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Special issue: “Working from home and Socio-Psychological Effects of the Internet Use” and “New developments in Digital Libraries”
Guest Editors: Mirjana Radović-Marković and Hermann Maurer

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Working from home and Socio-Psychological Effects of the Internet Use and New developments in Digital Libraries

Guest Editors: Mirjana Radović-Marković and Hermann Maurer

Guest Editor Mirjana Radović-Marković: Working from Home and Socio-Psychological Effects of the Internet Use

Working from home has realized significant economic benefits, but also psychological, and social limitations. The six papers discuss this topic as follows:

Paper no. 1, “Economic and social advantages and limitations of working from home in Serbia, Montenegro, Bosnia and Herzegovina, and North Macedonia” (by Đukanović, Borislav; Radović-Marković, Mirjana; Macanovic, Nebojša; and Maksimović, Ana). The authors of this study analyzed the economic and social advantages and limitations of working from (at) home in four countries of the Western Balkans - Serbia, Montenegro, North Macedonia, and Bosnia and Herzegovina. This paper discussed the most significant and numerous differences between those who work from home in Montenegro and others, especially those in Serbia and Bosnia and Herzegovina. Namely, those who work from home in Montenegro are the least optimistic about the "gig" economy; they have more psychosocial problems than everyone else, they do not have enough free time for recreational activities, and they complain about excessive work and the impossibility of separating business from private life. Based on the results of this research, the paper concluded that in such a very unfavorable economic, social and political environment in the countries of the Western Balkans, working from home, and especially freelance, remain the only oases of entrepreneurial freedoms and personal autonomy.

Paper no. 2, titled “Freelance in Four Countries of the Western Balkans” (by Đukanović, Borislav; Marković, Dušan; Krivokapić, Nataša; and Banović, Silva), pointed out that the most significant differences have been noted between freelancers from Montenegro and freelancers from the other three countries. The study showed that freelancers from Montenegro see less positive contributions working in the "Gig Economy" than others, and they significantly more often believe that the "Gig Economy" can't reduce unemployment and prevent brain drain abroad. The authors explain the negative attitudes of freelancers from Montenegro towards their work in the "Gig Economy" with the lower prevalence of freelancers, poorer job structure, and lower-income with an unfavorable socioeconomic status.

In paper No.3, “Psychosocial Adjustment to Work at Home in Serbia, Montenegro, North Macedonia, and Bosnia and Herzegovina” (by Đukanović, Borislav; Ćustović, Enita; Bandalović, Gorana and Dragojević, Arsen), the authors described psychosocial adjustment to work at home in the four Western Balkan countries. They investigated similarities, and differences among the countries. At last, they presented the profiles of psychosocial adjustment for each country.

“Rise of the Gig Economy and Further Trends in the Work Processes” (by Vučeković, Miloš; Radović-Marković, Mirjana; Nikitović, Zorana; and Sladana Vujičić) is the paper no 4. This article explored the process of remote work within the gig economy. It is pointed out that labor markets and employer-employee relations have been redefined around the world. When considering the countries of the Western Balkans, it is certain that we are witnessing changes in the way we work and that the number of those who work outside the employer's business premises has increased in Western Balkans.
It is expected that in the future, more and more attention will be paid to helping employees work in this way. In addition, the authors concluded that remote working that involves greater work flexibility will continue growing.

In paper no. 5, "Educational Characteristics of Students - Victims of Cyberbullying" (by Macanović, Nebojša; and Stojanović, Ružica), the authors tried to identify the presence and forms of cyberbullying among secondary school students in the municipality of Modriča (Bosnia and Herzegovina), as well as the relationship between the manner of cyberbullying and educational characteristics of students – the victims of cyberbullying. Based on the results of an empirical study, this paper concluded that violence is present in schools, in their yards, parks and hallways. In addition to the visible physical and verbal violence today under the influence of information - communication development takes completely different forms, which are much more dangerous and devastating for children and youth.

In paper no.6, "Internet Sex Addiction in Serbia and Montenegro" (by Đukanović, Borislav; Petrušić, Irena; Bandalović, Gorana; Maksimović, Ana; and Banović, Silva), the authors analyzed the problematic use of pornographic websites and Internet sex addiction in representative samples of respondents from different age groups including 2948 respondents from Serbia and 1486 from Montenegro. In this study, the authors focused on researching problematic and addictive behavior related to Internet sex in Serbia and Montenegro. They concluded that of all the addictions, sex addiction is the most difficult to control because it is a complex mixture of biological, psychological, cultural, and family factors, a combination that creates and intensifies compulsive sexual behaviors and indicates that such behaviors are almost impossible to resist even though sex addiction produces many negative consequences in various spheres of life.

We hope that this special issue will provide a contemporary resource for scholars and other readers who are interested in the gig economy and the transformation of work models, as well as the socio-psychological consequences of using the Internet and new technologies.

Mirjana Radović-Marković has a PhD in Economics and is a Professor of Entrepreneurship. She gained complete expert education from the Faculty of Economics, Belgrade University. She was elected to the position of full professor and principal research fellow in several universities worldwide. Prof. Dr Radovic-Markovic is a founder of three peer journals and their editor-in-chief. She has written 34 books and 275 articles. (H-index 23). She is, also, an elected member of Academia Europaea and its Section Committee "Economics, Business and Management Sciences"
Guest Editor Hermann Maurer: New developments in Digital Libraries

The three papers in the section on digital libraries have one common thread: It is clear that more and more printed books and brochures are also made available as electronic versions in some multi-media format, maybe even at some stage replacing printed material; it is also clear that the possibility to just read material will be greatly enhanced by allowing users to also interact with the material: by adding valuable information, by pointing to related documents, by asking questions, by interacting with other users or even the originators of documents.

The paper “Web Sites Need Much More User-Driven Interactivity” by Zaka, Bilal and Maurer, Hermann shows that the notion of interacting with electronic material and not just consuming it is some 30 years old. It was implemented in a few systems but has received surprisingly little attention until fairly recently. This is shown conclusively. It is also the first time that a clear distinction is made between system-driven and user-driven interaction. System-driven interactions play an essential role in e-Learning, computer games, opinion polls, etc. but were almost completely ignored (overlooked?) as a tool to enrich digital material through discussions, by adding to it, etc. The only attempts in this direction were much less focused discussion forums, social networks, etc. The paper focuses then on user-driven feedback possibilities that have been tested with very large information servers by the authors for some years, to be able to finally come up with workable solutions, leading to the ambitious NID project. NID goes far beyond just allowing interactivity, but also supporting various new functions never included in digital libraries. This was possible by adding intelligent tools more and more. Embedding explicit user interaction opportunities at all levels in a content publishing platform opens a gateway to many new features. It is our conviction that such systems in future will use all sorts of machine learning algorithms and automated inference tools. Best practices must be used for needed sustainable data pipelines for the system from its users. The software has been applied to a variety of applications as is pointed out in reports and experiments mentioned in the paper.

The paper “Emerging Technologies in Digital Libraries: Net Interactive Document (NID) Experiences and Prospects” by Zaka, Bilal is based on evaluating some of the most recent attempts in digital libraries, like the NMC Horizon Report, the application of big data principles to digital libraries, evaluations of user wishes and complaints in sophisticated large digital libraries, the tremendous problems in content curation in digital library systems that will require deep methods from AI and neural networks. Just consider a “trivial” problem: If a user reads an interesting paragraph in a book it would be nice if the software could point to other relevant spots in other books. Such a job is only possible by using advanced methods of natural language understanding. To be able to even approach a solution, each page of a document must be associated with important meta-data describing the contents of the page. One does expect a full-text search in electronic books. It is less trivial to make sure that one can specify a set of books so that all of them are searched at the same time in full-text form. Why? Well, it should be clear that fast full-text search only works by preprocessing documents and thus having an index for each of them. But if the set of documents can vary arbitrarily, how can one provide a precomputed index for each possible set? This and a host of other problems have been solved by the team developing NID, often relying on open resources developed by other organizations. NID was built to allow discussions, to have different levels of users and not just to allow annotations, but to also search in annotations (done right now on an experimental level). However, it is worth considering the complications arising: Take a searchable book; now an annotation is added; first, does this mean that the search index of the book has to be updated? And if so by what? An annotation, after all, can be a piece of text, but it can also contain e.g. a link. Should the destination of the link (or even some sentences in the destination document) also be included? This short description only scratches the surface of the paper. The paper shows many surprising possible applications and problems: some are solved, some seem solvable, and some require much further research. One can only hope that the financing of this very future-oriented project will be available to the extent needed.

In the paper “The Incorporation of NID into Digital Libraries and Its Benefits” Sonja Eisenberger distinguishes between digital books and digital libraries as collections of digital documents with additional features for both providers of the libraries and their users. She alerts readers to the fact that digital libraries are by no means a new concept. Even if one does not count concepts of “hyperlinked electronic documents” as already proposed by Ted Nelson in 1960 in his Xanadu, or powerful hypertext systems preceding the World Wide Web, or the idea to collect documents in a database with good query
features, digital library project wanted a more coherent but powerful structure. They do go back to at least “Project Gutenberg” in 1971, as is pointed out in the paper, or systems like the “Million Book Project” (started in 2007); “The World Digital Library” (2009), or systems like the Bavarian Electronic Library that was started with little fanfare already in 1997 are mentioned as an example for the many efforts in creating digital libraries. Notice that the paper makes a clear distinction between such libraries and the New Zealand Greenstone Project that provides tools for building digital libraries and as such has had much success. The next part of the paper concentrates on the International Image Interoperability Framework (IIIF) which allows unprecedented interoperability and media exchange between arbitrary institutions. The paper then explains the basic ideas of Net Interactive Documents (NID) to the extent necessary to compare it with the “newcomer” Hypothes.is which allows adding comments to existing documents by just adding server-side apps. This allows easy use but has limited functionality compared to the NID approach that dominates the other two papers in this section. 

A final warning: The editor responsible for this section has observed that almost all persons working on electronic books or digital libraries are in a way convinced that sooner or later digital documents will not be additions to printed material, but will replace them. This is foolish: No software, no media format will survive for, say, more than a hundred years (this is being optimistic). So how can we preserve electronic data for a long time? By converting stuff over and over again to new HW, SW and new formats. The problem is: A complete conversion will never be done, but only of important material. The problem is: What may not be considered important in 2050 may suddenly be very important in 2300, but will be long lost by then! Yes, I am serious: We lost much important information in the transition from other nets to the internet. I have experienced a typical case. Maybe it will amuse readers to look at the open-access paper I wrote some five years ago on the (In)stability of digitized information: https://austria-forum.org/aff/Geography/Cross-country_information/Stability_of_digitized_information.

Hermann Maurer,
PhD (Mathematics), University of Vienna 1965. Professor of Computer Science at the University of Calgary 1966-1971, University of Karlsruhe 1971-1977, since 1978 at Graz University of Technology. A visiting professor at six non-European universities. Various awards, including the Austrian Cross of Honor for Art and Science, first-class, and three honorary doctorates. Published several books and hundreds of scientific articles. Supervised 60 dissertations or “habilitations” and 400 diploma theses. Involved in large research projects and the founding of companies. Research initially more theoretical, then computer-aided new media, currently new technologies and knowledge structuring. For more on him see his entry as a member of Academia Europaea at https://www.ae-info.org/ae/Member/Maurer_Hermann
Short introduction for the 10th article: “Fuzzy Logic for Educational Purposes”

By William Steingartner

The Paper titled "Fuzzy Logic for Educational Purposes" (by Novitzká, Valerie; Steingartner, William; and Richnavská, Viktória) focuses on the principles of fuzzy logic and their implementation in the education process for young IT experts. The article highlights the importance of the topic within logic and formal methods for computer science. In addition, the authors supplemented their approach with a complex illustrative example which connects the theoretical principles with practical usage.

William Steingartner works as an Associate Professor of Computer Science at the Department of Computers and Informatics of the Faculty of Electrical Engineering and Informatics, Technical University of Košice, Slovakia. He defended his PhD thesis “The Rôle of Toposes in Informatics” in 2008. His main fields of research are the semantics of programming languages, category theory, compilers, data structures, and recursion theory. Additionally, software engineering is one of his key interests. He has been twice a Guest-Editor of IPSI Transaction Journals.
Economic and Social Advantages and Limitations of Working from Home in Serbia, Montenegro, Bosnia and Herzegovina, and North Macedonia

Đukanović, Borislav; Radović-Marković, Mirjana; Macanović, Nebojša; and Maksimović, Ana

Abstract: The authors of this study analyzed the economic and social advantages and limitations of working from (at) home in four countries of the Western Balkans - Serbia, Montenegro, North Macedonia, and Bosnia and Herzegovina. The research was carried out by applying an electronic survey on appropriate samples of 408 respondents from Serbia, 201 from Montenegro, 221 from North Macedonia and 201 from Bosnia and Herzegovina. For the research, a questionnaire consisting of 14 questions with answers in nominal form was created. The questions referred to several economic and social advantages and limitations of working from (at) home, starting with whether the respondents would recommend working from (at) home, the advantages of this work, the guidelines about establishing this type of business, whether to involve family members, what are the basic rules for a successful business from (at) home and performance evaluation, office organization, appearance and dress code, whether to engage in full-time or part-time work, the level of confidence of the owner in the business and earnings from year to year, the strategies used for this purpose, the most common problems and strategies for overcoming them, as well as practical advice to future entrepreneurs. In general, respondents from all four countries showed significantly more positive than negative attitudes toward working at (from) home, although there are noticeable and significant differences between countries. The main motives for working from home are flexible working hours and good earnings for all respondents. The respondents emphasized the importance of a well-designed business plan, but most have stereotypical strategies regarding the increase in performance. Also, they denied the importance of ergonomic rules for success, and in case of failure, they expect support and help from relatives and friends. There is a significant dose of ambivalence in business planning, making decisions about permanent or additional activities, and providing advice to others among the respondents. The main reasons should be sought in decreased and low-accumulative jobs (trade, providing of intellectual services, etc.) due to very limited initial investments. Respondents from Montenegro have the most psychosocial problems when working from (at) home and struggle with reconciling professional and family obligations with the least support from family and relatives. Respondents from North Macedonia are somewhat similar to them, although they are better positioned towards their families. The most successful and satisfied are the respondents from Bosnia and Herzegovina. This is the youngest population that is relatively mostly represented in the IT sector. Respondents from Serbia are most similar to respondents from Bosnia and Herzegovina in terms of satisfaction, as well as in closeness to family members, relatives, and friends.

Keywords: work at (from) home, economic advantages and limitations, differences between Serbia, Montenegro, North Macedonia, and Bosnia and Herzegovina

Manuscript received May 2022.
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1. INTRODUCTION

For many, working from (at) home was the only option during the Covid-19 pandemic, although its history is much longer. Over the last few decades, numerous studies have been conducted, displaying the prevailing view that working from (at) home has numerous economic benefits and savings compared to office work: non-payment of expensive rent and equipment of business premises and other services, significant time savings on going to and back from work, as well as preparation for work, reduced spending on clothing and cosmetics, more efficient usage of working time, higher productivity [4,17] and better coordination and organization of work tasks thanks to the application of new information and communication technologies [1, 3, 4, 6, 8, 9, 18], etc. In parallel with the predominantly economic benefits, a number of problems that arise on the psychosocial level are highlighted, such as loss of control over one's own life and behavior [10,15] and problems with self-motivation and self-confidence [5,13], inability to quit due to overwork [7]. The key issue generating other problems is setting up a balance between professional and family responsibilities [11,13]. Due to the inability to find a balance between family and professional obligations, the problems listed earlier occur, which can eventually lead to burnout [2,14,16].

2. OBJECTIVES

This paper seeks primarily to explain the economic and social benefits and limitations of working at (from) home. To the best of our knowledge, our research is the pioneering one in the Western Balkan region. Therefore, it is extremely exploratory and the goals do not derive from a firmer theoretical-hypothetical basis but are more landmarks for research. The first goal is to describe the economic and social advantages and disadvantages of working at home among the respondents in four Western Balkan countries. The second goal is to point out the similarities and differences in the work of the (from) home between Serbia, Montenegro, Bosnia and Herzegovina, and North Macedonia. The third goal is to compare the results of our research with accessible research from abroad.

3. SAMPLES

This survey was mostly conducted during the second half of 2020, the period of the acute pandemic in four Western Balkan countries. The basic criterion for selection was that the respondent permanently or temporarily performs work at (from) home and that they are capable and knowledgeable about filling in the questionnaire electronically. Although these are appropriate samples, in each of the four countries, we tried to include as many cities from each country as possible and as diverse a range of occupations for those who work from home. Due to numerous limitations, we were more or less successful. Therefore, we are aware that this research was not conducted on representative samples. Furthermore, the percentage of refusals to complete questionnaires was high (over 50%), and it could also affect representativeness.

The sample consists of 1031 respondents from four countries of the Western Balkans: 201 from Bosnia and Herzegovina, 201 from Montenegro, 221 from North Macedonia, and 408 from Serbia. Due to the lack of representativeness, forming conclusions based on the results among the general population of those working from (from) homes is unreliable and may serve more as some of the main landmarks for future research.

4. METHOD

4.1 Research Instrument

The fundamental research instrument was a questionnaire in which, in addition to basic socio-demographic questions, information on the type and length of work from home was required. This was followed by 14 questions on various economic and social aspects of working from home with nominal answers. The following questions were asked:
1. Would you recommend this type of work to others as the best choice for employment?
2. The advantages of doing business from home?
3. What are the guidelines for starting a business at home?
4. Have you included other members of your family in your regular business activities at home?
5. What are the basic rules for running a successful home-based business? (Circle the three most important).
6. How do you determine if your home-based business is on the right path to success?
7. How and under what conditions should an office be founded at home?
8. What should your appearance and dress code look like when working at home?
9. Should you be working full-time or part-time?
10. Are you one of those owners who believe that their business will grow gradually from year to year and consequently gain high earnings?
11. What strategies do you use to increase earnings?
12. The most common problems in running a home-based business?
13. What strategies do you use to overcome them?
14. What are your practical tips as a home business owner for future entrepreneurs?

5. **RESULTS**

The first question was "Would you recommend this type of work from home to others as the best choice for employment?" A relatively high percentage of respondents (between 40% and 50%) had no dilemma and answered affirmatively. However, about 30% hesitated and said "maybe", and about 6% said they would do so if it was the only option offered. The percentage of those who said "no" was very small and ranged between 2.5% and 5.9 %. Differences between countries are not statistically significant. There is a clear division where the first group of respondents is predominant, who has no doubt that it is the best form of employment, and those who are ambivalent to varying degrees. Still, it should be noted that the percentage of those who responded negatively is more than ten times smaller compared with those who consider working from home the best form of employment.

Respondents from all four states see the benefits of working from home, as mentioned by other authors [1,3,4,6,8,9,18, 20] and only a very small percentage do not see any advantage. The main advantages are financial because about a quarter believe that it is additional income that is earned through this type of work, and another fifth think that it is a permanent income. On average, close to a third spend longer time together with their family; close to a fifth believe that working from home establishes control over one's own life. The most significant difference is that providing permanent income is significantly more noticeable in North Macedonia than in Bosnia and Herzegovina (X² = 60.394; p = 0.000). This result is in favor of our assumption that poor financial situation and unemployment are probably the main factors why those working from home consider themselves to be somewhat privileged and who, therefore "overlook" or even neglect some unfavorable aspects of this work, as noted in other countries.

The responses to the question "What should be guided when starting a home-based business" were: with a good business idea by almost a quarter of the respondents, then in similar percentages reducing business costs due to lease of office space, transport costs, etc. find these as valid guidelines. The need to balance business and private life is seen as important since in Bosnia and Herzegovina the respondents stated it in 39.3% of cases, in Montenegro and North Macedonia close to 22%, and Serbia close to 30%. In similarly smaller percentages, respondents were guided by higher earnings and employment of household members. Statistically significant differences were found among countries (X² = 65.689; p = 0.000); in Montenegro, the most significant are different types of savings, and in Bosnia and Herzegovina, balancing between business and private life. The considerable inconsistency of motives is proof of serious external obstacles to starting a home-based business, where a good business idea does not dominate.
Only a dozen of the respondents from Bosnia and Herzegovina and Serbia included other family members in their regular business activities, whereas in Montenegro and North Macedonia it is almost 22%. It is interesting to heed that on average more than a third of the family members of the respondents do not show any interest in getting involved, while slightly more than a fifth are pleased with the advisory role. Finally, a little less than a fifth cannot do that because they do not have a contract with the employer. There are significant differences between states; the respondents from North Macedonia significantly less often stated that household members “are not interested due to other reasons”, and also from Montenegro significantly less stated that they are not interested, while from Serbia significantly more often family members are not interested in working at home (X² = 50.758; df = 15; p = 0.000). These differences may be due to fewer current jobs and lower payments in Montenegro and North Macedonia than in Bosnia and Herzegovina, where the share of the IT sector and better-paid jobs is relatively the highest, and the situation is similar in Serbia. Another reason is the weaker initial infrastructure for working from home and therefore the limited employment opportunities for more family members. The following modalities stood out among the basic rules for a successful business from home: training, workspace, previous experience, communication skills, and technical equipment.

When it comes to professional development, the differences between countries are highly significant; in Bosnia and Herzegovina 55.2% of respondents favor professional development and in North Macedonia 25.8% (X² = 42.095; df = 3; p = 0.000). This difference is not surprising because the structure is the most favorable in Bosnia and Herzegovina. Concerning the relatively large number of those working in the IT sector in Bosnia and Herzegovina, continuous training is imperative.

For over half of the respondents from Serbia and North Macedonia, the working space is important for successfully doing business from home, and for only a third of the respondents from Bosnia and Herzegovina and Montenegro. The difference is statistically significant (X² = 23.671; df = 3; p = 0.000). These differences are largely due to the type of activity; respondents from Bosnia and Herzegovina work on computers, while in Montenegro above the average work educate themselves through platforms, which do not require a large working space, and the nature of home activities in Serbia and North Macedonia is more polyvalent.

