technology [9].

Analysis of papers according to area of purpose based on five sets of intended use of paper: “In principle models” (81%), followed by groups: “Intended use for industry”, “Intended use for agriculture”, “Intended use for construction”, and “Intended use for the non-economic sector”. Basic analysis of purpose shows in Fig. 20; a detailed analysis is published in the book [9].

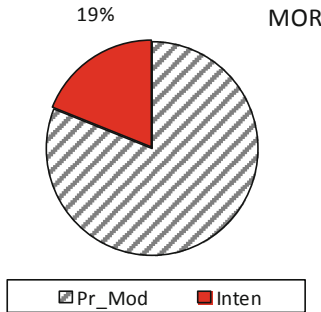


Fig. 20. Papers in “Maintenance Technologies” by intended in OTO proceedings 1990–2010 [9].

The category “Principle Models” in purpose of paper means that this paper discusses professional issues in this area and that this article is in principle useful and applicable in all sectors of maintenance - but in all other sectors of human activity – e.g. from fisheries, firefighting to activities to popular music). Namely, we want to emphasize that: (a) in such a category of works there is too much retelling of other people’s works and empty dosing, and what knowledge can be found in hundreds of other places (books, magazines, Internet), or (b) that there is little works related to the specific maintenance practice of a specific business entity. In other words - it would be far more useful for all participants in OTO conferences and the professional public if most of these papers (content) were presented on example of a specific business entity; theoretical and principled considerations are certainly needed, but not like this - by retelling other people’s models - and in a large number of papers.

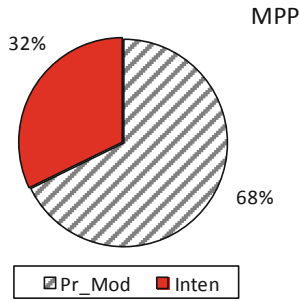


Fig. 21. Papers in “Maintenance processes and procedures” by intended in OTO proceedings 1990–2010 [9].

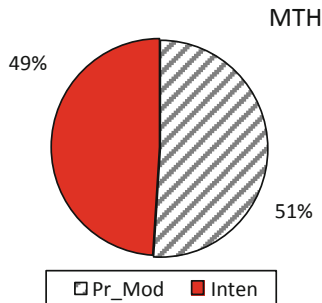


Fig. 22. Papers in “Maintenance Technologies” by intended in OTO proceedings 1990–2010 [9].

A comparison of Figs. 20, 21, and 22 shows that in the areas of “Maintenance Processes and Procedures” and “Maintenance Technologies” there are far fewer papers in the category of “Principle Models” and significantly more in the field of concrete application in industry, agriculture and construction.

3.2 Period 2011–2021

Thematic framework in this period have similar structure; most papers were published in group “Maintenance processes and procedures” (MPP), followed “Maintenance organization” (MOR) and “Maintenance technologies” (MTH), see Fig. 23.

Major changes in the structure of papers published at OTO conferences in this period occurred in terms of content, namely: a) the topics covered and b) the purpose of the papers. Papers in the group of “principle models” are much less represented, i.e. over 90% of papers are considered specific issues in the field of specific organizational and technical procedures and technology (see Fig. 24).

Also engineering areas (civil engineering, energy, informatics, machine and electrical engineering, computing etc.) are far more represented (see Fig. 25).

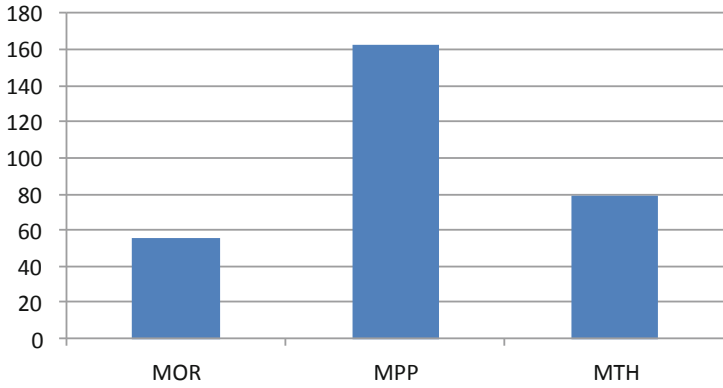


Fig. 23. Thematic framework of papers in OTO proceedings 2011–2021 [31–40].

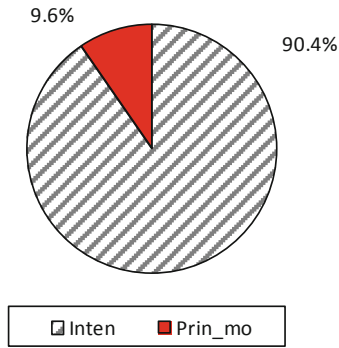


Fig. 24. Thematic framework of papers in OTO proceedings 2011–2021 [31–40].

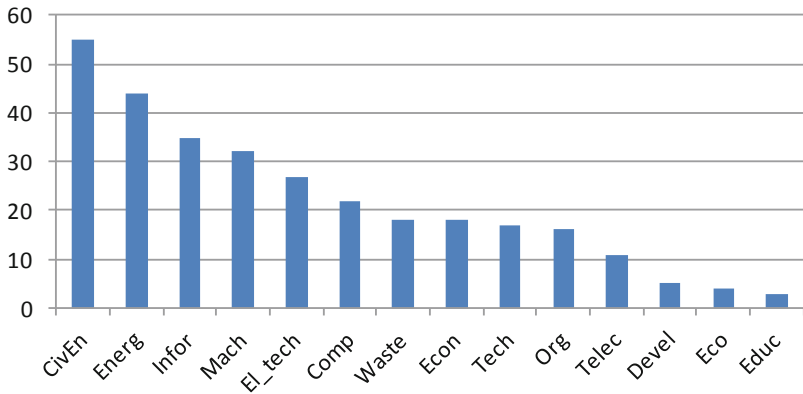


Fig. 25. Thematic area framework of papers in OTO proceedings 2011–2021 [31–40].