More than half of the respondents from North Macedonia and over two-fifths from Serbia indicated their previous experience as important for starting a home-based business. In contrast, 19.9% of respondents from Bosnia and Herzegovina and 26.4% from Montenegro cited previous experience as significant. The difference is statistically significant (X² = 60.386; df = 3; p = 0.000). Respondents from Bosnia and Herzegovina work relatively short hours from home, making it harder to assess the importance of experience, and Montenegrins are probably less likely to attach more importance to experience given a range of routine work activities from home that does not require too much experience to gain. Almost three-fifths of respondents from Montenegro believe that communication skills are not crucial for a successful business while two-fifths think of those as important. There is an opposite situation in the other three countries. The difference is statistically significant (X² = 21.373; df = 3; p = 0.000). The possible explanation is conditioned by cultural reasons; in Montenegro, family, non-formal family, friends, and similar relationships are probably more important for the success of a home-based business than good communication skills.

When it comes to technical equipment as a precondition for a successful home-based business, again three-fifths of Montenegrin respondents believe that it is not an important factor in running a successful home-based business, while two-fifths believe that it is. As in the previous case, the situation is completely reversed in the other three countries. The
differences are statistically significant ($X^2 = 28.704; df = 3; p = 0.000$). In this case, it is probably a classic rationalization "Technical equipment that I do not have or I do not own quality equipment to a sufficient extent is not even important." These rationalizations are more prone to nations who simply use the projective mechanism of negation when dealing with frustration to preserve an idealized image of themselves.

Table 1. Working from (at) home performance indicators

<table>
<thead>
<tr>
<th>Working from (at) home success indicators</th>
<th>Bosnia and Herzegovina</th>
<th>Montenegro</th>
<th>North Macedonia</th>
<th>Serbia</th>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Better balance of free time and working hours</td>
<td>89</td>
<td>44,3</td>
<td>57</td>
<td>28,4</td>
<td>34</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0,5</td>
<td>1</td>
<td>0,5</td>
<td>0</td>
</tr>
<tr>
<td>More time with family</td>
<td>14</td>
<td>7,0</td>
<td>28</td>
<td>13,9</td>
<td>32</td>
</tr>
<tr>
<td>Reduced work stress</td>
<td>47</td>
<td>23,4</td>
<td>44</td>
<td>21,9</td>
<td>27</td>
</tr>
<tr>
<td>Everything listed</td>
<td>0</td>
<td>0,0</td>
<td>1</td>
<td>0,5</td>
<td>0</td>
</tr>
<tr>
<td>Higher earnings</td>
<td>28</td>
<td>13,9</td>
<td>34</td>
<td>16,9</td>
<td>77</td>
</tr>
<tr>
<td>Higher work productivity</td>
<td>22</td>
<td>10,9</td>
<td>36</td>
<td>17,9</td>
<td>51</td>
</tr>
<tr>
<td>Total:</td>
<td><strong>201</strong></td>
<td><strong>100,0</strong></td>
<td><strong>201</strong></td>
<td><strong>100,0</strong></td>
<td><strong>221</strong></td>
</tr>
</tbody>
</table>

Table 1. illustrates that for respondents from all countries, a better balance of leisure and working hours is the most important indicator of success from work from home, as pointed out by other authors [13]. The exception is North Macedonia. The next most important is higher earnings. However, when it comes to higher earnings, it is noticed that it is twice as important to respondents from Serbia and North Macedonia than to respondents from Montenegro, and when it comes to respondents from Bosnia and Herzegovina two and a half times more important (Table 1). On the other hand, the reduction of business stress is a more important indicator of the success of work from home in Bosnia and Herzegovina, and Montenegro than in Serbia, and especially in North Macedonia.

The difference can also be seen when it comes to the most frequent category - "better balance of free and working time", at least when it comes to Bosnia and Herzegovina. All three differences reflect a kind of cultural model rather than stemming from the built strategy in the organization of work from home. Namely, in Montenegro, and especially in Bosnia and Herzegovina, there are more culturally inherited elements of the Eastern culture than in Serbia and Macedonia, where success and efficiency are measured more by money, which is more reminiscent of the Protestant spirit. All four countries contain elements of both cultures, and this distinction should be understood very conditionally. Differences between countries are statistically significant ($X^2 = 102.623; df = 18; p = 0.000$). In Bosnia and Herzegovina, significantly more as an indicator of success, they value a better balance of free and working time, better earnings significantly more in Serbia than in Bosnia and Herzegovina, and significantly higher productivity in North Macedonia. Contrary to some Western authors, who prefer productivity as a common denominator of successful remote work [4,17] people who work remotely in the Western Balkans largely prefer the importance of support and advice from family and friends in reducing stress at work.

The question "How and under what conditions can office be founded at home" is dominated by answers indicating that this question is of secondary importance for the respondents; only more than 5% said that the office should be equipped as in any other company, and only
12.5% of respondents from North Macedonia expressed such an attitude. Also, on average, only 8.3% of respondents emphasized ergonomic rules as important. On average, slightly more than a fifth of the respondents think that those who want to work do not need a special space. However, more than a third (36.9%) believe that it is enough to provide space so that others do not disturb them, and only a quarter believe that space should be set aside and an office built. Differences are statistically significant (X² = 48.649; df = 15; p = 0.000).

Respondents from North Macedonia significantly more than others support the idea of arranging an office similar to those outside the home, and respondents from Montenegro significantly less than others support the idea that those who are motivated to work do not need special space. If the respondents cannot agree that establishing an office and following ergonomic rules is secondary to successful work from home due to the existence of objective limitations, then self-motivation and self-confidence are key to starting and working remotely, undoubtedly [5,13].

When asked "What should the appearance and dress code look like when working from home", most respondents considered it peripheral and irrelevant. The answer "No need to dress up, which is the advantage of this job" was answered by an average of a quarter of respondents, while on average more than two-fifths (44.2%) said that it is not important how they look, but how well they perform. Less than a fifth pointed out that the wardrobe should be adjusted to the type of work, and only an average of 6.1% said that they should look the same as going to the office. There are significant differences between countries (F = 8.493; p = 0.000). In Bosnia and Herzegovina, they mostly responded "it doesn't matter how I look, but how I work" and many more opted that the wardrobe should not be adjusted to the type of work, whereas the respondents from North Macedonia significantly more often pointed out that it should.

These results indicate that the mental image of the respondents in all countries is under a strong cultural stereotype that "clothes do not make a man". This stereotype has a strong cultural foundation in collectivist cultural patterns that a person receives confirmation and acceptance from the collectivity if he acts following collective values and norms. Highlighting a person by appearance and dressing is not acceptable. All this is contrary to the Western individualistic value concept, which includes numerous individual characteristics of those who enter the mental image of a successful entrepreneur who works at home. The first form of confirmation of this mental image is behavioral - appearance and dressing.

Respondents answered ambivalently to the question "Should I be engaged in full-time or part-time work". Thus, a third (32%) claim that working from home is a job without working hours, while slightly more than a quarter (28.2%) believe that it is better to accept full-time work, and on average only 9.6% have additional work. Ambivalence is also reflected in the answers of 28.7% of respondents about whether there is an alternative job instead of working from home in additional or full-time. Differences between countries are significant; respondents from Bosnia and Herzegovina pointed out significantly less that it is a job without working hours, and respondents from North Macedonia and Serbia significantly more (X² = 90.860; df = 12; p = 0.000). Also, respondents from North Macedonia are significantly more willing to engage in additional working hours. Finally, the respondents from Bosnia and Herzegovina pointed out significantly more that their decision on whether to engage in full-time or part-time work also depends on whether they have an alternative job on offer, while respondents from North Macedonia were significantly less willing to accept the same option. Choosing the option "this is a job without working hours", which appears to be the most common choice in a third of cases, significantly relativizes all other options and provokes increased ambivalence, which is illustrated by the fact that it is better to work full-time than part-time.

Respondents use different strategies to increase earnings but in a different scope. It seems that the
type and scope of the measures they use are conditioned by the available time (when they usually do not have enough), limited financial resources, and not infrequently by real needs. They often do not use more complex strategies due to limited time and financial resources. It is often due to the belief that simpler and more accessible strategies are enough for them to do their job successfully. Certainly, the complexity and scope of strategies are significantly influenced by the type of activity, which will already be shown in the following percentage structures. As expected, the exchange of experiences with other colleagues from the same industry is the most accessible, simplest, and at the same time cheapest strategy. It is practised by an average of 29.5% of respondents. The second most common is the monitoring of professional literature, on average 18.6%. Respondents from Bosnia and Herzegovina deviate significantly from this average, and in 25.9% of cases, they constantly follow the professional literature. If it is known that this sample has an above-average number of those who work in the IT sector and programmers, following the professional and scientific literature is certainly the fastest and cheapest way to get new information to improve your work from home [19]. Whereas the respondents from Serbia, are the most numerous among those who improve their work from home by exchanging experiences with colleagues from the same industry. Unlike others, they are the only ones to be referred to.

Expert advice is used by an average of 13.9% of respondents, except for respondents from North Macedonia who deviate more than twice from that average - 29.4%. Significantly greater focus on experts in North Macedonia is due to the relatively higher representation of some activities, especially in industry and education, which to a greater extent include expert advice to improve work from home.

Attending professional seminars to obtain professional certificates occupies a peripheral place with only 8.3%. It might be due to the considerable routine of work done from home and insufficient involvement in global processes, as a result of which the acquisition of these professional certificates is for the majority a matter of personal prestige rather than a necessity for enhancing business from home. On average, more than a quarter (28.6%) do not have a special strategy to improve earnings, which, in our opinion, is due to the previously mentioned reasons - the unfavorable structure of activities performed from home, routinely carried out work, and insufficient engagement in modern global social, economic and technological processes.

The differences between the countries are statistically significant, the possible causes of which we tried to point out earlier. Respondents from North Macedonia rely significantly more than others on expert advice and significantly less on exchanging experiences with long-time colleagues in the same industry, while respondents from Bosnia and Herzegovina rely mostly on professional literature to improve their work performance and earnings.

<table>
<thead>
<tr>
<th>The most common problems of running a business from (at) home</th>
<th>Bosnia and Herzegovina</th>
<th>Montenegro</th>
<th>North Macedonia</th>
<th>Serbia</th>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Monotony at work leads to depression</td>
<td>17</td>
<td>8,5</td>
<td>24</td>
<td>11,9</td>
<td>47</td>
</tr>
<tr>
<td>Deficiency of social communication</td>
<td>34</td>
<td>16,9</td>
<td>41</td>
<td>20,4</td>
<td>58</td>
</tr>
<tr>
<td>No particular problems</td>
<td>53</td>
<td>26,4</td>
<td>52</td>
<td>25,9</td>
<td>89</td>
</tr>
</tbody>
</table>
Table 2. shows that respondents cite various problems which occur when running a home-based business. However, the problems that dominate international research, such as monotony, do not come to the forefront of our respondents. The lack of social communication is relatively most evident (especially in North Macedonia), and the excessive workload and the inability of separating business from private obligations occur in almost identical percentages. Our sample is separated from others by an above-average percentage of those who said that they have no particular problems due to working from home. The inability to be excluded from work due to excessive work is also significant in international research [7]. However, the most frequently mentioned and most serious problem is the separation of business and family obligations and finding a balance between those two [11,13]. The collapse of the boundaries between work and family leads to the most difficult consequences, such as burnout [2,14,16].

There is a significant difference between the four countries in the type of problems occurring due to working from (at) home (X² = 65.398; df = 15; p = 0.000). Respondents from North Macedonia feel significantly more defect in social communication due to working at home, while respondents from Bosnia and Herzegovina and Montenegro emphasize having fewer problems. The respondents from Serbia emphasize the problem regarding the separation of business and privacy obligations as a difficult one. Although it is hard to assess which of the abovementioned problems are the most difficult to solve for the respondents according to these results, it seems that the most difficult one is separating business and private obligations. The question is, why? As we have observed from the results of the international research, they summarize a range of other problems and represent their kind of common denominator, which e.g. includes lack of time for recreational activities and hobbies, decrease in social communications, difficulties in organizing and fulfilling planned professional and other activities, more stereotypes and routines in their execution than we would like, loss of self-confidence, feelings of isolation and abandonment, depersonalization and, lastly, the burnout.

There is a lack of adequate strategies for overcoming those problems and attempts to compensate for them with emotional relaxation among the family members and friends. Only two strategies allow direct problem-solving, while others are either inadequate or can only indirectly contribute to problem-solving. Those two strategies are attending meetings and seminars and meeting with associates once a week. On average, it is a quarter of them - 25.3%. Furthermore, in 17.1% of cases, respondents point out that they simply do not know what they could do because the alienation of those who work at home is great, which is why they are ready to seek the help of a psychologist. All others seek support and help from family members and friends - 56.1 %. This support and assistance is most common in Serbia (64.7%) and Bosnia and Herzegovina (61.2%) and least in Montenegro (41.8%), with statistically significant differences (X² = 79.711; df = 18, p = 0.000). Respondents ask for significantly less support and help for their problems at work from home in Montenegro, and significantly more in Serbia and Bosnia and Herzegovina. At the same time, respondents from Montenegro are looking for a significantly higher solution to problems at home by going to professional meetings and seminars; 20.4% of respondents from

<table>
<thead>
<tr>
<th>Overtime working meaning until the work is finished</th>
<th>42</th>
<th>20,9</th>
<th>38</th>
<th>18,9</th>
<th>28</th>
<th>12,7</th>
<th>64</th>
<th>15,7</th>
<th>172</th>
<th>16,7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard to separate business and private life</td>
<td>53</td>
<td>26,4</td>
<td>45</td>
<td>22,4</td>
<td>26</td>
<td>11,8</td>
<td>44</td>
<td>10,8</td>
<td>168</td>
<td>16,3</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>201</td>
<td>100,0</td>
<td>201</td>
<td>100,0</td>
<td>221</td>
<td>100,0</td>
<td>408</td>
<td>100,0</td>
<td>1031</td>
<td>100,0</td>
</tr>
</tbody>
</table>
Montenegro participate in professional meetings and seminars, 8% in Bosnia and Herzegovina and 7.1% in Serbia. However, this increased percentage of participants from Montenegro can be partly attributed to the above-average representation of educational profiles of those working from home in Montenegro, which include permanent education through professional gatherings and seminars.

Finally, the respondents were asked what practical advice would home business owners share with future entrepreneurs if they had the chance. Our respondents significantly agree on the content of practical advice, as well as their order. As expected, a good business plan is in the first place - 33.7%. However, it should be noted that the percentage is highest in Bosnia and Herzegovina (38.3%) followed by Serbia (37%) while the lowest is in Montenegro (27.4 %) and North Macedonia (29%). Similar percentage structures exist in the other two strategies, which assume that we treat work at home as responsibly as we treat work outside the home, as well as the imperative of continuous professional development. The need to constantly consult with experts for every aspect of the job whenever necessary is still significantly less represented in percentage - on average only 9.8%. Differences between countries are statistically significant (X² = 41.120; df = 12, p = 0.000). Proponents of a good business plan are significantly more represented in Bosnia and Herzegovina than in Montenegro, and the need for consultations with experts, whenever we have a problem, is significantly more in North Macedonia than in Bosnia and Herzegovina. The prevailing strategies are a good business plan and commitment to that plan, which are both the most important and probably the best strategies that home business owners advise to future entrepreneurs.

6. Discussion

The most significant and numerous differences are between those who work from home in Montenegro and others, especially those in Serbia and Bosnia and Herzegovina. They are the least optimistic about working at home and the “gig” economy; they have more psychosocial problems than everyone else, they do not have enough free time for recreational activities and they complain about excessive work and the impossibility of separating business from private life. In addition, they are less connected than all the others to the primary groups while working from home. Despite this, they believe that informal contacts can contribute the most to a successful home-based business. Moreover, they neglect the importance of better technological equipment for successful work from home. Not only do they evaluate the possibilities of working from home and freelance worse, but they are often inconsistent and even contradictory. For instance, in terms of successfully running a home-based business, they emphasize the importance of social connections, and they try to distance themselves as much as possible from the primary groups and rely primarily on professional training. Also, they emphasize the importance of motivation for a successful home-based business and emphasize a kind of demotivation due to burnout at work and the like. The respondents from Montenegro try to distance themselves from the primary groups during their work, and at the same time, they are frustrated by it. Due to all that, the respondents from Montenegro face more problems at work than everyone else, which is why they show inconsistencies in psychosocial behavior, and even confusion. Possible factors may include the nervousness and inconsistency of economic activities, and the relatively low level of consumerism, especially during the Covid-19 pandemic. Almost a third is engaged in online trade. In addition to the very unfavorable economic situation, we should not lose sight of the turbulent political context, which has further complicated the already confusing social situation. Although working at home is one of the best strategies of choice in such social constellations, the key question is to install the necessary technological infrastructure in a short time, even though the personnel base was probably satisfactory. Probably the most significant factor is the discrepancy between higher education and disincentive jobs, primarily related to online trade, and partly to routine forms
of educational content. The most significant factor of dissatisfaction is the discrepancy between higher education and disincentive jobs, primarily related to online trade, and partly to routine forms of educational content. According to some psychosocial patterns of behavior, the respondents from North Macedonia are most similar to them. In terms of the level of education and type of activity, they are most similar to the respondents from Montenegro. They are also similar in their dissatisfaction with their current work from home, especially due to the demotivation and routine of work, given their high school education. Due to the current dissatisfaction, they are not optimistic about working at home or the "gig" economy. Although they have significantly fewer psychosocial problems due to working at home, they are still more similar in this respect to respondents from Montenegro than those from Bosnia and Herzegovina, and Serbia. All these aspects of similarities with Montenegro at the same time significantly differentiate them from Bosnia and Herzegovina and Serbia.

Bosnia and Herzegovina and Serbia are generally quite different from Montenegro and Macedonia. In many respects, they are the opposite of the respondents from Montenegro. Unlike the respondents from Montenegro, the respondents from Bosnia and Herzegovina are the youngest, with the lowest general education, and are mostly employed in the IT sector. They have no psychosocial problems, balance well between business and private life, and have the support of family and friends at work. Also, they are satisfied with their work and income and maintain good social communication while working from home. The respondents from Bosnia and Herzegovina are optimistic about the perspective of their work. Furthermore, they jealously strive to preserve all this social and cultural capital, and that is why the most important thing for them to succeed in business is to preserve the borders between business and private life, for which they need flexible working hours. While for everyone the most important indicator of successful work from home is earning, it is a good business idea for them, since they are already well-positioned financially. They manage to achieve a very harmonious relationship between psychosocial, economic, and cultural patterns while working from home or as freelancers, while among the respondents in Montenegro there are disagreements, contradictions, and even conflicts between these areas.

The respondents from Bosnia and Herzegovina are well adapted to work at home. In our opinion, several factors are important for this adjustment. Firstly, it is about the young population that is highly motivated for work because they are involved in professional life relatively early. Secondly, they are above average motivated because they are disproportionately represented in the IT sector. The fact that their education is below average does not diminish them but probably goes in favor of above-average motivation for the IT sector and programming, because they acquired knowledge and skills in those areas outside the usual institutional framework. In this regard, this population is particularly interesting for monitoring possible directions of development of work at home, partly outside the usual institutional educational frameworks.

Although respondents from Serbia have some formal similarities with those from Montenegro (in terms of length of service) and North Macedonia (in terms of education), they differ significantly from respondents from Montenegro in several other characteristics, which are more similar to respondents from Bosnia and Herzegovina. They do not have noticeable psychosocial problems. Also, they are satisfied with their work from home and are optimistic about the future of their work. Like the respondents from Bosnia and Herzegovina, they nurture good social ties for the primary groups and a closer social environment to which they eventually turn for help due to business problems, which they generally do not have. Like others, they consider working from home to be the best option for employment, and for the success of the home business, they rely mostly on previous experience. They differ from the respondents from Bosnia and Herzegovina
because of the belief that earnings are the best indicator of the success of a home-based business. In everything else, they are quite similar.

When it comes to similarities, then it is certainly most important that everyone considers working from home the best choice if offered, especially when it comes to employment. Truth be told, there is one hedge for all; since everyone thinks that working from home has no limits, most would prefer to opt for flexible working hours under contract. Flexible working hours allow everyone greater autonomy in planning and achieving tasks and business goals and open space for personal initiative, freedom, and creativity, which are probably the main reasons why there is no alternative for most working from home. Another common denominator is good earnings. Unfortunately, everyone has in common that they are workers from home, and especially freelancers are neglected in their countries because most of them do not have health, pension, or any other insurance. In that respect, the situation with freelancers in Montenegro is somewhat better, and certainly the worst in Serbia. The most important common denominator is the undivided optimism of almost everyone who works from home, despite numerous difficulties and frustrations in achieving the success of that business, which are more objective than subjective when it comes to the countries of the Western Balkans. [21]. Objectives include limited economic and technological resources for individual entrepreneurial activities (lack or expensive funds to start a home-based business, high taxes and fees, monopolies that restrict and block free-market competition, illegal trade channels, corruption, etc.).

7. Conclusion

In such a very unfavorable economic, social and political environment in the countries of the Western Balkans, working from home, and especially freelance, remain the only oases of entrepreneurial freedoms and personal autonomy that are not directly affected by these external restrictions. It is a great paradox that this entrepreneurial elite of mostly young people, in which freelancers are at the top or near the top, is in the countries of the Western Balkans placed on the margins of socio-economic life.

References


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Freelance in Four Countries of the Western Balkans

Đukanović Borislav; Marković Dušan; Krivokapić Nataša; and Banović, Silva

Abstract: In this paper, the authors analyze the advantages and limitations of freelancing in four countries of Western Balkan. This work is based on the research with a total sample of 1031 respondents; 408 respondents from Serbia, 201 from Montenegro, 221 from North Macedonia, and 201 from Bosnia and Herzegovina. For the needs of the research, a special questionnaire was constructed and conducted by an electronic survey. The first goal of the research is to describe the functioning of freelancers in four countries, and the second is to describe the similarities and differences between countries of Western Balkan. In general, freelancers in all four countries have positive attitudes towards freelancing, although there are differences between them. Freelancers are especially satisfied with their income, and in Bosnia and Herzegovina with flexible working hours. No statistically significant differences were found among freelancers from four countries of Western Balkan in the structure of jobs they have worked in the last two years, nor in the assessment of the positive effects of new technologies on new forms of employment. They do not differ either in understanding that the work in the "Gig Economy" had less negative than positive effects on their private lives and in the fact that there are no differences in the assessment of the positive effects of freelance on the quality of life. They are no differences in terms of the proposed measures to improve the position of workers in the "Gig Economy". Unfortunately, there are also no differences in basic social rights (lack of health, disability, and pension insurance).

The most significant differences have been noted between freelancers from Montenegro and freelancers from the other three countries. Freelancers from Montenegro see less positive contributions working in the "Gig Economy" than others, and they significantly more often believe that the "Gig Economy" can't reduce unemployment and prevent brain drain abroad. The authors explain the negative attitudes of freelancers from Montenegro towards their work in the "Gig Economy" with the lower prevalence of freelancers, poorer job structure, and lower-income with an unfavorable socioeconomic status.

Keywords: Gig economy, freelance, creative industries, employment

1. INTRODUCTION

When it comes to new forms of telecommuting, which inaugurate the neoliberal economic concept, freelancers are its most typical product. They are characterized by the variability and instability of the profession due to the emergence of new professions, the need to change professions, and doing multiple jobs at the same time, without social protection mechanisms of the state. Production is being relocated to underdeveloped countries and service and IT activities are being favored, in which knowledge and creativity are particularly pronounced. The concept of creative industries (and increasingly creative economies) is primarily a political neoliberal concept of economic development in which the loss of jobs and income in traditional industries, based on the use of natural resources, is replaced by the creation of new industries that should be based on inexhaustible human resources. Researchers point to several economic benefits of freelancing, which bring benefits to both organizations and individuals [1-5].

Freelancers are most often employed in the creative industries (art, music, film, design) because they are most fully realized as autonomous, free, creative, and independent. This results in life satisfaction, a sense of fullness of life,
and self-affirmation. Individually and cumulatively, all of these motives are key to freelancers remaining in these creative jobs for years, despite the many social and psychological problems they constantly face. Contrary to one idealized, euphemistic image that depicts the present and future of freelancers as the elite and most important project of neoliberal economists, their lived reality is much less rosy.

Freelancers in the creative industries are mostly young people who are exposed to the relentless competition for jobs, especially when it comes to creative and well-paid jobs that satisfy their high aesthetic aspirations. The organization of the entire social life and psychological preoccupation are related to finding the best creative solutions for the jobs they got, as a result of which they are under constant psychological load and stress, even though they are constantly charged with pleasure hormones. They simply have no boundaries between work and private life and are therefore at high risk of burnout. The position of freelancers in Serbia is especially difficult. Although freelancing in Serbia ranks high tenth in the world, state and private sector assistance for the development of freelancing in Serbia either does not exist or is scarce and insufficient, and their position in society is legally insufficiently regulated [6].

Since the state does not support them, imposing high taxes and maximally bureaucratizing all procedures related to their work, most of them operate in the gray or black economy. Freelancers in Serbia are very dissatisfied, emphasizing that the state only accepts them when they bring foreign capital. Many are wondering why they should pay contributions when they do not have health insurance, and with their way of working, of course, they do not expect to receive a pension [6]. In addition, clients in Serbia pay much less than the price of freelancing for the same jobs abroad, make payment delays, or avoid payments.

AIM

Since this is a pioneering research of freelance in four countries of the Western Balkans, our research has a very exploratory character, so the goals are more benchmarks for analysis than they derive from a stronger theoretical - hypothetical basis.

The first goal is to describe the advantages and problems of freelancers in the Gig economy in the four countries of the Western Balkans.

The second goal is to analyze the similarities and differences among freelancers from the four Western Balkan countries.

2. MATERIAL AND METHODS

2.1. Sample

The sample consists of 1031 respondents from four countries of the Western Balkans: 201 from Bosnia and Herzegovina, 201 from Montenegro, 221 from North Macedonia and 408 from Serbia. The samples have a suitable character because the “samples” include everyone who works from home and who has agreed to fill in the questionnaire in electronic form. Due to the lack of representativeness, all generalizations of results to the general population of those who work from home are unreliable and may serve more as some of the main landmarks in future research.

Due to scarce personal financial resources, it was not possible to achieve more acceptable representativeness.

2.2. Research Instrument

For the empirical analysis of the goals, a questionnaire that treats the advantages and disadvantages of freelance was constructed.

The questionnaire construction procedure was relatively complex and lengthy. First, we produced a large number of claims (approximately the initial versions were five times more extensive than the final version). We supplemented the validation of the finally accepted claims in each questionnaire with estimates from three independent experts for each area. In the final version, only the claims that all three independent experts assessed as satisfactory remained.

In addition, clients in Serbia pay much less than the price of freelancing for the same jobs abroad, make payment delays, or avoid payments.

AIM

Since this is a pioneering research of freelance in four countries of the Western Balkans, our research has a very exploratory character, so the goals are more benchmarks for analysis than they derive from a stronger theoretical - hypothetical basis.
1. Information technologies will enable new employment models in the future?
2. Have you heard of Gig Economy and platform work?
3. What is important to you when choosing a job?
4. Would you work in the Gig Economy as the only source of income?
5. If you already work in the Gig Economy, is it your only job and source of income?
6. Would you change your full-time employment for a flexible contract job?
7. In the last two years, how many employers have you worked for?
8. In the last two years, which of the following types of jobs have you done in Gig Economy? Choose everything that applies to you. 
9. Do you have access to any of the following benefits offered by your job through the platform? Choose everything that relates to your business.
10. How has your participation in the Gig Economy negatively affected your life?

11. How has your participation in the Gig Economy had a positive impact on your life?
12. Can working in the Gig Economy significantly reduce unemployment?
13. Can working in the Gig Economy contribute to the quality of people's lives?
14. How to improve the position of workers working in the Gig Economy?

3. RESULTS AND DISCUSSION

Almost half of respondents are freelancers in the "gig" economy, without a contract with the employer, continuously or by projects, working online (47.6%). That percentage is almost three times higher in Bosnia and Herzegovina than in Montenegro, while North Macedonia is significantly approaching it, and Serbia occupies a middle position. It is important to emphasize that this is a consequence of the convenient coverage of the electronic survey and is by no means representative coverage (Table 1).

Table 1. Frequency distribution concerning the primary form of home working

<table>
<thead>
<tr>
<th>Working area</th>
<th>Bosnia and Herzegovina</th>
<th>Montenegro</th>
<th>North Macedonia</th>
<th>Serbia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>FH1</td>
<td>129</td>
<td>64,2</td>
<td>45</td>
<td>22,8</td>
<td>131</td>
</tr>
<tr>
<td>FH2</td>
<td>72</td>
<td>35,8</td>
<td>152</td>
<td>77,2</td>
<td>90</td>
</tr>
<tr>
<td>Total</td>
<td>201</td>
<td>100,0</td>
<td>197</td>
<td>100,0</td>
<td>221</td>
</tr>
</tbody>
</table>

Legend: FH1- Freelancer in the "Gig economy", without a contract with the employer, continuously or by projects, online; FH2 - Any other form of home working.

In Bosnia and Herzegovina, freelancers are predominantly employed in the IT sector, trade and education, in Montenegro in education, trade and tourism sector, and in Serbia and North Macedonia in trade and education. In all four countries in which research was conducted, there is a minimum of freelancers in the administration working area (Table 2).

Table 2. Frequency distribution concerning the working area

<table>
<thead>
<tr>
<th>Working area</th>
<th>Bosnia and Herzegovina</th>
<th>Montenegro</th>
<th>North Macedonia</th>
<th>Serbia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Administration</td>
<td>1</td>
<td>0,5</td>
<td>1</td>
<td>0,5</td>
<td>0</td>
</tr>
<tr>
<td>Economics, law, finance, research</td>
<td>8</td>
<td>4,0</td>
<td>5</td>
<td>2,5</td>
<td>3</td>
</tr>
<tr>
<td>Construction</td>
<td>5</td>
<td>2,5</td>
<td>13</td>
<td>6,5</td>
<td>12</td>
</tr>
<tr>
<td>Industry</td>
<td>17</td>
<td>8,5</td>
<td>15</td>
<td>7,5</td>
<td>23</td>
</tr>
<tr>
<td>IT and programming</td>
<td>52</td>
<td>25,9</td>
<td>4</td>
<td>2,0</td>
<td>22</td>
</tr>
<tr>
<td>Cosmetic and hairdressing services</td>
<td>6</td>
<td>3,0</td>
<td>8</td>
<td>4,0</td>
<td>3</td>
</tr>
</tbody>
</table>
Freelancers are the most numerous and significant group of those who work from home and remotely. Changes in the way of working across platforms presuppose constant adaptation to new technological innovations. Following this belief, 89.6% of respondents stated that information technology will enable new forms of employment in the future and no statistically significant differences were found between countries.

When asked "What is most important to you when choosing a job", no statistically significant differences were found between countries. However, it should be mentioned that the most important for respondents from Bosnia and Herzegovina is flexible working hours (40.3%). Flexible working hours are a prerequisite and common denominator for achieving several positive benefits of working from home (autonomy and freedom, motivation, good planning of daily activities, establishing boundaries between work and private life, etc.). It is emphasized by many authors [7-10]. Good incomes are important to respondents from Montenegro (44.4%), North Macedonia (42%) and Serbia (44%). Job training comes at the end and is mentioned by a quarter of respondents, relatively the most in Serbia and Bosnia and Herzegovina.

If working in the Gig economy was the only job, 76.5% of respondents from Serbia answered that they would accept such a job, and 49.6% of respondents from Bosnia and Herzegovina answered the same. The difference is statistically significant; respondents from Bosnia and Herzegovina would significantly less often accept freelance as the only source of income, and significantly less often than others if it were the only option (X2 = 30.192; df = 6; p = 0.000).

When asked "Would they change their full-time employment for a flexible contract job", 51.2% of respondents from Bosnia and Herzegovina said "yes" and only 34% from Serbia. More than a half (65.6%) of respondents from Serbia said either "No" or that they just want a secure job. However, no statistically significant differences were found between countries when asked "Would they change their full-time employment for a flexible contract job".

No significant differences were found between countries in terms of translation representation. 7.8% of respondents practice lectures in Bosnia and Herzegovina, 30.5% in North Macedonia and 28.9% in Serbia. The difference is statistically highly significant (X2 = 25,430; df = 3; p = 0.000). Lectures from home are practiced significantly more in North Macedonia and Serbia and significantly less in Bosnia and Herzegovina.

In the researching freelance work area participate 25.6% of respondents from Bosnia and Herzegovina and 43.5% from North Macedonia. The difference is statistically significant (X2 = 9.403; df = 3; p = 0.024).

No statistically significant differences were found among freelancers who performed "other work" from home. However, it should be mentioned that about one-sixth of the respondents from Bosnia and Herzegovina practice "other jobs" work area, and about a quarter from three other countries. The reason is certainly in the fact that respondents from Bosnia and Herzegovina work significantly more often in programming and the IT sector. Due to several advantages, they have fewer needs and motivation to look for other and additional jobs.
The next question is about the benefits that work from home through platforms offers. These include life, health, pension insurance or none of those listed.

When it comes to life insurance, it is noticed that a very small percentage of respondents in all countries are benefited in this way; 7.8% of respondents in Bosnia and Herzegovina, 11.1% in Montenegro, 9.2% in North Macedonia and 6.6% in Serbia. Differences between countries are not statistically significant.

Of high concern is that in all four countries, on average, only one-quarter of respondents (24.8%) have health insurance; 21.7% of freelancers in Bosnia and Herzegovina, 35.6% in Montenegro, 36.6% in North Macedonia and only 15.1% in Serbia. Significantly more health-insured persons among freelancers have Montenegro and North Macedonia, and significantly fewer in Serbia (X² = 21,722; p = 0.000).

Data on pension insurance are also upsetting; in Bosnia and Herzegovina, only 7.8% of respondents received pension insurance, in Montenegro 31.1%, in North Macedonia 29.0% and in Serbia 16.3%. Significantly more persons exploited the right to pension insurance in Montenegro and North Macedonia, and fewer in Bosnia and Herzegovina and Serbia (X² = 24,324; df = 3; p = 0.000).

Without any kind of insurance are 71.3% of freelancers in BiH, 44.4% in Montenegro, 59.5% in North Macedonia and 78.9% in Serbia. There are significantly less freelancers in Montenegro who have not obtained any insurance than in Serbia (X² = 25,584; df = 3; p = 0.000).

The above points to the importance of creating legal regulations, i.e. regulating the existing ones, in order to provide work benefits to all workers, regardless of the type of contract they have with the employer, and not only to permanent employees [10].

The next question is: "In what aspects of life has your participation in the Gig economy negatively affected your life?" Four modalities stood out: professionally, privately, it did not affect negatively, it affected financially. The vast majority of freelancers said there were no negative consequences for their professional engagements - more than 95%, in all four states. It is logical that then the differences cannot be statistically significant. Satisfaction with freelancers is also expressed by freelancers in other research [2].

On average, 4/5 of freelancers pointed out that participation in the Gig economy had no negative consequences on their private lives, except in Serbia, where the percentage is about 3/4. No statistically significant differences were found between countries [3,4]. Although in other studies, freelancers pointed out their satisfaction with freelance, they pointed out more often the problems they encountered while doing freelance [2,6]. We have already pointed out that home employees and freelancers tend to point out a "blessing in disguise" (to paint the world in pink).

The answers to the following two questions show a more critical attitude. Freelancers were asked about the positive impacts of their work in the Gig economy in the same areas. In assessing the positive contribution to the profession freelancers were significantly more moderate than when reporting on the negative professional impact. Positive contributions to the Gig economy were reported by 51.9% of freelancers in Bosnia and Herzegovina, 43.5% of freelancers in Macedonia, 57.8% of freelancers in Serbia and only 28.9% of freelancers in Montenegro. The differences are statistically significant (X² = 14.443; df = 3; p = 0.002). The lowest level of positive contributions was reported by freelancers in Montenegro, and the highest level of positive contributions was reported by freelancers in Serbia.

In a very high percentage, which ranged between 95% and 100%, freelancers in all four countries pointed out that they had no financial problems due to their work in the Gig economy. No statistically significant differences were found using the X² test.

Let us recall that about 4/5 of freelancers pointed out that their engagement in the Gig economy did not have negative consequences on their private lives. In similar percentages (except for Montenegro) they stated also that there were no positive consequences for their private lives; 73.6% of freelancers in Bosnia and Herzegovina, 86.3% in Macedonia, and 74.7% in Serbia stated that freelance did not have a positive impact on their private life. However, the most positive were freelancers in Montenegro, 57.8% of them stated
that freelance did not have a positive impact on their private life. Significantly more in Montenegro and significantly less in North Macedonia ($X^2 = 16.302; p = 0.001$).

In Bosnia and Herzegovina, only 0.8% of freelancers reported that their work in the Gig economy did not have a positive impact and in Montenegro 11.1%. The differences are statistically significant; significantly more freelancers from Montenegro negatively assessed the cooperation in the Gig economy than in Bosnia and Herzegovina ($X^2 = 10.737; df = 3; p = 0.013$).

As in the previous case, freelancers generally more often pointed out that working in the Gig economy did not have negative financial consequences than they pointed out positive financial gains, although it should be noted that these financial benefits still stood out in high percentages. Thus, these positive benefits were emphasized by 76% in Bosnia and Herzegovina, 80.9% in North Macedonia, 86.7% in Serbia, and only 46.7% in Montenegro. Freelancers from Montenegro assessed the financial contributions of work in the "gig economy" much more negatively, and significantly more positive than freelancers in Serbia ($X^2 = 34.463; p = 0.000$).

It seems that financial benefits were the most important, which is why freelancers were generally very positive about their engagement in freelance.

Due to its potential, the Gig economy is in the focus of the public and an area of great interest to politicians, societies and researchers [11-12].

To the question "whether working in the Gig economy could significantly reduce unemployment" more than $2/3$ of respondents answered "yes"; and only about 6% of respondents had negative attitudes about reducing unemployment. About $1/4$ of respondents reported a neutral attitude. However, freelancers from Montenegro have more negative attitudes than the respondents from Bosnia and Herzegovina, North Macedonia, and Serbia; 26.7% believe that working in the gig economy can not reduce unemployment, and 24.4% reported a neutral attitude. Freelancers from Montenegro answered with "no" significantly more often than the respondents from Bosnia and Herzegovina, North Macedonia, and Serbia ($X^2 = 23.772; df = 6; p = 0.001$).

To the question "Does working in the Gig economy contribute to the quality of life" only about 5% of freelancers reported that working in the Gig economy did not contribute to their quality of life. Freelancers from Montenegro in 13.3% of cases showed a negative attitude when asked does working in the Gig economy improve the quality of life. Also, more than a $1/4$ of respondents (freelancers) from Montenegro were undecided (neutral attitude) when asked does working in the Gig economy improve the quality of life. In the other three countries, about $1/5$ of respondents were neutral when asked whether working in the Gig economy improves the quality of life. However, the differences between Montenegro and the other three countries do not reach the level of statistical significance.

No statistically significant differences were found in the attitudes of freelancers in the four countries in which the research was conducted on improving the position of workers in the Gig economy. It should highlight that freelancers from Montenegro more often pointed out the strengthening of legal legislation (57.8%) and freelancers from Bosnia and Herzegovina more often insist on strengthening the trust of employers towards freelancers, in order to easily extend the employment contract (40.3%).

The differences among freelancers in the four states in which the research was conducted are statistically highly significant ($X^2 = 54.887; df = 6; p = 0.000$). Freelancers from Bosnia and Herzegovina reported significantly more "yes" answers and freelancers from North Macedonia had significantly fewer "no" answers, Serbia had significantly more "Not sure" answers, and Montenegro significantly more "no" answers. Freelancers from Bosnia and Herzegovina and North Macedonia have $2/3$ (North Macedonia) and over 70% (Bosnia and Herzegovina) positive beliefs that working through platforms in the "gig economy" will reduce the brain drain abroad, and freelancers from Serbia are significantly more often than others indecisive, and, compared to Montenegro, significantly more frequently do not believe in brain drain reduction (Table 3).

The distribution of answers to the question “Can work across platforms and in the Gig economy reduce brain drain abroad” is given in Table 3.
Table 3. Frequency distribution concerning attitude on the possibility of brain drain reduces

<table>
<thead>
<tr>
<th></th>
<th>Bosnia and Herzegovina</th>
<th>Montenegro</th>
<th>North Macedonia</th>
<th>Serbia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Yes</td>
<td>94</td>
<td>72,9</td>
<td>19</td>
<td>42,2</td>
<td>86</td>
</tr>
<tr>
<td>No</td>
<td>15</td>
<td>11,6</td>
<td>17</td>
<td>37,8</td>
<td>5</td>
</tr>
<tr>
<td>Not sure</td>
<td>20</td>
<td>15,5</td>
<td>9</td>
<td>20,0</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>129</td>
<td>100,0</td>
<td>45</td>
<td>100,0</td>
<td>131</td>
</tr>
</tbody>
</table>

4. CONCLUSION

In Bosnia and Herzegovina, freelancers are predominantly employed in the IT sector, trade and education and in Montenegro, Serbia and North Macedonia in trade and education. In all four countries, there are fewer of them in industry and tourism. There are almost ten times more freelancers in the IT sector in Bosnia and Herzegovina than in Montenegro.

Respondents in all four countries are convinced in 89.6% of cases that the new technologies will enable new forms of employment and thus revolutionize economic activities, in which no differences have been identified between countries.

When asked "What is important to you when choosing a job", freelancers from Bosnia and Herzegovina differ significantly from freelancers in Serbia, North Macedonia and Montenegro. The most important for them is flexible work time. Freelancers in Bosnia and Herzegovina are most exposed to all the negative impacts of working in the Gig economy, which were discussed in the introductory part, and flexible working hours allow them to avoid or reduce the negative impacts. For freelancers from Serbia, North Macedonia and Montenegro great income is most important, especially because they are not as exposed to relentless competition as freelancers in the IT sector. Let us remind that in North Macedonia, Serbia, and even Montenegro freelancers are more involved in the educational sector which is more routine and less demanding than the work in the IT sector. Considering all the challenges of freelance in the IT sector in general, and especially in the Western Balkans, freelancers from Bosnia and Herzegovina would significantly less often than others accept freelance as the only source of income if it was the only employment option. Although due to all the challenges related to creativity, freedom and autonomy of the individual, freelancers from Bosnia and Herzegovina would rather accept a flexible contract freelance job than a permanent full-time freelance job, the differences still do not reach the level of statistical significance.

When asked about the jobs they accepted in Gig economies in the last two years, translation jobs are significantly represented, but there are no statistically significant differences found between the countries. However, home lectures were more frequent in North Macedonia and Serbia, and less frequent in Bosnia and Herzegovina.

When it comes to the benefits of working from home through platforms, the situation in all four countries in which the research was conducted is devastating, and the worst is in Serbia. While on average a ¼ of freelancers from the four countries in which the research was conducted have health insurance, there are only 15,1% in Serbia. The situation with pension insurance is even worse; in Montenegro and North Macedonia pension insurance has about 30% of freelancers and in Bosnia and Herzegovina only 7,8%. The difference is statistically significant. Finally, 71,3% of respondents from Bosnia and Herzegovina, 44,4% from Montenegro, and 78,9% of respondents from Serbia did not have any insurance. Freelancers from Montenegro receive significantly more benefits.

Interestingly, about 3/4 to 4/5 of freelancers in all four countries in which the research was conducted pointed out that engaging in freelance did not have negative consequences on their private lives. Differences between countries are not statistically significant.
During the assessment of the positive contribution to the profession, freelancers were, however, significantly more moderate than they reported about the negative professional impact. Positive contributions to working in the Gig economy were reported by 51.9% of freelancers in Bosnia and Herzegovina, 43.5% in Macedonia, 57.8% in Serbia, and only 28.9% in Montenegro. The differences are statistically significant ($X^2 = 14.443; df = 3; p = 0.002$). Freelancers from Montenegro reported the lowest positive contributions to freelancing. Freelancers from Serbia reported the highest positive contributions to freelancing. The financial benefits of freelance contributed the most to the positive attitudes in all four countries in which the research was conducted.