4 Organization of OTO Conference

The organization of a scientific conference, as well as the publication of proceedings, is complex projects that involve a large number of executors and require significant financial resources that exceed the capabilities of a non-profit professional association (such as the Osijek Maintenance Society) especially in the war and postwar years.

However, with the self-organization and correct commitment of dozens of experts from all over the region, these demanding jobs are always realized with quality and on time; starting from the first call, conference program and posters, through the holding of the conference to the UDC classification and technical editing of the proceedings, thousands of working hours were spent without paying fees. Neither the authors nor the reviewers were paid. Conference halls and printing of proceedings were paid by the sponsors of the conferences - large companies, chambers of commerce or higher education institutions from the region.

The first 15 conferences were organized by the Osijek Maintenance Association (OMA) with the co-organization of the Faculty of Electrical Engineering Osijek (EEF). The organizers and co-organizers of later OTO conferences were: Faculty of Agriculture Osijek (FAO), Polytechnic Požega (PP), Faculty of Civil Engineering Osijek (FCEO) and Panon, think tank for strategic studies Osijek - as shown in Table 5.

Over the past thirty years, several hundred experts and professors have volunteered and enthusiastically performed functions in the organization of OTO conferences - many of them for ten years. On this occasion we cannot state their names - this is published in Book 1 (see Fig. 26).

- Members of scientific and program committee of the OTO conference were professors of Osijek faculties until 2015, when OTO became international, and in addition to scientists from Croatia, members of these committees were also scientists from Bosnia and Herzegovina, Hungary, Slovenia and Serbia.
- The members of the Organizing Committee were from: OMA, Osijek faculties and representatives of sponsors - large industrial companies.
- The editors of the proceedings were professors from Osijek faculties.
- Promotional and other organizational activities were carried out by employees of the Faculty of Electrical Engineering Osijek.

On average, over a hundred participants attended OTO conferences; within each meeting participants visited production processes in the industrial system - host of the meeting, and with each meeting was organized an exhibition of tools and devices used in the maintenance of industrial plants. The proceedings were always printed before the OTO conference - so participants had a book so they could more easily follow authors' presentations. Until 2015, all papers in proceedings were in Croatian, and from 2016 to 2020, the papers (at choice of the author) were published in either Croatian or English. As of 2021, the OTO proceedings are complete in English.

Table 5. Organizer and Co-organizers of OTO conferences [10–40].

Year	Organizer	Co-organizers		
1990	OMA	EEF	–	–
1992	OMA	EEF	–	–
1993	OMA	EEF	–	–
1994	OMA	EEF	–	–
1995	OMA	EEF	–	–
1996	OMA	EEF	–	–
1997	OMA	EEF	–	–
1998	OMA	EEF	–	–
1999	OMA	EEF	–	–
2000	OMA	EEF	–	–
2001	OMA	EEF	–	–
2002	OMA	EEF	–	–
2003	OMA	EEF	–	–
2004	OMA	EEF	–	–
2005	OMA	EEF	–	–
2006	OMA	FAO	–	–
2007	OMA	FAO	PP	
2008	OMA	FAO	–	–
2009	OMA	FAO	–	–
2010	OMA	FAO	–	–
2011	OMA	FAO	–	–
2012	OMA	EEF	FCEO	FAO
2013	OMA	EEF	FCEO	FAO
2014	OMA	EEF	FCEO	FAO
2015	OMA	EEF	FCEO	FAO
2016	OMA	EEF	FCEO	FAO
2017	EEF	–	–	–
2018	EEF	–	–	–
2019	PANON	EEF	FCEO	–
2020	PANON	EEF	FCEO	–
2021	PANON	EEF	FCEO	–



Fig. 26. OTO 2020 proceedings.

5 Conclusion

The analysis organization of OTO conferences in period 1990–2021 and analysis of published papers in OTO proceedings indicate successful work of a large group of industry experts from Slavonia region and professors from Osijek faculties in first two decades, and in the third decade and experts from several neighboring countries. Despite the war aggression against Croatia and the difficult transition and post-war conditions, the OTO conference has been held continuously for the past 30 years.

Thirty OTO conferences were organized in 12 different cities, with sponsorship of about thirty companies and several higher education institutions from the region of Slavonia.

At thirty OTO conferences, a total of 1321 authors presented (published in the proceedings) over 630 professional and scientific papers on the following topics: (1) Maintenance organization, (2) Maintenance processes and procedures and (3) Technologies used in maintenance.

Most of papers are in the field of technical sciences (mechanical engineering, electrical engineering, construction, and petrochemical technology), followed papers in field of economics and organization and agronomy. All papers for the OTO conference were reviewed by two reviewers, and since 2006 the papers have been categorized.

In OTO activities, autopoiesis organization and self-denying and volunteer work of dozens of experts from companies and higher education institutions from the region prevailed.

OTO conferences have contributed to (a) a high level of expertise in the operation and maintenance of industrial plants in Slavonia region, and (b) the development of industrial culture in the region's economy and public services. Thus, a modern form of dissemination of professional technological and organizational knowledge that crosses the borders of the Slavonian region was realized.

In 2021, the OTO conference outgrows the regional framework of Croatia and neighboring countries of Southeast Europe and becomes an international European conference.

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