Except for Montenegro, respondents believe that working in the "Gig Economy" can reduce unemployment. Less than half of freelancers from Montenegro believe that working in the "Gig Economy" can reduce unemployment. Differences are statistically significant in the belief that working in the "Gig Economy" can reduce unemployment.

No statistically significant differences were found regarding the attitudes of freelancers about measures of worker's position improving in the Gig economy among the four countries in which the research was conducted.

Finally, freelancers from Bosnia and Herzegovina and North Macedonia point out that statistically more often working in the Gig economy can significantly reduce the brain drain abroad, while in Montenegro they significantly more often deny that statement.

In general, it can be concluded that respondents in all four countries in which the research was conducted have positive attitudes towards different aspects of their engagement in the Gig economy. There are no significant differences when it comes to the impact of new technologies on new forms of employment, the types of work that freelancers have done in the last two years, or the assessment of the negative and positive consequences of working in the Gig economy. All respondents emphasize good income as the most significant advantage.

Notable differences appear between freelancers from Bosnia and Herzegovina and others when it comes to job choosing. Freelancers from Bosnia and Herzegovina are significantly more likely to emphasize flexible working hours. Due to the exposure to great psychophysical efforts in the IT sector in which they work predominantly, flexible working hours enable them to balance better between high external pressures and internal psychological tensions and to reduce those pressures and tensions. Since they are more familiar with the good and also bad sides of freelancing, freelancers from Bosnia and Herzegovina are more critical than others. However, the most significant differences are between freelancers from Montenegro and others; Freelancers from Montenegro see less positive contributions than working in the "Gig economy" than others, significantly more often believing that the Gig economy can not reduce unemployment and prevent brain drain abroad. Overall, they saw fewer positive contributions to working in the Gig economy than others. Despite all the above, social assistance and the protection of freelancers from the state are relatively the best in Montenegro.

The negative attitude of freelancers in Montenegro towards working in the Gig economy can be explained by the relatively lower prevalence of freelancers, poorer business structure and therefore relatively lower-income, and also limited market. However, the indirect influence of unfavorable socio-economic and political factors should not be excluded.

When it comes to the other three countries (Bosnia and Herzegovina, Serbia and North Macedonia), it can be noticed that the overall picture is more positive, which can be explained by their perception that they are in a way privileged by the creative nature of the work they do and also a good income. Therefore, they are more inclined to highlight the better sides of work in the "Gig Economy", contrary to expectations, and even though they are „stepchildren“ of the state in terms of health, disability and pension insurance, especially in Serbia.
REFERENCES
Psychosocial Adjustment to Work at/from Home in Serbia, Montenegro, North Macedonia, and Bosnia and Herzegovina

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Abstract: In this study, on the convenience samples of 408 respondents from Serbia, 201 from Montenegro, 221 from North Macedonia, and 201 from Bosnia and Herzegovina, the authors described psychosocial adjustment to work at/from home in the four Western Balkan countries, similarities and differences among the countries and, using qualitative analysis, they presented the profiles of psychosocial adjustment for each country. For this research, a special questionnaire was constructed with answers on a five-point Likert scale. In the analysis and processing of empirical data, ANOVA was used.

The results of the research confirmed the findings of other researchers that the attitudes of the respondents towards various psychosocial aspects of working from home are mostly positive, although there are significant differences among the countries; the biggest differences are between respondents from Montenegro and everyone else. Respondents from Montenegro estimate work at/from homeless favorably than all others; they have less time for activities and hobbies, pay less attention to family and partners, show more tension and anxiety while working, their relatives and friends support them less than other respondents. Jobs that are well below their professional education demotivate them. Respondents from North Macedonia are relatively similar to them, while respondents from Serbia and Bosnia and Herzegovina show a much more optimistic image, which is why they are similar.

The lack of social care of the state towards the respondents who work at/from home and remotely is common to all respondents, but it is most pronounced in Serbia.

Index Terms: psychosocial aspects, psychosocial profiles, similarities and differences, work at/from home

1. INTRODUCTION

Research usually highlights the positive economic benefits of working at/from home, which can be measured quite accurately (higher productivity, numerous savings, reduced office space and associated costs, saving money and time on the way from home to office and vice versa [5]; [10]; [8]; [1]; [19]; [7].

When it comes to psychosocial aspects of work at/from home, it is much more difficult to measure them accurately, and researchers’ agreement on the positive and negative consequences of this form of work is significantly lower. Positive psychosocial factors include greater autonomy and freedom in business planning and work process planning [9], greater efficiency in fulfilling work tasks and greater self-confidence [20]; [12]; [15]; [13]; [2]; [16], greater commitment to work and job [6], more balanced fulfillment of work and non-work obligations [21], and improvement of communication skills [22]. Flexible working hours are considered to be most important for successful work at/from home [11], along with systematic social support from family and managers and a good work-life balance [4].

The negative consequences of working at/from home and remotely vary depending on demographic, socio-psychological, and cultural factors. However, the most important is whether the research was conducted before or during the Covid-19 pandemic. Almost without exception, there are more negative and more significant socio-psychological consequences if working at/from home was practiced during the Pandemic, and especially if working from home occurs due to the Covid-19 pandemic. Uncertainty about the duration of the Pandemic as well as job and income uncertainties give rise to loss of self-confidence, anxiety, and depression [17]. According to another survey on remote work (telework) in 2019, 49% of workers had mental health problems [14]. Similarly, a study including 2,500 teleworkers has shown that 66% of those under the age of 25 suffered from one or more symptoms of mental disorders [17]. Exploring the psychosocial problems of working from home, American social psychologists emphasize feelings of loneliness, social isolation, anxiety, stress, and depression due to loss of direct social interactions, with a special focus on the importance of social network support (family, friends, and employers) [18].
Psychological responses to job uncertainty, salary reduction, productivity decline, layoffs, and more during the Pandemic can include low mood, poor motivation, exhaustion, anxiety, depression, burnout, and suicidal thoughts, but also several physical health disorders such as digestive problems, changes in appetite and weight, dermatological reactions, fatigue, cardiovascular disorders and diseases, musculoskeletal disorders, headaches, and other unexplained pain [3]; [18] as well as addictive disorders.

2. AIMS
Since the research of psychosocial problems of those who work at/from home has been conducted for the first time in the four Western Balkans countries, it has an exploratory character, which is reflected in the entire research design, primarily aimed at presenting the phenomenological image of the problem.

The first aim is to describe the psychosocial characteristics of those who work at/from home in the four Western Balkans countries.

The second aim is to analyze the psychosocial similarities and differences of those who work at/from home in the four Western Balkans countries.

The third aim is to describe the psychosocial profiles of those who work at/from home in the four Western Balkans countries.

3. METHOD

3.1. Samples
The total sample consists of 1031 respondents from four Western Balkans countries: 201 from Bosnia and Herzegovina, 201 from Montenegro, 221 from North Macedonia, and 408 from Serbia. Those are convenience samples because the “samples” include everyone who works from home and who has agreed to fill in the electronic questionnaire. Due to the lack of representativeness, all generalizations of the results to the general population of those who work at/from home are unreliable and may serve as potential benchmarks in future research.

3.2. Research Instrument
To examine the psychosocial adjustment to work at/from home, we constructed a special questionnaire with answers on a five-point Likert scale. The construction process was relatively long and complex. First, over 200 statements were formulated, which were then reduced to 50 in three rounds of elimination. After that, three independent experts reduced the number of statements to 13 in three rounds. The 13 statements that entered the third round included only those statements for which all three experts agreed that they best operationalize the research problem. The answers to all 13 statements were given in the form of a five-point Likert scale, where 1 means the lowest and 5 the highest agreement with the statement. The statements are as follows:

Since I started my own business, I have had much less time for myself and my hobbies.

Working from home does not prevent me from devoting enough time and motivation to engage in physical activities (exercise/sports).

Working from home has negatively affected the amount and quality of my sleep.

Since I started to work from home, I have been paying less attention to my family or partner.

Since I started to work from home, I have had more time to hang out with friends.

The job I am currently running fulfills me.

My current income is enough to cover all my basic needs.

I am confident in the future success of the business I am currently running.

I have trouble separating my job from my private life.

I would like to have more contact with other people during my work.

Since I started to work from home, I feel more tense and upset.

My family and close friends mostly support me in my current job.

During working from home, others (family, friends, and neighbors) do not disturb me, and I can fully dedicate myself to work.

We performed data processing and analysis in the SPSS program. In addition to descriptive statistics, we used ANOVA and correlation analysis.

Finally, based on empirical results, we performed a qualitative analysis in which we described the basic psychosocial profiles in the four Western Balkan countries.
4. RESULTS

We presented the distribution of the items from the Psychosocial Adaptation Scale by reducing the five-point scale to a three-level scale in order to more clearly see the significant numerical differences among the four countries.

Table 1. Distribution of items from the Psychosocial Adaptation Scale in the four Western Balkans countries

<table>
<thead>
<tr>
<th>Statements</th>
<th>Bosnia and Herzegovina</th>
<th>Montenegro</th>
<th>North Macedonia</th>
<th>Serbia</th>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Undecided</td>
<td>Yes</td>
<td>No</td>
<td>Undecided</td>
</tr>
<tr>
<td>1.</td>
<td>19.4 37.8 42.8</td>
<td>64.3 27.4 28.4</td>
<td>37.1 9.5 53.4</td>
<td>34.3 17.2 48.6</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>15.5 20.4 64.2</td>
<td>17.9 27.9 54.3</td>
<td>19.0 11.8 69.3</td>
<td>23.3 13.5 63.2</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>15.0 18.9 65.1</td>
<td>25.3 22.4 52.3</td>
<td>14.9 15.4 69.7</td>
<td>16.2 11.8 72.1</td>
<td>17.5 16.0 66.6</td>
</tr>
<tr>
<td>4.</td>
<td>9.5 15.9 74.7</td>
<td>24.9 23.4 51.6</td>
<td>20.4 11.8 67.9</td>
<td>16.9 17.2 65.4</td>
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<td>5.</td>
<td>15.5 31.8 52.8</td>
<td>17.4 30.3 52.3</td>
<td>22.6 24.0 53.4</td>
<td>26.0 24.5 49.5</td>
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<td>6.</td>
<td>7.5 17.9 74.6</td>
<td>3.5 29.4 67.2</td>
<td>20.8 13.1 66.1</td>
<td>9.0 18.4 72.5</td>
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<td>7.</td>
<td>14.9 25.4 59.7</td>
<td>11.0 30.3 58.7</td>
<td>17.2 17.1 65.6</td>
<td>16.7 22.3 60.1</td>
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<td>8.</td>
<td>10.0 28.4 61.7</td>
<td>9.5 24.9 65.7</td>
<td>22.2 19.0 58.9</td>
<td>16.4 26.5 57.2</td>
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<td>9.</td>
<td>20.9 25.4 34.3</td>
<td>33.8 28.9 37.3</td>
<td>23.1 19.9 57.1</td>
<td>16.4 20.8 62.7</td>
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<tr>
<td>10.</td>
<td>38.3 27.4 34.3</td>
<td>54.7 28.4 18.6</td>
<td>40.8 27.1 32.2</td>
<td>33.8 28.4 37.5</td>
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<tr>
<td>11.</td>
<td>10.0 20.9 69.2</td>
<td>21.9 28.4 49.8</td>
<td>17.2 17.6 65.2</td>
<td>12.3 14.5 73.3</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>3.5 14.4 82.1</td>
<td>4.0 21.9 74.1</td>
<td>17.6 13.6 68.8</td>
<td>5.9 11.8 82.4</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>9.5 20.4 70.2</td>
<td>14.5 18.4 66.7</td>
<td>21.2 15.8 62.9</td>
<td>9.6 13.5 77.0</td>
<td></td>
</tr>
</tbody>
</table>

It is very important to remember that negative statements were recorded on this scale.

Table 1 shows that the answers to the first statement “Since I started my own business, I have much less time for myself and my hobbies” reveal significant differences among countries. We applied ANOVA (F=9.881; p=0.000). Respondents from Montenegro have much less time for their hobbies and activities than respondents from Bosnia and Herzegovina (I-J= -0.62189; p=0.000), respondents from North Macedonia (I-J= -0.61165; p=0.000), and respondents from Serbia (I-J= -0.58224; p=0.000).

Respondents from Montenegro significantly more often gave negative answers to the second statement “Working from home does not prevent me from devoting enough time and motivation to engage in physical activities (exercise/sports)” than respondents from North Macedonia (I-J= -0.3224; p=0.012), while respondents from Serbia gave negative answers less often than those from North Macedonia (I-J= -0.2159; p=0.049), although this difference is almost on the border of significance. Concerning this statement, no statistically significant differences were found between Serbia and Montenegro. It can be concluded that since they work at/from home, respondents from Montenegro have more problems and less motivation to engage in physical activities than those from North Macedonia, while in this respect they do not differ significantly from those from Serbia and Bosnia and Herzegovina.

Table 1 shows that respondents from Montenegro were relatively more faced with reduced and poor-quality sleep due to working from home; almost a quarter (22.4%) said they had trouble sleeping. This was confirmed by the findings of ANOVA (F=10.038; p=0.000). Respondents from Montenegro had significantly more sleep problems due to working from home than those from Bosnia and Herzegovina (I-J= -0.35821; p=0.004), those from North Macedonia (I-J= -0.52509; p=0.000), and those from Serbia (I-J= -0.56940; p=0.000, Table 1).

When it comes to the fourth statement “Since I started to work from home, I have been paying less attention to my family or partner”, a quarter of respondents from Montenegro again pointed out that they pay less attention to family or partner because of working from home (Table 1). These differences were confirmed using ANOVA (F=8.243; p=0.000). Respondents from Montenegro have been paying less attention to family and partners since they started working from home than respondents from Bosnia and Herzegovina (I-J= -0.60697; p=0.000), North Macedonia (I-J= -0.35814), and Serbia (I-J= -0.43638).
As for the fifth statement “Since I started to work from home, I have more time to hang out with friends”, no statistically significant differences were found among the countries (F=1.182; p=0.316). Table 1 shows that more than half of the respondents reported a lack of time to hang out with friends due to working from home and more than a quarter cannot estimate that accurately. Still, it can be noticed that the percentage of those who do not think that they have less time for friends because of working from home is higher in North Macedonia, and especially in Serbia, while this percentage is the lowest in Bosnia and Herzegovina, followed by Montenegro. However, these differences do not reach the level of statistical significance and should be observed as mild tendencies.

The sixth statement “The job I am currently running fulfills me” shows that respondents are generally satisfied with the work they do at/from home. The percentage of the dissatisfied ranges from 3.5% (Montenegro) to 9% (Serbia, see Table 1). The only exceptions are respondents from North Macedonia, where the percentage of those dissatisfied with working from home reaches as much as 20.8% (Table 1). The ANOVA also showed that respondents from North Macedonia were significantly less satisfied with their current work from home than everyone else (F=4.542; p=0.004). They are less satisfied than the respondents from Bosnia and Herzegovina (I-J= - 0.2982; p=0.005), Montenegro (I-J= - 0.2683; p=0.012), and Serbia (I-J= - 0.3220; p=0.000).

Three-fifths of respondents from all four countries are very satisfied or satisfied with their current income, while the percentage of those who are dissatisfied is only about one-sixth (Table 1). Similar to the work that respondents do at/from home and which they are most satisfied with, respondents are also satisfied with their current income, although to a lesser extent (see Table 1). However, the differences among countries in terms of current income do not reach the level of statistical significance (F=0.122; p=0.947).

About three-fifths of the respondents in all four countries are confident in the future success of the work they are currently doing (Table 1). ANOVA revealed no statistically significant differences among the countries (F=2.463; p=0.061). However, it should be noted that the respondents from North Macedonia are relatively most skeptical about the future success of the work they are currently doing, which may explain the value of the F test which in this case approaches the significance limit of 0.05.

Respondents from Montenegro find it harder than others to separate work from home from private life; a third of them said that they had problems, while much fewer respondents in other countries reported such a problem (see Table 1). These relative differences are greatest when it comes to Serbia, where half as many respondents had these problems (Table 1). The differences are statistically highly significant (F=14.023; p=0.000).

Due to working from home, respondents from Montenegro feel most tense and upset (Table 1). It is interesting to note that the majority of respondents from Bosnia and Herzegovina said that they do not feel tense and upset while working from home (about 70%), which is similar to those from North Macedonia, while almost three-quarters of respondents from Serbia did not show confusion and ambivalence of feelings due to working at home. The differences are statistically significant when comparing Montenegro and others, as well as Serbia and Macedonia (F=12.672; p=0.000). Respondents from Montenegro are significantly more tense and upset during work from home than those from Bosnia and Herzegovina (I-J = - 0.50578; p=0.000), North Macedonia (I-J = - 0.32516; p=0.015), and Serbia (I-J = - 0.50578; p=0.000).

Respondents from Montenegro, less than anyone else, want to have contact with other people while working from home; it should be noted that more than half did not express this wish, (Table 1). The differences are statistically significant compared to the other three countries; in relation to Bosnia and Herzegovina (I-J= - 0.46386; p=0.000), North Macedonia (I-J= - 0.35821; p=0.000), and Serbia (I-J= - 0.73101; p=0.000).

Relatives and friends supported respondents in their work from home in very similar percentages, while they were relatively least supported by relatives and friends in North Macedonia, followed closely by those in Montenegro (see Table 1). Respondents from Bosnia and Herzegovina were significantly more supported at work than respondents in North Macedonia and Montenegro,
as well as respondents from Serbia compared to Macedonia and Montenegro (F=10.718; p=0.000). In Bosnia and Herzegovina, they are significantly more supported by relatives and friends than in North Macedonia (I-J=0.4053; p=0.000) and Montenegro (I-J=0.2189; p=0.033). They also feel more supported in Serbia than in North Macedonia (I-J=0.4495; p=0.000) and Montenegro (I-J=0.2631; p=0.003). Bosnia and Herzegovina and Serbia do not differ significantly from each other.

Finally, the family and friends of our respondents do not interfere with their work from home and allow them to devote themselves to work in large percentages ranging from just over two-fifths (North Macedonia) to over three-quarters (Serbia, see Table 1). In that respect, Serbia and Bosnia and Herzegovina are the most similar. However, the differences are still statistically significant (F=7.138; p=0.000). Family, friends, and neighbors are less likely to prevent respondents from Serbia from devoting themselves completely to working from home than respondents from North Macedonia (I-J=0.4342; p=0.000) and Montenegro (I-J=0.3029; p=0.003). Respondents from Bosnia and Herzegovina are also less disturbed than those from Macedonia (I-J=0.025, p=0.025). No statistically significant differences were found between Serbia and Bosnia and Herzegovina.

5. Psychosocial Profiles

5.1. Bosnia and Herzegovina

Respondents from Bosnia and Herzegovina are the youngest population in terms of age. They have significantly lower education than everyone else, especially the respondents from Serbia and Montenegro. As for their job, they work significantly more than others in the IT sector as developers.

According to several characteristics, respondents from Bosnia and Herzegovina are relatively well-adapted to working from home; they have enough time for their leisure activities and hobbies, although sometimes they lack time for physical activities. They have no problems with the amount and quality of sleep. Because of working from home, they do not neglect their family or partners, but to a certain extent, they do neglect their friends. The work they do from home fulfills them. They maintain good contacts with other people while working from home and successfully separate their work from home from their private life. They do not feel tense and upset while working from home, and they are supported and helped in their work from home by relatives and friends.

5.2. Montenegro

As in other countries, gender-related differences have not been determined, and respondents from Montenegro are on average relatively younger, following closely those from Bosnia and Herzegovina. Unlike respondents from Bosnia and Herzegovina, they are significantly more likely to have college and higher education, with almost half of them having a university degree. Their work-from-home jobs include mostly trade and education (almost half of the total number). They work from home for the longest time. In many ways, Montenegrin respondents who work from home are special. Since they work from home, they have much less time for their activities and hobbies, including engaging in sports and recreational activities, have a shorter and poorer sleep, pay less attention to family and partners than everyone else, and have slightly less time for friends. However, they are more satisfied with their work than the respondents from North Macedonia. Macedonian respondents find it harder than others to separate their work from home from their private life, they want social contact with others less than everyone else while working from home. Because of working from home, they feel more tense and upset than everyone else, while their relatives and friends are less supportive and helpful with their work from home compared to most respondents from other countries.

Respondents from Montenegro face more problems at work than everyone else, which is why they show inconsistencies in psychosocial behavior, and even confusion.

5.3. North Macedonia

In addition to the fact that there are no significant gender-related differences, respondents from North Macedonia come immediately after Serbia in terms of average age. According to the level of education, there occupy second place, right after Montenegro, with almost a third of Macedonian respondents having a university degree. Similarly to the respondents in Montenegro, they work in a similar percentage in trade and education. According to the length of work from home, they are second, right after Montenegro.
Despite these similarities in social profiles, more differences than similarities with Montenegro were found in psychosocial adjustment. The similarity with the respondents from Montenegro is that due to working from home, they do not have the desired time for sports and recreational activities. It should be emphasized that the respondents from North Macedonia were the most dissatisfied with the work they currently do from home, although in that respect the differences among the countries do not reach the level of statistical significance. Probably as a result of dissatisfaction with their current job, they are the most skeptical about the perspective of their current job in the future. They are significantly less tense and upset about the work they do from home than respondents from Montenegro. However, they are the second most tense and upset respondents, after those from Montenegro, and the differences reach the level of statistical significance when compared to Serbian respondents.

Respondents from North Macedonia, as well as from Montenegro, are less supported by family, relatives, and friends and are more disturbed while working from home than respondents in Serbia and Bosnia and Herzegovina. It is known that the more educated have a slightly more negative perception of work from home than the less educated. Accordingly, are the more educated in Montenegro and North Macedonia more inclined to perceive relatives and friends negatively, or are relatives and friends really less helpful and more disturbing? This is hard to say.

Respondents from North Macedonia differ significantly from those from Montenegro when they work from home. This is seen in the following:
- they have more time for various activities and hobbies;
- they have somewhat more time to engage in sports and recreational activities;
- they have a longer and better sleep;
- while working from home, they pay more attention to family and friends;
- they more successfully separate work from private life;
- they socialize more while working from home;
- they feel less tense and upset while working from home.

5.4. Serbia

Respondents from Serbia are, on average, the oldest. In terms of the educational structure, they are very similar to those from Macedonia, and in terms of higher education, to respondents from Bosnia and Herzegovina and North Macedonia. They have significantly fewer highly educated people working from home than Montenegro and more than Bosnia and Herzegovina. They are similar to Montenegro in the length of work from home.

In all aspects mentioned earlier, Serbia is consistently different from Montenegro, and in all other aspects, it is similar to North Macedonia, except that Serbian respondents are significantly more satisfied with the work they currently do from home and are more optimistic about the future of that work. On the whole, the respondents from Serbia provide the most optimistic image of work from home and it seems that they are the best psychosocially adjusted to that work.

6. CONCLUSION

The most significant and numerous differences are between those who work from home in Montenegro and others, especially those in Serbia and Bosnia and Herzegovina. They are the least optimistic about working at home and the "gig" economy [23]; they have more psychosocial problems than everyone else, they do not have enough free time for recreational activities, and they complain about excessive work and the impossibility of separating work from private life. In addition, they are less than all the others connected to the primary groups while working from home. Despite this, they believe that informal contacts can contribute the most to a successful home-based business. They try to distance themselves from the primary groups during their work, and at the same time, they are frustrated by it. Due to all that, the respondents from Montenegro face more problems at work than everyone else, which is why they show inconsistencies in psychosocial behavior, and even confusion. Possible factors may include underdeveloped and inconsistent economic activities, and the relatively low level of consumerism, especially during the Covid-19 pandemic. Almost a third of them are engaged in online trade. In addition to the very unfavorable economic situation, the turbulent political context should not be overlooked, which further complicates the confusing social situation. However, it seems that the most important factor is the feeling of frustration because they do jobs that are often significantly below their educational level, which is why relatives and friends have an
ambivalent and even rejective attitude towards them.

According to some psychosocial patterns of behavior, the respondents from North Macedonia are most similar to them. They are most similar to the respondents from Montenegro in terms of the level of education and the type of job. They are also similar to Montenegrin respondents in being dissatisfied with their current work from home, especially in terms of work demotivation and routine, regarding their higher education, which in turn causes frustration. Due to the current dissatisfaction, they are not optimistic about working from home or the "gig" economy. Although they have significantly fewer psychosocial problems due to working from home, in this respect they are more similar to respondents from Montenegro than those from Bosnia and Herzegovina and Serbia. All these aspects of similarities with Montenegro at the same time significantly differentiate them from Bosnia and Herzegovina and Serbia.

Bosnia and Herzegovina and Serbia generally differ the most from Montenegro and Macedonia. According to numerous characteristics, the respondents from Bosnia and Herzegovina represent the opposite of the respondents from Montenegro. Unlike the respondents from Montenegro, they are the youngest, with the lowest education, and are mostly employed in the IT sector. They have no psychosocial problems, they balance well between business and private life, and they receive support from their family and friends. They are satisfied with their work and income and maintain good social communication while working from home. They are optimistic about the perspective of their work. They strive to jealously preserve this social and cultural capital, and that is why they find it most important for their business success to preserve the boundaries between business and private life, which requires flexible working hours. It is obvious that the respondents from Bosnia and Herzegovina are well-adapted to working from home. In our opinion, several factors are important for this adjustment. First, this is a young population that is highly motivated for work because they were involved in professional life relatively early. Second, they are above average motivated because they are over proportionately represented in the IT sector. The fact that their education is below average does not reduce, but probably goes in favor of the above-average motivation for the IT sector and programming, because they acquired the knowledge and skills in those areas outside the usual institutional framework. Therefore, this population is particularly interesting for monitoring possible directions of the development of work from home, partly outside the usual institutional framework, given the strong scepticism that freelance promotion and development are possible mostly or only in institutional educational frameworks.

Although respondents from Serbia have some formal similarities with those from Montenegro (in terms of length of service) and North Macedonia (in terms of education), they differ significantly from respondents from Montenegro in several other characteristics, which make them more similar to respondents from Bosnia and Herzegovina. They do not report psychosocial problems. They are satisfied with their work from home and optimistic about the future of their work. Similarly to the respondents from Bosnia and Herzegovina, they nurture good social ties with the primary groups and a closer social environment to which they eventually turn for help due to work-related problems, which they generally do not have.

Respondents in the four countries show a significant degree of satisfaction with work at/from home and psychosocial adjustment, with some exceptions related to those who work at/from home in Montenegro. In this respect, they are similar to the findings of other researchers [9]; [20]; [12]; [15]; [13]; [2]; [16]; [21]; [4]. However, one gets the impression that our respondents report a more optimistic image than the actual, especially when considering the poor social protection provided by state bodies, especially in Serbia. Even though some groups are frustrated by doing jobs below their qualification level, they still feel privileged because of the axis of professional autonomy, higher employment, and better income. Montenegro is an exception to some extent, for the reasons discussed earlier.

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Abstract: In today’s business environment, telework has become more common. It provides a win-win situation for employers and employees. Namely, for workers, the benefit is the flexibility to work when they want and where they jobs, across geographies. On the other hand, employers reduce labor costs. During the COVID 19 pandemic, the number of workers who did their work from home increased significantly and it is predicted that this way of working will continue its growth trend not only due to the flexible and agile ways of working, but also due to cost reduction opportunities this change brings.

Index Terms: telework, gig economy, freelancer, digitalization, COVID 19

1. INTRODUCTION

The process of globalization has brought people, economies, and cultures together, and has contributed the most to the free flow of goods and services (Rabrenovic, Mitrovic, Kovacevic, 2021). Two significant phenomena that have occurred in the past few years have been emigration and the COVID-19 pandemic crisis. These events shook the world on a global level, causing political, economic, social, and other consequences (Andjelkovic, Radosavljevic, Radosavljevic, 2021). Teleworking and flexible forms of work are the results of the technological revolution and globalization (Taborosi, Maljugic, 2021).

Remote work must be based on confidence, respect, dialogue, and achieved results (European Commission, 2007). In this manner, it has provided employees greater freedom in organizing their free time thanks to the application of new information technologies (Radovic-Markovic, et al. 2021a). This tendency will continue in the future. Namely, the trend of digitalization and automation in the work processes of many different industries will simply not disappear after the end of the pandemic. The application of various technologies improves the learning environment and provides preconditions to transform teaching into learning (Vucbekovic, Medic, Markovic, 2020). Therefore, in professional and scientific circles, there is a growing opinion that by 2030, about half of the world’s workforce will be "giggers" (Harper and Winson, 2018).

To better assess the further trend of changes in the work processes and structure of business organizations during and after COVID 19, we will analyze the basic characteristics of these changes.

2. EU FRAMEWORK ON TELEWORK

The EU “Framework Agreement on Telework” from 2002, was signed by European social partners. It creates a contractual obligation for signatory countries to implement the agreement at all levels of the national system. Within the Agreement, telework is defined as a form of organization and/or execution of work with the usage of information technologies, in the context of work, i.e., employment contracts, in which the job that could be done on employers’ premises is done outside them. Namely, one of the main differences between this type of employment and the traditional work arrangement is that in this case the workers are paid only for that particular job. Therefore, jobs are not performed based on permanent employment of people who have certain knowledge, but a contract is concluded for the provision of a specific service (Radovic-Markovic, et al., 2019).

Whether the COVID 19 will be over in the next few years or sooner, remote work involving greater flexibility will continue the growth trend. The workplace is becoming less and less important. New technologies and changes in the organization of work lead to an increasing number of companies accepting working remotely. However, even if working from home allows more freedom and different opportunities for better use of time, business owners often fall into other traps - they suffer from a lack of organizational skills needed for the changing environment and do not know how to structure responsibilities and time well, and even sometimes lose their identity.

New models of work usually involve new jobs, which will continue to be created in the formal economy. However, when determining new models of work, we must not neglect the informal economy (Radovic Markovic, 2020; Radovic Markovic, 2008), which has begun to gain increasing importance in the conditions of the employment and employment crisis in many
countries. Namely, in the conditions of the economic crisis caused in 2008, as well as the latest crisis caused by COVID-19, the informal economy has become a wide-open market for personal skilled work and service provision. It is expected that in the future, more and more attention will be paid to helping employees work in this way. In line with this, many companies start courses for the acquisition of required knowledge and skills such as required knowledge for work on a computer, report writing skills, development of communication skills by phone, good organization, work on acquiring responsibility, independence in decision-making, estimating of the situation and managing project documentation. In addition, European businesses will need to revisit tax regulations.

There are big differences between countries in terms of legal regulation of work from home. In some countries, this way of working is completely legally regulated, having in mind the interests of employees through health and social protection (Radović-Marković and Jovanović, 2021). At the same time, the state interests are kept through tax contributions. Implementation measures of the agreement are different among member states depending on their national procedures. Three manners of implementation are distinguished: by collective contract; by joint guidelines, rulebooks, and recommendations on telework, which are non-obligatory and voluntarily, and, the third one, by national legislation.

On the other hand, the countries that need to join the EU are just beginning to put this form of work into the legal framework. In this context, they lag far behind the countries in the EU. Therefore, the legislation in the Western Balkans should be brought closer to EU standards, which is one of the conditions for the harmonization of laws upon accession to the European Union. Whether we will witness the standard legal frameworks in the future, following the Covid19 experience, remains open for debate. In any case, businesses must navigate tax regulations carefully in 2022 and the years ahead.

An index has recently been created that analyzes the economic impact of teleworking. This requires serious analysis such as:

- What are the indicators for small countries, and what for more developed larger countries? Has the Covid pandemic pushed poor countries to record debt?
- How has working from home stopped the rise in unemployment in European countries?
- How is the organizational culture changing and what skills and knowledge do managers and employees need?

In addition, it is necessary to consider and offer answers to questions such as:

- What is the daily life of people who work from home?
- Are there any differences compared to those who work in employers’ offices?
- Does working from home with the help of modern technologies create dependence on the Internet? How to influence it and create a balance between work and life?
- To what extent does working from home create stress and what are the problems that employees face?

3. FREELANCER EXPANSION

There are several reasons for freelancer expansion:

- It is a way to generate additional income for debt repayment or savings.
- It is easy to start if the individual already has the necessary skills and equipment to do the job.
- It enables greater independence in relation to permanent employment in a company.
- It is often flexible and allows you to work part-time or outside the working hours.

Almost half of the freelancers did not feel the impact of the economic crisis. Namely, since the global financial crisis of 2008-10, companies began to shift to contract workers, which led to the emergence of the gig economy, which is in full swing. Consequently, the question arises as to what effect the crisis will cause Covid-19 on existing forms of work and how companies will change in organizational and technological terms.

“Some enterprises have already begun to reprioritize their digital roadmaps with a focus on implementing more automated and robotic processes as quickly as possible” (Capgemini, 2020). We must point out that this change is business-case driven, which it wasn’t before COVID-19. Organizations have recognized that automation and digitalization are not only a cost reduction measure but are now a matter of business continuity.

4. A CHALLENGE FOR THE COUNTRIES OF THE WESTERN BALKANS

In the new agenda of the European Commission for the countries of the Western Balkans until 2025, one of the goals is to intensify digitalization. In the European Union, one of the set goals is to digitalize 70% of businesses by 2027 (Radović-Marković, Stevanović, Milojević,
However, to achieve that, certain conditions must be reached. The first is the availability of the Internet and the other one are digitally literate employees and tools such as software and platforms that enable remote work. Of course, the legal framework for the protection of workers must follow these changes.

When considering the countries of the Western Balkans, it is certain that we are witnessing changes in the way we work and that the number of those who work outside the employer's business premises has increased. For example, in Serbia in 2017, only 3.1% of employees worked from home. Already in 2019 (before the pandemic), that percentage increased to 4.9, which is 0.5 below the European average. However, the trend has continued to grow. The total percentage of employees working from home in the second quarter of 2020 was 12.1%, which is 2.9% more than in the first quarter of 2020 (Radović-Marković et al. 2021).

Analyzing comparative data from the countries of the region, it can be pointed out that Northern Macedonia has the best Internet coverage in the country - 81%, but at the same time, the smallest number of employees work from home, only 10%. In Serbia, the Internet coverage is 75% (Fig. 1), but we are the leader in the region with the highest percentage of online workers. In this context, the absence of the workers’ obligation to come to a physical workspace, be it a hall, an office, or a workshop, caused fears among employers regarding the decline in productivity.

Urgent research was done during 2020, and even the latest one from 2021 indicates that between 60 and 70% of respondents, both workers and managers did not indicate that there is a decline in productivity when working “from a private address” (Radović-Marković et al. 2021).

Another piece of related information shows that even after the pandemic, working from home will be a reality. Bosnia and Herzegovina, which has an extremely pronounced problem of emigration (nevertheless) combined with high unemployment among the youngest workers aged 18 to 24, has the highest percentage of workers of this age - working from home. Almost 60 per cent of them, which is three times more than in Serbia, Montenegro, Croatia, and Northern Macedonia.

For the countries of the Western Balkans to maximize the impact of the Internet and new technologies, significant investments in infrastructure are needed. The significance of digitalization has been recognized in the Republic of Serbia, resulting in reforms, economic growth, education and digitalization being among the main priorities of the Government. So, Serbia has improved its score in 4G investment over the last year (Digital Serbia, 2020). It is expected that investments will be made in 5G infrastructure by 2025. The combination of the 5G network, the use of IoT data and artificial intelligence will transform the labour market.

Although Serbia has over 100,000 freelancers, the law does not recognize them. For some freelancers, this is the main job, and for some, it represents extra income. However, among them, there are a lot of those who are not registered and do not pay taxes, which damages the budget of Serbia. Therefore, there are more and more calls for a legislative response at the European and national levels in the domain of this form of business (Radović Marković, Tomaš, 2019, Vučeković, et al. 2021).

The age structure of freelancers shows differences for the analysed countries (Fig.2).
New types of non-standard employment arrangements appear in the form of short-term engagement in the gig economy. For non-EU countries in the Western Balkans, this mode of employment has become particularly attractive due to lower wages and high unemployment rates compared to member states. Therefore, many saw a chance to stay and live in the local environment, while earning European salaries (Radović-Marković, et.al. 2021).

CONCLUSION

Labor markets and employer-employee relations have been redefined around the world. The increase in real estate prices makes it impossible even for large corporations to open offices in multiple locations. Providing work from home avoids such investments. Accordingly, this trend is expected to continue when the pandemic passes (Radović-Marković, M., et. Al. 2021a).

This is confirmed by statistics from European countries and developing six economies, which also show that working from home is the future of employment. Thus, Upwork estimates that by 2028, 73% of all its departments and branches will have remote workers (Allthingstalent, 2020). In addition to Upwork, other organizations also need to recognize and understand the growing influx of Generation Z into the workforce. For these workers born in the digital age, the concept of remote working cannot only be attractive but is also seen as a key criterion for achieving job satisfaction. “For the younger generations, as well as for the growing number of members of the older generations, the future of remote working has already begun” (Lee, 2020, p. 1).

Therefore, having in mind the social psychological, economic, and political factors that will influence the further growth of employment in this way, it is necessary to carry out reforms in education in European countries so that all generations use their chance.

In Western Balkans, thanks to modern technologies, some organizations have built an excellent foundation for working from home, while others have not. Some have software that helps employees organize tasks more easily and quickly and plan their responsibilities and working hours. This contributes to simple and efficient remote operations. In addition, the pandemic has fuelled innovation in digital tools and platforms and increased the digitalization of business processes. However, for digital tools and software to meet their purpose, training is a necessity. As a result of this development, the need for a digitally competent workforce has increased (Radović-Marković, Djukanovic, 2022).

Finally, it can be concluded that knowledge is one of the most important factors in economic development and the goal of every country should be directed toward building a knowledge-based economy (Dimitrijevic, Mijailovic, 2021). Without the appropriate knowledge, gaining the trust of employers and flexible organizational culture, many countries will not meet this challenge by 2025.

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Educational Characteristics of Students - Victims of Cyberbullying
Macanović, Nebojša and Stojanović, Ružica

Abstract: An increasing number of children and young people are exposed to peer violence via the Internet, but despite this, the fact that it is still not sufficiently recognized as a serious problem in society is worrying. The virtual world gives bullies anonymity, dominance, courage, a sense of security and power. By being involved in the virtual world, children and young people, victims of violence, always experience violence again and feel helpless and depressed, because they cannot fully influence the violent content. In our research, we were based on secondary school students, because they are the most vulnerable category when it comes to violence on the Internet. The subject of the research includes identifying the presence and forms of cyberbullying among secondary school students in the municipality of Modriča, as well as researching the relationship between the manner of cyberbullying and the educational characteristics of students – the victims of cyberbullying. The results of the research indicate that out of the total number of respondents, 39.7% of them were victims of cyberbullying, and when it comes to educational indicators, the victims of cyberbullying are mostly students with excellent and very good results.

Keywords: violence, cyberbullying, students, school.

1. INTRODUCTION

The rapid and dynamic development of digital technologies, and especially social media, has led to the growth of online socialization, and a reduction in the number of contacts in real life. People connect much more intensely and great geographical distances are not a problem for everyday communication. However, with too much openness on the Internet, people, especially children, have become more exposed to various forms of public humiliation and ridicule. All those who are present on social networks can become victims of digital violence at any time.

Before the development of modern technologies, peer violence took place on playgrounds, in parks, in school hallways, and on the street, and it was much easier to spot and react to it. Today, everything happens in the "virtual world", but that does not diminish the seriousness of this problem. A child or young person may still be exposed to various forms of violence, and other children may still be involved who may not take on the role of the abuser but will not prevent violence; however, what is particularly worrying is the fact that a child cannot escape this violence and it never stops. Every day, the child "carries his abuser inside him", which is why peer violence via the Internet is especially worrying and difficult to recognize. The consequences of online violence can sometimes be more serious than those caused by peer violence in real situations, because the audience can be much larger, and due to anonymity, the perpetrators can be more cruel and violent than in the real world. Today, schools are places where victims of violence are found, looking for reasons for attacks and abuse via the Internet, and for that reason, we wanted to determine how much some educational indicators of students can be related to violence on social networks. Anyone can be an abuser today on any of the social networks at any occasion and temporal environment, but also a victim of such violence. It is this issue that prompted us to point out, through an empirical study, how much this phenomenon is present among secondary school students and what the educational characteristics of students, who are most often victims of cyberbullying, are.

2. THE CONCEPT AND CHARACTERISTICS OF CYBERBULLYING

Like most of the terms belonging to the sphere of information and communication technologies, digital violence is a relatively new
phenomenon that has become the subject of serious scientific discussions in recent decades. There are several definitions of digital violence, and some are more general and include all forms of harassment using digital technologies, while others focus on specific forms of digital violence. [1] However, the most important thing is mutual violence in the physical world and digital violence, so that the consequences are felt in the physical world and the space in which violence occurs in a new and different challenge.

The term most commonly used when it comes to Internet violence is cyberbullying. Cyberbullying is any form of peer violence in cyberspace or the imagined world. It is characteristic of cyber violence that a person can constantly experience inconveniences, in an apartment, in a cafe, or at school, and that can last 24 hours a day. Cyberbullying is a relatively new concept in the world, but also in our country and is constantly growing. [2]

Cyberbullying is a very broad term and can refer to all online behaviours that are committed with the goal of attacking one's mental, moral, emotional, or social integrity. [3] Further, digital violence can be seen as a modern form of peer violence that is carried out through the media, with the aim of humiliating and belittling the victim.

Many domestic and foreign authors have spoken about the characteristics of cyberbullying [4]; [5]; [6]; [7]; [8]; [9]; [10]. Olweus [6] states that cyberbullying has all the characteristics of traditional peer violence because it is aggressive behaviour that is expressed through negative actions and it is always intending to hurt the victim. Further, there is always disproportionate power between the victim and the perpetrator, and what is important to emphasize cyberbullying is characterized by repetitiveness. The most common reasons for cyberbullying are the physical appearance of the victim and academic achievement, i.e., intelligence. Certainly, often some anomalies and physical shortcomings can be a sufficient reason to ridicule, insult, and belittle the victim via the Internet. In addition, their school achievement, intelligence, and abilities often cause envy in others who do not have such affinities and abilities, which is why they are often the target group for violent attacks through various social networks, where in such circumstances some of their statements are taken out of context to present themselves as villains or narcissistic persons. Financial status can be a reason for attacks via the Internet and social networks. The reason may be a poor financial situation which causes the victim to be ridiculed and insulted, but the victim can also be a person of good financial status, where other reasons for the attack are often sought to later extort money from the victim. This type of digital racketeering is more and more present. Further, one of the reasons why cyberbullying occurs is religion and ethnicity. Often belonging to a religious community, skin colour, and origin can be a reason for cyberbullying. In particular, these attacks were expressed during some religious holidays or other significant events for that religious community. Sexual orientation is a phenomenon that is often the cause of cyberbullying. As in the previous factors, this one leaves unforeseeable consequences for the victim, who in such circumstances often tries to commit suicide, because she cannot cope with the everyday problems and attacks she experiences. [11]

When we talk about peer cyberbullying, we can say that there are certain signs of recognition. However, this type of violence is more difficult to recognize than traditional forms of violence. Some of the most common indicators that warn of the presence of cyber violence in children are depression, anxiety, low self-esteem, social isolation, poor school performance, anxiety after using a computer or mobile phone and impaired health. The most common consequences of cyberbullying are low self-esteem, suicidal thoughts, frustration, depression, fear, retaliation, etc. Electronic violence can leave more consequences than traditional violence because it can occur at any time and anywhere in the virtual world. [12] Cyberbullying is a problem that threatens the physical and mental health of young people because it is linked to depression, anxiety, suicidal behaviour, substance abuse, declining school performance, and homicides in the school environment. [13] Although another person cannot be physically harmed during communication in the digital world, cyberbullying has negative consequences for people's psychophysical health, the behaviour of children and adults, and emotional and social functioning of people. [14] Also, content that is degrading and offensive to a person can be seen by a large number of people in a short time, which can prolong the course of abuse of the same person by persons who are not in direct contact with him. In addition, the same content can remain permanently online, and follow the person throughout his life. Inappropriate and offensive content can be made available to a large number of people, making the victim of violence even
more helpless. If persons are verbally assaulted, they are unlikely to remember every word sent to them by the abuser, while in the case of cyberbullying, a person can re-read the message sent to them every day through the means of communication. Therefore, we can say that cyberviolence brings with it traumatic consequences in the form of unpleasant feelings that can last a lifetime. [12] The results of one study tell us that 93% of students who have suffered cyberbullying feel sad, depressed, anxious and hopeless, 31% of students feel very upset, 19% feel hurt and 18% of students feel ashamed. [14]

Social networks are the basis through which internet violence occurs, through insults, threats, hacking profiles, stalking, spreading false information, abuse, etc. A concrete example of cyber violence on social networks is groups that are founded against someone or something, in which a large number of children and young people join. [15] Among the most famous and popular social networks are Facebook, Instagram, Twitter, YouTube, Blog, TikTok, etc. Social networks enable children, young people and adults to share their thoughts and ideas, but also hatred towards others to the general public. There are numerous researches on cyber violence in the world, the region and in our country. In 2012, IPSOS conducted a survey on cyberbullying on a sample of 18,687 citizens in 24 countries (Italy, Spain, France, Belgium, Poland, Germany, Hungary, Russia, Sweden, UK, China, Japan, India, Indonesia, South Korea, Turkey, Canada, USA, Brazil, Argentina, Mexico, Saudi Arabia, South Africa, Australia). The survey showed that as many as 66% of respondents are aware that there is cyberbullying and that they have seen, read or heard something about this problem. 3% of respondents said that children were regularly victims of cyber violence, 21% several times, while 6% of respondents said that children were victims once or twice. 12% of parents stated that their child was a victim of cyberbullying. The highest number of cases of cyber violence exists in India (32%), Brazil and Saudi Arabia (19%), and 15% in the United States. [16]

A study on youth was conducted in Bosnia and Herzegovina, which shows that 85% of citizens access the Internet every day, and more than 75% have an Internet connection in their place of residence. 95.1% of respondents said they have a Facebook profile and use it daily, 83% use Viber daily, 74.7% have an Instagram profile, and 72.9% of respondents visit YouTube daily. These social and communication networks are most often used in BiH. When it comes to harassment and abuse on the Internet, 51.4% of respondents said that someone once posted information or a photo without his or her permission, 39.9% said that an indecent comment was posted on a social network about them, and 30.6% of respondents confirmed that they were or were victims of threats on a social network. Every third person has experienced that someone used information about them to embarrass or tease them. 49.4% of respondents stated that the reason for harassment on the Internet was a hobby or interest, way of dressing (46.9%), 29.6% stated that the reason was religious, ethnic or racial, and 11.1% of respondents stated that the reasons were good grades in school or college and cite jealousy as the reason. When it comes to harassment by respondents, 22.3% stated that they once made an obscene comment about someone, 22.6% that they posted a photo or information without the permission of another person, and only 3.2% admitted that they consciously published a lie about someone. [17]

In addition to its educational character, the school also has an important educational role. Starting from that, the school must not only react to every violence that happens in it, but it also should work on preventing it from happening at all, that is, to take all necessary preventive activities, including the move toward repressive measures, as an indicator to other perpetrators of what awaits them if they follow in the footsteps of the perpetrator who is being punished. A school is a place where cases of violence often occur, but it is also a place where violence should be prevented through effective activities and joint action of students, teachers and parents. All employees in the school have certain obligations in both preventive and intervention activities, but the school is also obliged to form a special team for protection against violence, as a result of full commitment to the protection and prevention of violence in schools. [18]

Schools will not be able to transform into non-violent schools until they have incentives from outside that will be able to initiate changes in the school itself, and be the initiator of various programs and forums. Therefore, it is important that through the implementation of prevention programs to combat peer violence in schools to achieve internal change in the school itself, which will perceive the creation of a nonviolent environment in the school as an open process and close cooperation that seeks to remove barriers to strengthen the competencies of the
school and its participation in the education of all children, and maximum commitment to children and the needs of children. These changes will mean a change in attitudes and value systems in the school, will ensure the emphasis on the importance and value of individualization and strengthening the individual's personality versus the collective, and nurturing and respecting diversity, bringing all in the collective to the same thinking. [19]

3. RESEARCH METHODOLOGICAL FRAMEWORK

3.1. Research Aim

The research aims to determine the presence and manner of cyberbullying among high school students in the municipality of Modriča, as well as the educational characteristics of students - victims of cyberbullying.

3.2. Research Hypotheses

Main hypothesis: We assume that cyberbullying is present at high schools in the municipality of Modriča and that there is a statistically significant difference in cyberbullying among students in Modriča's secondary schools concerning the educational characteristics of respondents.

Particular hypotheses:

H1. Various forms and methods of cyberbullying can be identified and determined among students at the Public Institution Secondary School Centre "Jovan Cvijić" Modriča.
H2. We expect that there is a statistically significant difference between the forms and methods of cyberbullying determined among students at the Public Institution Secondary School Centre "Jovan Cvijić" Modriča and their school performance.
H3. We assume that there is a statistically significant difference between the forms and methods of cyberbullying that occur in students at the Public Institution Secondary School Centre "Jovan Cvijić" Modriča and the classes they attend, i.e. the school grade.

3.3. Research Variables

Within the research, variables are defined, which are integral parts of the defined research hypotheses.

The independent variables:

- School performance;
- School grade.

Dependent variables:

- Abuse through pictures and videos from the phone;
- Abuse via SMS;
- Email abuse;
- Abuse through telephone calls;
- Website abuse;
- Abuse through interactive games;
- Abuse by sending pornographic content;
- Attack through password theft and profile hacking.

3.4. Research Methods and Techniques

In this research, we used general and basic scientific methods, i.e. induction and deduction methods, analysis and synthesis methods, testing method, content analysis method, statistical method, comparative method and theoretical description method.

To investigate the frequency and characteristics of cyberbullying problems, we used the survey method, using a survey technique. For this research, a questionnaire consisting of 21 questions was constructed. Processing of research results was realized using the software package for statistical data processing SPSS 21.00 for Windows.

3.5. Research Population and Sample

The population from which the research sample was structured represented the total number of secondary school students in the municipality of Modriča. The research sample consists of 343 students of both genders and from all four grades of several secondary schools (Gymnasium, School of Economics and Electrical Engineering School) in the Public Institution SSC "Jovan Cvijić" in the municipality of Modriča. The age of the respondents ranges from 15 to 18 years of age. The research period covered the period from December 2020 to February 2021.
4. **RESEARCH RESULTS AND DISCUSSION**

4.1. Presence of Cyberbullying in Secondary Schools in the Municipality of Modriča

The first special hypothesis (H1) that we set in our research was related to the identification and determination of various forms and methods of cyberbullying among secondary school students in the municipality of Modriča. To test this hypothesis, we analysed the data we collected on the presence of cyberbullying victims. We also analysed the number of victims according to the forms and methods of cyberbullying.

**Table 1. Presence of cyberbullying in secondary school students**

<table>
<thead>
<tr>
<th>Students victims of cyberbullying</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>136</td>
</tr>
<tr>
<td>No</td>
<td>207</td>
</tr>
<tr>
<td>Total</td>
<td>343</td>
</tr>
</tbody>
</table>

Looking at the data presented in Table 1, we notice that out of 343 surveyed students in secondary schools, 136 or 39.7% of them stated that they were victims of cyberbullying, and 207 or 60.3% of students answered that they were not victims of cyberbullying. Based on the presented data, we can determine that a far higher number of students answered that they were not victims of violence via the Internet. However, the numbers show us that cyber violence is present among the students at the Public Institution Secondary School Centre "Jovan Cvijić". However, there is a possibility that some students answered incorrectly, e.i. that some students answered out of fear that they were not victims of cyberbullying because they think that if they did, they could be targeted by cyberbullies again.

4.2. Forms and Manners of Committing of Cyberbullying in Secondary Schools in the Municipality of Modriča

In Table 2, we show the relationship between the number of victims and the forms and manner of committing cyberbullying. That is, according to the data we collected from students, we stated how many students were victims of certain forms and ways of committing cyber violence.

**Table 2. Overview of the manner and forms of cyberbullying in relation to the number of victims**

<table>
<thead>
<tr>
<th>Victims of cyberbullying through various forms</th>
<th>SMS messages</th>
<th>Tel. calls</th>
<th>Images</th>
<th>E-mail</th>
<th>Chat rooms</th>
<th>Web sites</th>
<th>Porn. contents</th>
<th>Online games</th>
<th>Profile hacking and password theft</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>20</td>
<td>20</td>
<td>19</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>15</td>
<td>10</td>
<td>21</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>14,7%</td>
<td>14,7%</td>
<td>14%</td>
<td>5,9%</td>
<td>8,8%</td>
<td>8,1%</td>
<td>11%</td>
<td>7,4%</td>
<td>15,4%</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
<td>19</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>15</td>
<td>10</td>
<td>21</td>
<td>136</td>
</tr>
</tbody>
</table>
The data shown in Table 2 indicate that of the total number of students who admitted to being victims, 20 or 14.7% were victims of cyberbullying by sending inappropriate and offensive text messages, and 20 or 14.7% of students were victims of cyberbullying through phone calls. 19 or 14% of students were victims of cyberbullying by receiving inappropriate and offensive images. 8 or 5.9% of students were harassed and abused by email, and 12 or 8.8% of students in chat rooms. 11 or 8.1% of students were abused and harassed through websites. We found that 15 or 11% of students experienced abuse through obtaining pornographic content, and 10 or 7.4% of students through interactive games. 21 or 15.4% of students experienced an attack through profile hacking and password theft.

Analysing the presented data, we can see that the most pronounced forms and ways of cyber violence are those that manifest themselves via mobile phones, i.e. by sending harassing and malicious SMS messages, pictures and making calls. The reason for this is the fact that almost all young people during adolescence own a smartphone and spend most of their free time using the services of the Internet and smartphones, so they are exposed and become a target of cyber bullies.

Among the most present ways and forms of manifestation of cyber violence are profile hacking and password theft. We are also witnesses here that all surveyed students have a profile on one of the social networks, and that sometimes they do not protect their accounts out of ignorance, so they can easily become victims of cyberbullying. Further, we can also single out cyber violence by sending porn content as one of the more present forms of internet violence in secondary schools in the municipality of Modriča. It could be said that one of the reasons is that in this period young people are still not mature enough to be able to judge for themselves who they should contact, i.e., they are still not able to protect themselves from paedophiles and people who refer such content to others.

4.3. The Presence of Forms and Methods of Cyberbullying Among Students in Relation to School Performance

The second particular hypothesis (H2) that we set in our research was whether there is a statistically significant difference between the forms and methods of cyberbullying that occur in students at the Public Institution Secondary School Centre "Jovan Cvijić" and school performance.
Table 3. Presence of forms and manners of cyberbullying in relation to school performance of secondary school students

<table>
<thead>
<tr>
<th>Forms and manner of cyberbullying in victims</th>
<th>The school performance of students who are victims of cyberbullying</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excellent</td>
</tr>
<tr>
<td>SMS messages</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>Telephone calls</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>65%</td>
</tr>
<tr>
<td>Images</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>52,6%</td>
</tr>
<tr>
<td>E-mail</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>50%</td>
</tr>
<tr>
<td>Chat rooms</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>50%</td>
</tr>
<tr>
<td>Web sites</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>54,5%</td>
</tr>
<tr>
<td>Pornographic contents</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Online games</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Profile hacking and Password theft</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>38,1%</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>40,4%</td>
</tr>
<tr>
<td>Df</td>
<td>24</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

Analyzing the data from Table 3, we see that out of a total of 136 students who were victims of cyberbullying, 55 or 40.4% were students with excellent results, 53 or 39% were students with very good results, 27 or 19.9% are students with good results, while 1 or 0.7% are students with satisfactory school performance. Of the total number of students, 20 students answered that they were abused and harassed by receiving SMS messages, of which 3 or 15% are students with excellent results, 8 or 40% are students with very good results, then 9 or 45% are students with good results, and there were no students with satisfactory school performance. Then, 20 students answered that they were victims of cyberbullying by receiving harassing phone calls, and of that number, 13 or 65% are students with excellent results, 6 or 30% are students with very good results, then 1 or 5% of students with good school performance. There
were no students with satisfactory school performance. 19 students answered that they were abused and harassed by receiving disturbing and inappropriate pictures, of which 10 or 52.6% were students with excellent school results, 6 or 31.6% were students with very good results and 3 or 15.8% are students with good results. Also, 8 students answered that they were harassed by receiving emails, i.e. 4 or 50% are students with excellent results, 3 or 37.5% are students with very good school results and 1 or 12.5% are students with very good school results, while no student with satisfactory school performance has been a victim of cyberbullying in this way. In the chat rooms, 12 students experienced cyberbullying, i.e. 6 or 50% were students with excellent results, 4 or 33.3% were students with very good results, 2 or 16.7% were students with good results, and none the student with satisfactory school performance was not abused in this way. 11 students experienced cyber violence through content from websites, i.e. 6 or 54.5% are students with excellent results, 4 or 36.4% are students with very good school results, and 1 or 9.1% are students with good school performance. Interestingly, no student with satisfactory school performance responded that he had been abused in this way. We found that 15 students experienced abuse through receiving pornographic content, i.e. 3 or 20% were students of excellent school performance, 7 or 46.7% were students of very good school performance, and 5 or 33.3% were students with good school performance. We found that 10 students answered that they were victims of cyberbullying while playing interactive games, i.e. 2 or 20% are students with excellent results, 6 or 60% are students with very good results, then 1 or 10% are students with good school results, and 1 or 10% is a student with satisfactory school performance. 21 students experienced an attack through password theft and profile hacking, i.e. 8 or 38.1% are students with excellent results, 9 or 42.9% are students with very good school results, 4 or 19% are students with good results, and no student with satisfactory school performance responded that he/she had been abused in this way.

According to the obtained data, we can conclude that students with better school performance, i.e. excellent and very good results are more endangered compared to students with poorer, i.e. good and satisfactory school performance results.

4.4. Presence of Forms and Manners of Performing Cyberbullying Among Students in Relation to the Class that Students Attend

The third special hypothesis (H3) that we set in our research was whether there is a statistically significant difference between the forms and manners of cyberbullying that occur in students at the Public Institution Secondary School Centre “Jovan Cvijić” and the classes attended by students.

From the data presented in Table 3, we found that there is a statistically significant difference between the form and manner of cyberbullying and school performance. This fact is confirmed by the calculated chi-square. The determined $\chi^2 = 23,639$ at $df = 24$ is statistically significant at 0.05, thus confirming our second hypothesis.
Table 4. Presence of the form and manner of performing cyberbullying in relation to the class attended by students

<table>
<thead>
<tr>
<th>Forms and manner of cyberbullying in victims</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMS messages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telephone calls</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>25%</td>
<td>35%</td>
<td>15%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>Images</td>
<td>9</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>45%</td>
<td>5%</td>
<td>30%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>E-mail</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>31.6%</td>
<td>10.5%</td>
<td>26.3%</td>
<td>31.6%</td>
<td>100%</td>
</tr>
<tr>
<td>Chat rooms</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>37.5%</td>
<td>0%</td>
<td>50%</td>
<td>12.5%</td>
<td>100%</td>
</tr>
<tr>
<td>Web sites</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>25%</td>
<td>41.7%</td>
<td>8.3%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>Pornographic contents</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>36.4%</td>
<td>9.1%</td>
<td>18.2%</td>
<td>36.4%</td>
<td>100%</td>
</tr>
<tr>
<td>Online games</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>26.7%</td>
<td>20%</td>
<td>33.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Profile hacking and password theft</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>20%</td>
<td>20%</td>
<td>30%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>42.9%</td>
<td>28.6%</td>
<td>19%</td>
<td>9.5%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>28</td>
<td>30</td>
<td>33</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>33.1%</td>
<td>20.6%</td>
<td>22.1%</td>
<td>24.3%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Based on the data from Table 4, we see that out of a total of 136 students who answered that they were victims of cyberbullying, 45 or 33.1% of them are first-grade students, 28 or 20.6% are second-grade students, then 30 or 22.1% are third graders, while 33 or 24.3% are fourth graders. Out of the total number of students, 20 students answered that they were abused and harassed by receiving SMS messages, of which 5 or 25% are first-grade students, 7 or 35% are second-grade students, then 3 or 15% are third-grade students, and 5 or 25% are fourth graders. In addition, 20 students answered that they were victims of cyberbullying by receiving harassing phone calls, and out of that number, 9 or 45% are first-grade students, 1 or 5% are second-grade students, 6 or 30% are third-grade students, and 4 or 20% are fourth graders. Then, 19 students answered that they were abused and harassed by receiving disturbing and inappropriate pictures, of which 6 or 31.6% were first graders, 2 or 10.5% were second graders, 5 or 26.3% were third-grade students, and 6 or 31.6% are fourth-grade students. 8 students answered that they were harassed by receiving e-mail, i.e. 3 or 37.5% are first-grade students, 4 or 50% are third-grade students.
students and 1 or 12.5% are fourth-grade students, while no student from the second grade was not a victim of cyberbullying in this way. In the chat rooms, 12 students experienced cyber violence, i.e., 3 or 25% are first-grade students, 5 or 41.7% are second-grade students, 1 or 8.3% are third-grade students, and 3 or 25% are students from fourth grade. 11 students experienced cyberbullying through websites, i.e. 4 or 36.4% are first-grade students, 1 or 9.1% are second-grade students, 2 or 18.2% are third-grade students, and 4 or 36.4% are fourth graders. We found that 15 students experienced abuse through receiving pornographic content, of which 3 or 20% were first graders, 4 or 26.7% were second graders, 3 or 20% were third graders, and 5 or 33, 3% are fourth graders. Ten students answered that they were victims of cyber violence while playing interactive games, i.e. 3 or 30% are first-grade students, 2 or 20% are second-grade students, then 2 or 20% are third-grade students, and 3 or 30% are fourth graders. 21 students experienced an attack through password theft and profile hacking, i.e., 9 or 42.9% are first-grade students, 6 or 28.6% are second-grade students, 4 or 19% are third-grade students, and 2 or 9.5 % are fourth graders.

Looking at the data as a whole, we found that there is no statistically significant difference between the form and manner of cyberbullying and the classes they attend. This fact is confirmed by the calculated chi-square. The determined \( \chi^2 = 23,639 \) at df = 24 is not statistically significant, which means that we have not confirmed this hypothesis. Considering all the data we obtained, we can conclude that the occurrence of cyber violence is not conditioned by the class that students attend. That is, all forms and methods of cyberbullying are present in all classes in secondary schools.

5. CONCLUSION

We can talk about the presence of cyberbullying in high schools based on the number of identified victims and the number of students who admitted that they once abused others on the Internet. Based on the obtained results, we determined that there are students who are victims of violence on the Internet (39.7%), but also students who have committed violence against others (28.3%). All forms of cyberbullying are present among secondary school students in the municipality of Modriča. Hacking of profiles and theft of passwords (15.4%) appear as the most common form and manner of cyberbullying in secondary schools in the municipality of Modriča. In addition, other forms and methods of cyberbullying that appear in a high percentage are sending harassing SMS messages (14.7%), making harassing phone calls (14.7%), and sending harassing pictures (14%). We have identified that there is a connection between the manner of cyberbullying and the educational and demographic characteristics of secondary school students in the municipality of Modriča. We found that there is a statistically significant difference between the way cyberbullying is done and the school performance of students. Further, we found that there is no statistically significant relationship between the way cyberbullying is done and the classes that students attend. Boys were more likely to be victims of cyberbullying (55.1%). With the arrival of a new generation of students, i.e., the students who were in the first grade at the time of the survey (33.1%), there was an increase in the number of students who were victims of cyber violence compared to the number of victims in the second (20.6%), third (22.1%) and fourth (24.3%) grades of secondary schools. Cyber violence was present in all four grades, and there was an increase in the first-grade students (33.1%). In the research, we came to the result that the victims of cyber violence were more often students with better school performance. It is their school achievement, cognitive abilities, excellence in classes, and achievements from various competitions that can be the reason for bullying and peer violence via the Internet. It is these data that indicate how important the educational characteristics of students are in the research of the other side, i.e. abuser personality structures and reasons for virtual attacks. What is especially indicative is that in the analysis of data related to the purpose of using the Internet and social networks, we found that 100% of surveyed students have a profile at least on a social network. Facebook (47.2%) and Instagram (30.9%) stood out as the most popular social networks.

Numerous researches on violence on the Internet point to the problems of all those factors that should be the foundation of a child’s healthy growing up, and those are primarily the family and the school. Parents’ computer illiteracy, insufficient control of children both at home and inside while using smartphones or other devices, insufficient communication with children about daily activities, and lack of understanding of their needs greatly increase the risk of such children.
seeking attention and interlocutors on social networks. Inappropriate content and photos, comments, and thus become a potential victim of cyberbullying.

The school, on the other hand, directs its potential to education by putting the upbringing of students in the background or leaving that role primarily to parents. Assessment is a measure of everything, not preparing children for life, work and learning. Violence is present in schools, in their yards, parks, and hallways, but in addition to the visible physical and verbal violence today under the influence of information - communication development takes completely different forms, which are much more dangerous and devastating for children and youth.

Today, children and young people grow up with smartphones and social networks and they are an integral part of their daily lives, but we must be aware that they will become both an inevitable and growing companion of their growing up. That is why it is necessary to understand the real risks and problems that cyberbullying brings and to protect young people, but also the adult population.

REFERENCES


Nebojša Macanović, was born on January 1, 1977, in Banja Luka. He finished primary and secondary school, as well as the Faculty of Philosophy in Banja Luka. He graduated in 2001, from the Department of Pedagogy, with the topic Development of military schools in Serbia in the period from 1804 to 1918. In 2008, he defended his master's thesis at the Faculty of Philosophy in Banja Luka ‘Acceptance of institutional re-educational treatment, imprisonment, rejection of the prison code and the success of resocialization of convicts’, and in 2012 the doctoral dissertation Criminogenic infection, its characteristics and the possibility of prevention and resocialization of students and juvenile delinquents in primary and secondary school. He works at the Faculty of Political Sciences as an associate professor in the subjects of pedagogy, social pedagogy, pedagogical resocialization, prevention of conflict and peer violence at school. From 2004 to 2010, he was employed at the Penitentiary and the Banja Luka Correctional Facility as an assistant director for treatment. He has published fifteen books, and over a hundred scientific and professional papers in the field of pedagogy, social pedagogy, pedagogical resocialization, prevention of conflict and peer violence at school. He is the president of the Center for Modern Knowledge and the coordinator of numerous projects in the field of education, media inclusion of persons with disabilities, children's rights, prevention and resocialization of juvenile offenders and lifelong learning. He is the editor-in-chief of the collection of papers published within the international scientific conference "Social Deviations" and a reviewer of numerous journals from the region and Europe. He is married and the father of three children. (e-mail: nebojsa.macanovic@fpn.unibl.org)

Ružica Stojanović was born on December 11, 1996 in Doboj. She graduated from Gymnasium in Modriča. After graduating from high school, in the academic year 2014/2015 she enrolled at the Faculty of Political Sciences in Banja Luka, study program Social Work. She graduated on November 5, 2019, defending her dissertation entitled "Social Protection in the Municipality of Modriča" - on the subject of Social Policy. She graduated with a master's degree in Social Work in the field of Mediation at the Faculty of Political Science, the University of Banja Luka in 2021. She has published several scientific and professional papers and is the co-author of a scientific monograph entitled Violence on the Internet - cyberbullying. She has also participated in three international scientific conferences and shows special interest in the social protection of children with special needs. She is employed at the Day Care Center for Children with Special Needs "Sunc Oberwallisa" in Modriča.
Internet Sex Addiction in Serbia and Montenegro
Đukanović, Borislav; Petrušić, Irena; Bandalović, Gorana; Maksimović, Ana; and Banović, Silva

Abstract: In this study, the authors analyzed the problematic use of pornographic websites and Internet sex addiction in representative samples of respondents from different age groups including 2948 respondents from Serbia and 1486 from Montenegro. A standard questionnaire of 33 questions with answers in binary form was used. In addition to epidemiological indicators, the study also included nine family risk factors and six risk factors associated with early psychosocial developmental disorders. Finally, the social profiles of Internet sex addicts in Serbia and Montenegro were described. The results of the research showed that Internet sex addicts are mostly young adults aged 20 to 30. The overall dependency rate was estimated within average limits. In general, Internet sex addiction is among the lowest of all behavioral addictions. The authors see the reason for this in the greatest potency of this addiction for the development of addictive patterns of behavior, but also in the great predictiveness of this addiction together with the gambling addiction for the emergence and development of other behavioral addictions. All examined risk factors (except for shyness and reticence) do "separate" Internet sex addicts from those who do not have the listed risk factors at zero level of significance. However, an examination of the prediction of Internet sex addiction using binary logistic regression showed that aggressive and criminal behaviors in early youth, followed by disorders in educational and emotional relations between parents and children, have the highest predictive values for Internet sex addiction. Social profiles are unclear and unstructured, and the authors explain this by the fact that biological, not sociological, and sociocultural factors play a dominant role in developing addictive patterns of behavior.

Keywords: Internet sex addiction, risk factors, social profiles

1. INTRODUCTION

Internet sex addiction is not a special category of behavioral addiction, but only a special form in which all the symptoms of sex addiction are manifested, although phenomenologically it does show some specifics that can in no way justify its separation into a special addictive pattern. Therefore, first of all, it is necessary to briefly analyze the basic characteristics of this addiction. According to the DSM-4 classification of numerous behavioral addictions, only gambling addiction has been given the status of a special clinical category, even though sex addicts show symptoms of addictive behavior.

Today, it is considered that sex "addiction" is present if there are three or more out of eight symptoms listed below:

1. Constantly repeated failure of addicts to resist sexual impulses to engage in compulsive sexual behavior.
2. Frequent engagement in these behaviors to a greater extent or for a longer period than planned.
3. Addicts' persistent desire or failed attempts to stop or control themselves.

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4. Preoccupation with sexual behavior or preparatory activities (rituals) for the realization of these behaviors.
5. Excessive engagement of addicts in compulsive sexual behaviors, although expectations of fulfilling professional, family, and social obligations are in the foreground.
6. Continuation of compulsive sexual behaviors, despite ongoing social, financial, psychological, and marital problems caused by these behaviors.
7. Limiting or giving up social and professional activities due to sexual behavior.
8. Disturbance, anxiety, restlessness, and irritability in anticipation of engaging in compulsive sexual behavior.

Like other behavioral addicts, sex addicts experience a loss of control over the use of pornographic content (they lose orientation in time, even in the social context). There is a constant increase in tolerance - addicts spend an increasing amount of time on pornographic websites or in the compulsive search for sexual partners using electronic media, etc. The rise of unhealthy fantasies also inspires various aspects of deviant sexual behavior. It is important to point out that compulsive use of Internet sites with sexual content is usually the initial phase in developing the addiction.

The same compulsive behavior that characterizes other addictive diseases is typical for sex addiction. Like alcoholics and drug addicts, sex addicts show mental distortions and use immature and neurotic defence mechanisms while justifying their deviant behavior and blaming others for it. They have little or no insight into their problems in almost all spheres of life and completely uncritically justify their behavior that has led to the problems of sex addiction. Of all addictions, sex addiction is the most difficult to control. Sex addiction syndrome is a complex mixture of biological, psychological, cultural, and family factors, a combination that creates and intensifies compulsive sexual behaviors and indicates that such behaviors are almost impossible to resist even though sex addiction produces many negative consequences in various spheres of life.

The explanation is hard to find in psychosocial relationships. From a biological point of view, it has been shown that some formations in the right temporal lobe make individuals dependent on sex from birth. The inability to control sexual impulses is related to the neurochemical imbalance in the noradrenaline, serotonin, and dopamine systems.

Common sense and most public opinion suggest that addiction is most often associated with hypersexuality - the pursuit of frequent sexual intercourse not only every day but several times during the day and night, whether in heterosexual or homosexual relationships or combined. However, persons with such habits are still a minority among sex addicts. Compulsive sexual activities can manifest in several other ways. These often include watching pornographic images and movies, constantly accessing websites with sexual content, compulsively collecting and viewing printed material with sexual themes, images, and content, placing personal ads with sexual offers, running a "chat room" on the Internet with sexual allusions and offers, using "hot" telephone lines, etc. All these activities are, as a rule, accompanied by frequent and intense masturbation. These compulsive activities are usually introductory to the onset and development of sex addiction and are a regular companion of this addiction. At the same time, frequent changes of sexual partners (one-night stands) occur as well as more or less regular use of prostitution services, etc.

As with all other behavioral addictions, addiction to pornography presents an escape from reality into actual reality, caused by several biological, psychological, and social factors. Excessive viewing of pornographic content significantly shortens the time for real-life activities, leads to neglecting professional activities, family obligations, serious disorders of family life, divorce, moral condemnation, stigmatization, and conflict with the law due to deviant sexual activities. Just like other addicts, an Internet sex addict compulsively surfs the Internet sites with sexual content and engages in other pornographic content. If they are prevented from accessing sexually explicit websites or viewing other pornographic material for any reason, the "abstinence syndrome" occurs,
which includes psychological and vegetative symptoms, sleep and eating disorders, as well as other behavioral addictions.

Internet sex addicts can perform various life activities, including professional ones, only when their compulsive need for pornography is satisfied. Sometimes, when searching for pornographic content on the Internet, they ask for the tacit support of their superiors, and not infrequently, that support is a condition for accepting the job. In more serious forms a public disorder occurs, which includes strong sexual arousals towards objects and actions that are considered less conventional and less accessible to sex addicts. The syndrome includes fetishism (strong sexual arousal from objects or parts of the partner’s body or clothing), voyeurism (strong sexual arousal by observing sexual behavior), exhibitionism (strong sexual arousal when others watch one’s sexual behavior), and pedophilia (arousal due to sexual contact with children).

In this study, we focused on researching problematic and addictive behavior related to Internet sex in Serbia and Montenegro.

2. RESEARCH METHODOLOGY

This is the first representative study of 11 behavioral addictions in Serbia and Montenegro. On this occasion, we singled out Internet sex addiction. Since this is a pioneering research, it primarily has an exploratory character.

2.1 Objectives

The first objective is to determine the prevalence of problematic Internet sex and Internet sex addiction in Serbia and Montenegro.

The second objective is to examine the risk factors for Internet sex addiction.

The third objective is to describe the social profiles of Internet sex addicts in Serbia and Montenegro.

2.2 Samples

The three-stage stratified and random samples from Serbia and Montenegro consist of three subsamples:

The sample from Serbia consists of a subsample of 1636 (55.5%) students in the eighth grade of primary schools and all grades of secondary schools, aged 13 to 19 years, and a sound sample of 579 (19.6%) young adults aged 20 to 30 years and a subsample of 773 adults aged 31 to 69 years. The total sample included 2948 respondents.

The sample from Montenegro also consists of three subsamples - a subsample of 903 (61.5%) students in the eighth grade of primary schools and all grades of secondary schools, aged 13 to 19, a subsample of 279 (19.0%) young adults aged 20 to 30, and a subsample of 287 (19.3%) adults aged 31 to 78 years. The total sample included 1486 respondents.

2.3 Research Instrument

In addition to socio-demographic characteristics and questions about risk factors, the questionnaire also contained 33 questions about various aspects of Internet sex addiction with answers in a binary form.

2.4 Data Processing and Analysis

Data were processed in the SPSS program. In addition to descriptive statistics, t-tests, ANOVA, correlation coefficients, and binary logistic regression were used.

3. RESULTS

3.1 Epidemiology of the Problematic Use of Pornographic Sites and Addiction to Them

Pornography is a big business. Only in 2006, revenue from the pornography industry was $97 billion. Every second, about $3000 was spent on pornography in the United States at the end of the century. These findings are indirectly supported by the fact that Internet sites with sexual content are the most visited and come immediately after sports sites. The reason for such widespread use is that sexually explicit websites are available to all ages and all social strata at any time, especially on the
Internet. By 1997, there were about 900 pornographic sites on the Internet. Just a year later, that number grew to between 20000 and 30000. These sites differed significantly in the number of paying users - from several hundred to several thousand people. Revenues skyrocketed [12]. The growth in popularity of these sites is associated with three characteristics: availability, accessibility, and anonymity [49].

In the Serbian sample of 2877 respondents who completed the questionnaire for examining addiction to Internet sites with sexual content, 2318 of them (80.6%) reported having no problems due to viewing sexually explicit websites and showed no symptoms of addiction; 386 (13.4%) do have problems, and 173 (6.0%) show symptoms of addiction. In the Montenegrin sample of 1489 respondents, 1134 (77%) have no problems due to viewing sexually explicit websites, 287 (19.5%) do have, 51 (3.5%) are addicted to Internet sex, and 17 (1.1%) of them did not respond.

Internet sex addiction is more expressed in the Serbian sample, but fewer people have problems due to surfing sexually explicit websites than in Montenegro. Although we lack valid representative data from other national surveys, based on partial epidemiological results, we can conclude with great caution that our results are on average or slightly above average, especially given that our respondents are markedly young (mostly 14 to 30 years old) and most prone to compulsive surfing sexually explicit websites.

Using ANOVA, statistically, significant differences were found between subsamples (F=8.814; p=0.000). No statistically significant differences were found between students and young adults aged 20 to 30 using Post Hoc tests. However, students are significantly more likely to have problems due to Internet sex or being addicted to it compared to adults aged 31 to 78 (I-J=1.40505; p=0.000), just like young adults aged 20 to 30 compared to the adult sample (I-J=1.42891; p=0.001).

In the Serbian sample, using ANOVA, statistically, significant differences were found, but they are not particularly pronounced (F=7.203; p=0.004). The analysis of Post Hoc tests did not find statistically significant differences between the subsample of students and the subsample of young adults aged 20 to 30. Students are more addicted to Internet sex than adults aged 31 to 69 (I-J=0.76955; p=0.004). Young adults aged 20 to 30 are statistically significantly more likely to be addicted to sexually explicit websites than adults aged 31 to 69 (I-J=1.21520; p=0.000). The difference between these two subsamples of adults is significantly more pronounced in young adults aged 20 to 30, which is probably due to sexually explicit websites being less available to students than to young adults aged 20 to 30.

It can be concluded that the differences in terms of Internet sex addiction are relatively more pronounced among Montenegrin students. This is also shown by Pearson's correlation coefficient, which is higher in the Montenegrin sample (r= - 0.121; p=0.000) than in the Serbian sample (r=0.061; p=0.001). One of the possible explanations for the small differences between the young and the old in both Serbia and Montenegro is the lower availability of sexually explicit websites for young people than in other Western countries.

In both samples, young people under the age of 30 are significantly more addicted to Internet sex than adults. In light of previous research results according to which young people are up to 15% more addicted to the Internet [11], which includes Internet sex, this result is quite expected.

The results become clearer if viewed, tentatively speaking, in the context of "Internet addiction", where compulsive surfing pornographic websites is a special, inseparable aspect of sex addiction. Addiction to pornographic websites generally does not produce so many negative consequences, including serious conflicts with the law, such as voyeurism, fetishism, pedophilia, and others. Some of the previously mentioned studies provide a phenomenological picture of this particular aspect of addiction to pornographic websites [1, 5, 7, 8, 19, 22, 24, 26, 27, 28, 33, 35, 36]
3.2 Risk Factors

Researchers find risk factors for rape in hypersexuality and compulsive change of sexual partners [31] as well as in previous aggressive behavior [3, 41]. However, they are almost unanimous in their view that sexually deviant persons and persons belonging to deviant subcultures tend to compulsively surf sexually explicit websites and be addicted to all other pornographic content [47, 50]. Moreover, it can be noticed that people who practice paid sex are more prone to compulsive surfing sexually explicit websites. Risk factors do not have to be related to psychopathological patterns, but simply occur because members of deviant subcultures share deviant values and moral patterns that allow for all other forms of deviant behavior, including Internet sex addiction.

It is worth mentioning one group of risk factors that seem common sense and are preconditions for all types of Internet addiction. These factors include good computer knowledge, good software skills, and the amount of time spent on the Internet [23]. These are highly interrelated factors.

Sexual arousal is a powerful driver of compulsion to view pornographic content, although there is a lack of unified views on the number and effect of physiological and psychological mechanisms that underpin compulsive behavior [10, 53, 54]. Negative psychological beliefs and feelings (feelings of loneliness, deep life disappointment, low self-esteem, feeling that everything in life is trivial and that the only purpose of life is enjoyment, tendency to give up solving problems, lack of will to work, and unemployment) are the next groups of risk factors cited in a study by Greek authors [15]. Compulsive surfing of sexually explicit websites with autoerotic pleasures is cited as a risk factor for Internet sex addiction [14, 38].

Interpersonal sensitivity, depression, paranoid thinking, and psychoticism are risk factors for Internet sex addiction [53, 54], while the duration of pornographic sites usage is a risk factor for the development of various psychological symptoms in heterosexual men [10, 17, 18, 46]. Numerous differences have been observed among men when it comes to accepting sexually explicit material [4, 6, 9, 30, 52]. However, certain regularities can be noticed. Men who compulsively seek sensations [55], erotophilic [14], hypermasculine [34], and who have previous experience with sexually explicit materials [4] will develop particularly negative attitudes towards women.

Other researchers also underline that the abuse of psychoactive substances is associated with the compulsive use of pornographic sites on the Internet [14, 38], as well as hypersexuality [43]. Besides the abuse of psychoactive substances, participation in various types of criminal activities is mentioned as a risk factor in one study [40].

Several studies recognized the lack of different forms of social control as a risk factor for addiction to pornographic sites, as also other types of deviant behavior [21, 25, 37, 40]. One of the risk factors for Internet sex addiction is a lack of religiosity [20, 32, 45, 50]. As expected, those with more liberal moral and political views are more prone to Internet sex addiction than conservatives [32, 44]. Some researchers also highlight unhappy marriage as a risk factor for Internet sex, as well as for deviant behavior in general [40].

Furthermore, depressive symptomatology is often highlighted as a risk factor for Internet sex addiction and sex addiction in general. The connection between negative, depressive feelings and the tendency to compulsive sexual behavior, primarily in men, is explained by the relationship between the process of excitation and inhibition. For people with depressive symptoms, increased sexual desire and arousal are associated with the suppression of dopamine secretion. It is a fact that sexual arousal raises dopamine secretion. What determines whether it will happen? From the extent to which disinhibition mechanisms have been initiated in the social environment, e.g. by watching pornographic content on the Internet. On the other hand, mechanisms of disinhibition among individuals struggling with anxiety affect compulsive masturbation. Finally, obsessive-compulsive disorder is also a risk factor for
various compulsive sexual activities. Dissociative phenomena in a compulsive sex addict enable separation from reality, which is a condition for one to achieve sexual pleasure without a partner, i.e. virtually, without having feelings of anxiety, fear, and guilt. Also, depressive symptomatology inevitably occurs as a consequence of social embarrassment, shame, and guilt due to social condemnation, stigma, and discrimination because of morally unacceptable sexual behavior and addictive lifestyle associated with it, as well as numerous individual and social problems which are the results of compulsive sexual behavior.

In our research, the risk factors imply all those processes, states of behavior, and phenomena that are associated with the emergence and development of problematic behavior or addiction to Internet sex. We included two groups of risk factors: family risk factors and risk factors associated with early psychosocial developmental disorders. The first group included nicotine and alcoholism among parental members, separation and divorce of parents, mental illness, prostitution, suicide, murder and crime among parental members, excessive austerity, indulgence, overprotection and rejection by father and mother, and serious conflicts with one or both parents due to their misunderstanding, neglect or abuse of the respondent by one or both parents. The second group included the following risk factors: the tendency to frequent quarrels in childhood and early youth, the tendency to frequent fights in childhood and early youth, lack of interest in school, serious learning disabilities, poor school performance, excessive shyness, and withdrawal, conflicts with the law (misdemeanors and crimes).

The significance of the differences in 15 risk factors for samples in Montenegro and Serbia are presented in Table 1.

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Serbia (^1)</th>
<th>Montenegro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicotineism</td>
<td>t= -3.628; p=0.000</td>
<td>t= 8.002; p=0.000</td>
</tr>
<tr>
<td>Alcoholism</td>
<td>t= -10.038; p=0.000</td>
<td>t= 8.002; p=0.000</td>
</tr>
<tr>
<td>Separation and divorce of parents</td>
<td>t= -3.026; p=0.000</td>
<td>t= 3.802; p=0.000</td>
</tr>
<tr>
<td>Mental illness, prostitution, suicide, murder, and crime among members of parental families</td>
<td>t= -8.010; p=0.000</td>
<td>t= 7.008; p=0.000</td>
</tr>
<tr>
<td>Excessive strictness, indulgence, overprotection and rejection by the father</td>
<td>t= -5.557; p=0.000</td>
<td>t= 4.272; p=0.000</td>
</tr>
<tr>
<td>Excessive strictness, indulgence, overprotection and rejection by the mother</td>
<td>t= -4.786; p=0.000</td>
<td>t= 4.364; p=0.000</td>
</tr>
<tr>
<td>Serious conflicts with one or both parents due to their misunderstanding</td>
<td>t= -7.938; p=0.000</td>
<td>t= 8.149; p=0.000</td>
</tr>
<tr>
<td>Neglect or abuse of respondents by one or both parents</td>
<td>t= -7.809; p=0.000</td>
<td>t= 6.970; p=0.000</td>
</tr>
<tr>
<td>Propensity of frequent quarrels in childhood and early adolescence</td>
<td>t= -8.458; p=0.000</td>
<td>t= 8.365; p=0.000</td>
</tr>
<tr>
<td>Propensity of frequent fights in childhood and early adolescence</td>
<td>t= -8.309; p=0.000</td>
<td>t= 4.827; p=0.000</td>
</tr>
<tr>
<td>Lack of interest in school</td>
<td>t= -10.349; p=0.000</td>
<td>t= 7.346; p=0.000</td>
</tr>
<tr>
<td>Serious learning disabilities</td>
<td>t= -6.997; p=0.000</td>
<td>t= 5.939; p=0.000</td>
</tr>
<tr>
<td>Poor school achievement</td>
<td>t= -8.789; p=0.000</td>
<td>t= 7.808; p=0.000</td>
</tr>
</tbody>
</table>

\(^1\) Differences in omens (positive for Montenegro and negative for Serbia) are due to different numerical values given to binary answers, not actual differences.
Table 1. shows that those who had risk factors differed significantly in terms of more pronounced use of pornographic sites and greater dependence on Internet sex than those who did not have these risk factors. All differences in both samples with excessive shyness and withdrawal among which there are no significant differences, while in respondents from Serbia there are, although the value of the t-test is relatively low. It is noticed that the average values of the t-test are slightly higher among the respondents from Serbia, especially when it comes to aggressive behavior in youth and lack of interest in school. However, alcoholism, socio-pathological phenomena among members of parental families, and then neglect and abuse by parents in childhood, aggressive behavior, and especially conflicts with the law, best "separate" Internet sex addicts from those who did not have these risk factors in parental families and during early psychosocial development. Deviant behaviors, accompanied by aggression and, in particular, crime are relatively important for the problematic use of pornographic sites and Internet sex addiction as found in other studies [15, 16, 36, 40, 54].

We were particularly interested in how much certain risk factors predict the emergence and development of problematic behavior and addiction to Internet sex. To this end, we subjected risk factors to binary logistic regression.

Table 2. Statistics of binary logistic regression of Internet sex dependence for the sample from Serbia

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B coefficient</th>
<th>Wald</th>
<th>Significance</th>
<th>Exponentially B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental alcoholism</td>
<td>-0.620</td>
<td>19.801</td>
<td>0.000</td>
<td>0.538</td>
</tr>
<tr>
<td>Propensity to fight</td>
<td>-0.685</td>
<td>18.196</td>
<td>0.000</td>
<td>0.504</td>
</tr>
<tr>
<td>Lack of interest in school</td>
<td>-0.584</td>
<td>20.945</td>
<td>0.000</td>
<td>0.558</td>
</tr>
<tr>
<td>Conflicts with the law</td>
<td>-0.445</td>
<td>4.141</td>
<td>0.042</td>
<td>0.641</td>
</tr>
</tbody>
</table>

Respondents in the sample from Serbia whose one or both parents were alcoholics are almost twice as likely to become addicted to Internet sex, and almost as many if they were prone to fights in their early youth or showed a lack of interest in school. If they have had a conflict with the law in just over a third of cases, they have a chance of becoming addicted to Internet sex.

Table 3. Binary logistic regression statistics from Internet sex for the sample from Montenegro

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B coefficient</th>
<th>Wald</th>
<th>Significance</th>
<th>Exponentially B</th>
</tr>
</thead>
<tbody>
<tr>
<td>No socio-pathological phenomena in parental families</td>
<td>0.735</td>
<td>8.329</td>
<td>0.004</td>
<td>2.085</td>
</tr>
<tr>
<td>Excessive strictness, indulgence, overprotection, and rejection by the father</td>
<td>0.399</td>
<td>4.039</td>
<td>0.044</td>
<td>11.490</td>
</tr>
<tr>
<td>Propensity to fight</td>
<td>0.794</td>
<td>16.596</td>
<td>0.044</td>
<td>2.213</td>
</tr>
<tr>
<td>Lack of interest in school</td>
<td>0.483</td>
<td>8.756</td>
<td>0.003</td>
<td>1.620</td>
</tr>
<tr>
<td>Conflicts with the law</td>
<td>0.958</td>
<td>19.005</td>
<td>0.000</td>
<td>2.606</td>
</tr>
</tbody>
</table>

Respondents in the sample from Montenegro who did not have adequate educational and emotional relations with their mothers were 1.5 times more likely to develop Internet sex addiction and slightly more than 1.5 times if they showed a lack of interest in school (Table 3). Finally, respondents who were inclined to fight close to two and a half times were more prone to Internet sex addiction than those who conflicted with the law over two and a half times (Table 3).
The set of predictors that significantly increase the chances of Internet sex addiction is similar to that of gambling, only the strength of individual predictors is lower. This is not accidental because a strong association between gambling, sex, and Internet sex has been noticed (180, 291, 297). These also have in common some essential personality traits, and above all, increased aggression and readiness for action by people addicted to Internet sex (34, 346, 348, 342, 349).

### 3.3 Social Profiles of Internet Sex Addicts in Serbia and Montenegro

Based on the qualitative synthesis of numerous quantitative data, we created social profiles of Internet sex addicts in Serbia and Montenegro. On this occasion, we present the final results of the synthesis of a large number of empirical data, for which we would otherwise need more time. Internet sex addicts in Serbia are most often men aged 20 to 30, and then up to 20. Internet sex addicts are uncharacteristic of their education and occupation. They are more often of agricultural and then managerial social origin and unmarried. Usually, they grew up in larger families and lived in bigger apartments or houses, while they are not characteristic in terms of other economic - housing characteristics.

Internet sex addicts in Montenegro are men, primarily 20 to 30 years old, and then older. They have an indeterminate educational status. There are many occupations: farmers, private individuals - entrepreneurs, and managers. They are of managerial social origin. Their marital status is also heterogeneous: divorced, widowed, and married. They grew up more often in larger than in smaller families. Their monthly income is above average. They live in larger apartments - houses of unknown comfort.

The results in both samples indicate that social profiles are quite diffuse in terms of education and occupation, as well as in terms of marital status, and in Serbia more often unmarried. Both samples are dominated by young people aged 20 to 30. Regarding the structure of the family and the comfort of housing, no significant regularities have been identified. However, sex addicts in Montenegro are somewhat more likely to come from the manager’s social strata, significantly more often than in Serbia they are businessmen and have a slightly better financial situation.

Although Internet sex addicts in Montenegro are somewhat better socially profiled, in several sociological characteristics, sex addicts in both countries are insufficiently clearly profiled. Let us remember that the use, abuse, and addiction to certain psychoactive substances were related to certain social strata and carried attributes of social and cultural prestige. Initially, it was marijuana, the use of which in the 1960s symbolized the revolt of middle-class youth against the established values of their parents (hippie movement). The drug of the upper classes was and remains cocaine. The question arises: why don’t Internet sex addicts have a clear social profile?! Sex addiction, whose addiction to Internet sex is only one of its specific manifestations, belongs to addictions that have a great tendency in developing addictive behavior, which is almost impossible to influence with cognitive strategies because the centers for sex addiction are located in the deepest parts of the brain, in charge with our basic instincts. Precisely because of the huge potential for the development of addictive patterns, it is one of the least widespread behavioral addictions, which, when it appears, "does not choose" addicts by any sociological or cultural characteristics.

We believe that simply for these reasons, Internet sex addicts in both countries are not socially profiled, although in Montenegro they are to a lesser extent. It is difficult to say whether this is due to the need of members of the leading social background and layers of private individuals to express their personal and social power over women in Montenegro, as one of the important areas where men demonstrate social power if they have it. Only by conducting new targeted research can one provide an answer. Anyway, men are not aware of this perverted manifestation of social power at all. But it is a mistake to attribute and rationalize it with their emotional and social attraction to the opposite sex, as one of the important areas in which men demonstrate social power if they have it. Anyway, it is difficult to make conclusions.
4. DISCUSSION

Internet sex addiction is just one of the manifestations of sex addiction, which has great potential for developing addictive patterns of behavior and attracting other behavioral addictions and addictions to psychoactive substances, of which gambling and alcohol addictions are the most common and most important.

Although not accepted as a clinical category of addiction in the DSM - 4 classifications, sex addiction is characterized by three basic symptoms of addiction: loss of control, inability to abstain, and increased tolerance, along with numerous health, psychological, and social problems. In the previous pages, we described in detail the symptoms of Internet sex addiction. Food and sex are an indispensable part of human existence, while this is not the case with addiction to other substances and activities. There are biological limitations for both. The situation becomes so complicated that sex addiction has huge potential for establishing addictive patterns of behavior. In this study, we sought to examine the prevalence of problematic behavior and addiction to Internet sex, the risk factors for the emergence and development of these addictions, and describe the social profiles of Internet sex addicts in Serbia and Montenegro.

In our study, we included two groups of risk factors, family risk factors and risk factors associated with early psychosocial developmental disorders. The first group includes nicotine and alcoholism among parents, separation, and divorce of parents, mental illness, prostitution, suicide, murder and crime among parents, excessive austerity, indulgence, overprotection and rejection by father and mother, and serious conflicts with one or both parents due to their misunderstanding, neglect or abuse of respondents by one or both parents. The second group included the following risk factors: the tendency to frequent quarrels in childhood and early adolescence, the tendency to frequent fights in childhood and early adolescence, lack of interest in school, severe learning disabilities, poor school performance, excessive shyness, and withdrawal, conflicts with by law (misdemeanors and criminal offenses).

All risk factors, with excerpts and withdrawal in early childhood and adolescence, "separate" those who had risk factors for Internet sex from those who did not. The significance of the differences is at zero level. However, alcoholism, socio-pathological phenomena among members of parental families, and then neglect and abuse by parents in childhood, aggressive behavior, and especially conflicts with the law, best "separate" Internet sex addicts from those who did not have these risk factors in parental families and during early psychosocial development. This has been confirmed in other studies [16, 21, 37, 40, 54].

The results of our further analysis on the prediction of risk factors for the emergence and development of problematic behavior related to pornographic sites and Internet sex addiction only more convincingly indicated the connection between aggressive behavior and this addiction. Namely, the application of binary logistic regression showed that the greatest prediction for the development of Internet sex addiction is carried by risk factors that indicate aggressive and antisocial behavior. Alcohol dependence, which also includes the manifestation of verbal and physical aggression, is also highly predictive of the onset and development of Internet sex addiction. Immediately after these, the important risk factors in Montenegro include psychodynamic disorders of respondents with mothers, which are conditioned by the overprotective and controlling behavior towards their sons.

Finally, we described the social profiles of Internet sex addicts in Serbia and Montenegro. In general, social profiles are quite vague, and undefined, somewhat more so in Serbia than in Montenegro. The reasons should be sought primarily in the great potential of creating addictive patterns in Internet sex, which is influenced more by biological than sociological...
and cultural factors, which was discussed in more detail earlier. Increased tendencies of members of managerial social origin and owners of private businesses in Montenegro are a consequence of a specific way of expressing social power towards women, which members of these strata are usually not aware of. They wrongly explain it as mutual liking and attraction to people of the opposite sex. As with other addictions, the symbolic fulfillment of desires replaces real emotional and sexual activities in Internet sex addicts.

As we said earlier, Internet sex addiction is relatively the least prevalent of all behavioral addictions, but with the highest potency for the onset and development of addictive behavior, which cannot be greatly influenced by cognitive strategies since the center of addiction is in the brain parts in charge for the functioning of our instinctive activities. According to our research findings, addiction to sex, Internet sex, gambling, and alcohol is a key structure of addictive behavior that, when it occurs, dictates the emergence and development of most other addictions in general [11]. This finding is not only theoretically but also practically important because this triad predicts the occurrence of most other addictions and reduces the chances of successful prevention, therapy, and, rehabilitation. That is why the early diagnosis of this triad is highly significant.

5. References


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Abstract: Websites present information or services but often do not allow users to provide feedback or ask questions. The topic of this paper is to first discuss various types of interactivities that are currently available, and then explain what one would expect from advanced systems. The article makes it clear that much has still to be developed. We start by mentioning a number of currently used approaches and show that they almost exclusively belong to a category we call “provider-driven”. They miss the very desirable possibility of what we call “user-driven” feedback that is, at the most, available in a very rudimentary form. We then present some user-driven feedback attempts that culminate with a description of some of the features of a new system NID (for Net-Interactive Documents). We analyze and describe the first results obtained and, finally, summarize to show what future systems should provide.

Index Terms: annotations, dialogues, discussions, feedback, interactivity, remarks, questions

1. INTRODUCTION

Many websites, including some of the very large companies, provide lots of textual and multimedia information yet do not allow users to report errors or omissions discovered, or to ask questions. Often no E-Mail address is provided (usually because an avalanche of emails is feared), and if a phone number is provided, users are usually “entertained” for many minutes with music while they are waiting for an attendant, or are presented with a long list of FAQs that very often do not contain the question the user is interested in. Automated answer robots usually react only to standard phrases, i.e. are often not much better than help systems with a search function. Some systems allow discussions with specialists but are usually not free of charge.

However, some systems do allow, even insist on, inputs from users. Typical cases are E-Learning systems that require users to answer questions or multiple-choice quizzes, (multi-person) computer games that require inputs from users and possibly communication between users, and systems that expect users to grade activities that were offered (like booking systems for hotels or restaurants, online shops, etc.). This kind of input that is required from the user, we call “provider-driven” interaction.

User interactions can be categorized at multiple levels, the most basic form can be simple one-click interactions such as likes or dislikes. On a secondary level of interaction, the user interactions may require an effort of typing something such as comments and feedback. Another more progressive type of interaction involves the possibilities of content co-creation that allows next-level user interactions. While some conventional web information portals allow generic forms of basic and secondary interactions by users, they are not linked with the context of the content. It is very important that users are allowed to give inputs on specific information entities available on the website.

User interactions or user data is considered to be a fuel for running artificial intelligence (AI) based analytics on next-generation websites. Business intelligence engines running at the back of most modern consumer services websites gather user data implicitly. It is equally important to provide site users with easy opportunities to control the data inputs given to the system.

In our work, we explore the importance of user interactivity and data inputs in conventional information system websites e.g. libraries and content publishing platforms. These platforms are now increasingly making use of cutting-edge AI algorithms thus requiring the needed fuel (user data) for optimal performance.

The second author was involved in advanced E-Learning environments and multi-person gaming efforts using distributed computer networks even before the arrival of the Internet see e.g. [1], [2], [3] or [4], using what was then called Telesoftware (similar to today’s apps) and later [10] allowing arbitrary types of interaction. It is amazing how many years many of those ideas were lost due to the success of the originally only one-way-information-presenting system - WWW.

The rest of this paper is structured as follows. We present attempts at “user-driven” interaction (in contrast to the mentioned “provider-driven” interactions) in the next two sections. Then, we discuss the basics and problems of a new NID system (Net-Interactive Documents) which allows many types of user-driven interactions. Finally, we have a brief look at some special features of NID.
in a separate section, followed by a conclusion and an outlook.

2. Early Attempts at User-Driven Feedback

The turn of the decade 1980 to 1990 was decisive for developing interactive systems on networks of computers. Until the end of the '80s a number of superb networked multimedia systems were created in the US e.g. the famous HyperTIES, "an early hypertext system at the Human-Computer Interaction Laboratory (HCIL), University of Maryland (starting 1984)" by Ben Shneiderman, or the famous Hypermedia System from the Brown University based on ideas of Andries van Dam. Those systems were tied to some existing networks.

Starting around 1990, the progress of the internet made it possible to develop systems accessible via the net. Gopher, developed at the University of Minnesota by Mark McCahill was certainly the leader for a while, with thousands of installations worldwide. WWW started to emerge as an information system for physicists worldwide headed by Robert Cailliau with Tim Berners-Lee as a collaborator (whose role was later overemphasized), see [5]. Also, the second author of this article was, with a large team in Graz, involved in developing Hyperwave, see [6] or [9], certainly the most advanced system of the three. However, the first graphic browser was developed for WWW, driving Gopher from the market and Hyperwave into a niche of big companies who desperately needed more structure than offered only with links by WWW.

Those developments are important in the context of this paper since both Gopher and Hyperwave had already advanced features for adding "annotations" to existing material. Maybe it is worth mentioning that Hyperwave permitted users to even associate information with a moving object in a video clip. That was a highlight moving with the object and remaining clickable all the time. The simpler HTML protocol used for WWW did not allow this, so this feature was later eliminated from Hyperwave.

The second author and some of his best friends were convinced early on, that users of an information system should have the possibility to add questions or information to the material presented on websites.

Their first major attempt was to establish a truly open-source journal J.UCS [https://jucs.org](https://jucs.org), (nothing to pay for the submission or publication, nothing to pay for reading). The comparatively low costs for running this on a Hyperwave server were picked up by a consortium of universities, see [7] and [8].

Every paper in this journal (now in year 26 with over 350 issues!) has a field "Comments" that allows adding links to the presented material or to insert further information. Such comments will be called "annotations" in the rest of this paper, following more modern terminology. All such annotations are reviewed by an editor of the journal and, after approval, they are visible to the public. Note how important such annotations are for (scientific) papers: A paper may thus suddenly get a link to a more recent result, improving the earlier one; or someone may point to an error that the author then can correct; or may prefer not to present certain special issues of a definition but refer to details discussed in an earlier paper, etc.

The three instigators of J.UCS (Calude, Maurer and Salomaa) are proud to have established this first truly open source journal and even with, at that time, still unusual features like being able to add annotations. For the explanation of annotations, the journal says: "Annotations go through a refereeing process much like other contributions and are made available to the public if deemed appropriate."

The number of annotations obtained was small, yet led to several improvements. It was argued for a long time that the reason for the small number of annotations was that it often took a long time until annotations were available to the public. Be it as it may be, between 1994 and about 2010 J.UCS [7], [8] was one of the few (if not the only one) big information servers allowing user-driven annotations.

A radical change came with Austria-Forum which was first implemented in 2007 [16]. Austria-Forum is by now a network with some 1.4 Million multimedia entries and almost 4.000 digitized books.

Registered users are allowed to add comments (annotations) at the bottom of every page on this server, showing their user names and thus allowing the administrator to change or erase comments or contact authors where it is necessary. This approach produced two problems: (a) If users registered with an E-Mail address that stopped working at some stage, such contacts became impossible; (b) Over the years the feature was misused seriously at least four times. A typical misuse was that someone wrote a program that added overnight annotations to thousands of pages with advertisements or such. Hence the facility has now been restricted to
members of the Editorial Board of Austria-Forum. However, to permit all users to send messages, each page of the server contains a “Feedback button” that allows anonymous feedback to the administration of Austria-Forum. Anonymous means that writers of annotations are unknown, i.e., if they ask a question, they cannot get an answer unless they include in their message a way to contact them. This anonymity was supposed to reduce the effort to send messages, but was still only used by less than 1% of all readers: Since messages only went to a small group, misuse was impossible. However, it also meant that sometimes the same kind of message (correction, complaint, ...) was sent by several persons. Overall, even a comparatively small number of messages obtained created quite a load on the Austria-Forum team, since some annotations could not be answered by the team but required contacting some specialists. It is this additional burden which has prevented annotations in cases where they would be very desirable.

Typical examples are the thousands of conference proceedings and other books made available electronically by some publishing companies. Discussing this issue, why they do not allow readers to send annotations (typically questions) concerning a particular contribution, the answer of the publisher was not unexpected, along the following lines: “This is too much effort. When we receive an answer, we have to find the contact parameters of the author(s). In many cases, this is nontrivial, since authors were in contact with book editors, not with us. Even if we find contact parameters, they may not be valid anymore; and even if they are, it may take a long time to receive a reply which we then have to forward. All counted, we cannot afford such an effort.”

Facts like this influenced how we started to look at user-driven feedback, resulting in some major decisions when developing NID, as will be seen in section 4. However, we will first discuss other approaches to user-driven feedback.

3. Other Approaches to User-Driven Feedback

To avoid the mentioned problems some publishers of scientific journals, such as one of the most widely read scientific IT journals - the Communications of the ACM, do allow annotations to contributions that are only made public after the reviewers of the paper have approved it. This distributes the effort of answering the questions to the small expert group that acted as reviewers and accepted the paper for publication. A problem with this kind of user feedback is that it is at the end of a paper, so it is not easy to pinpoint the exact place the annotation is referring to. The former editor in chief of CACM, Moshe Vardi, explained that the feature is used, but less than expected, yet he and many colleagues think that “passive reading” will be more and more replaced by “active reading”, i.e., reading with the possibility of user-driven interactions as time goes by. This was another encouragement for us to proceed with the development of NID.

The most common forms of user-driven feedback, are discussion forums and blogs, stand-alone or attached to newspapers, journals, etc. Authors of contributions are known to the public only by a pen-name they have chosen. Only the information provider (hopefully) has valid contact parameters. In most cases the information provider just acts as a mild censor, rarely interfering with the material. Thus, such attempts are more for communication between users rather than users and information providers.

We believe that annotations in papers and books placed right at the spot they are addressing would be very valuable, but clearly, some mechanism has to be developed to reduce the burden to deal with them. This has led us to the development of a software-package NID (Net-Interactive Documents) that seems to effectively address some of the problems mentioned and additionally provides for further possibilities, as we present in the following section.

4. Net-Interactive Documents (NID)

NID documents range from a few pages to arbitrarily thick books. They reside on a NID server and consist of a number of pages, each presented as a picture according to the IIIF standard [17]. Thus, it may be a scan of the document. Such a scan is then usually also converted into a PDF file using advanced OCR techniques. Consequently, this allows full-text searching in NID documents, where even the text in pictures of the original book is searched. The reason for choosing IIIF will be explained in a separate paper in this issue by the first author of this paper who is responsible for many ideas and the implementation of NID. NID books can also be produced from PDF or Word files, or PPTs.

Concerning user-driven interaction, the main points are: (a) each page allows anonymous feedback using a form as shown in Fig.1 or (b) allows an annotation at any spot of the NID document by taking from the menu-line a pencil
and using it to outline an arbitrary area on the page. This action opens a form that allows inserting text, links, images, or other multimedia objects, using the form shown in Fig.2.

![Feedback Form](image)

**Feedback!**

Email (Optional)

Enter your email...

Feedback *

Enter your feedback here...

Submit  Cancel

**Fig.1:** The feedback form is available on every page of a NID document.

![Annotation Form](image)

**Fig.2:** This form allows the insertion of various types of information at any place on any page.

![NID Page Highlighted](image)

**Fig.3:** This shows parts of a NID page with various areas highlighted.

Using mouse-over the last marked item “Josef W. Wohinz”, opens a picture of professor Wohinz as seen in Fig.4.

![Professor Wohinz](image)

**Biography in german**

Fig. 4: Picture of Professor Wohinz and a link to his biography

Whenever an annotation is made by anyone, a message is sent to someone who is supposed to check the annotation.

The crucial point in NID is that the message concerning a new annotation is sent to one or more persons responsible for the relevant part of the document. I.e. evaluating and modifying an annotation is completely distributed to those persons responsible for the items at issue, without bothering editors or publishers!

This was successfully done with the EUROSPI 2021 proceedings [13]. The 55 individual papers of the conference are associated with the respective authors, see [https://nid.iicm.tugraz.at/Home/Collections/31](https://nid.iicm.tugraz.at/Home/Collections/31), parts of it as shown in Fig.5.

![Eurospie 2021 Papers](image)

**Fig.5:** Eight of the 55 papers of Eurospie 2021.
Let us look at the first one, written and presented by the second author, see https://nid.iicm.tugraz.at/Home/ViewBook/411. The first page is shown in Fig. 6. All annotations that were added by someone trying to correct or add information or asking a question went directly to the author of this paper, who would react promptly. Thus, later readers would find additional material not incorporated in the original paper.

The book mentioned has been picked on purpose since it also gives an independent overview of other features of NID.

The annotation feature of NID is not just important for technical reports but has also been successfully used for engaging students of all age levels to read a contribution, do some research on a topic of interest and add the information found as an annotation. Even high-school students got quite enthusiastic, as pages like https://nid.kinderphilosophie.at/Home/ViewBook/253 show. But applications of NID are also useful for communities and all kinds of organisations acting as a simple knowledge-management system and much more, as explained in [16].

NID offers, for every document, handling annotations in different ways. One can define for a NID document that annotations, even done by anonymous users, are possible and immediately available to the public; or that annotations can only be done by registered users; or can be made by anyone, but are made visible only after potential changes by the information provider, or to all, or to a certain group of users, or only to the one having made the annotation, etc. NID offers a very flexible group structure e.g. that allows different groups to see pages with annotations, or doesn’t allow even to look at some pages.

Our experiments to embed explicit user interaction opportunities at all levels in a content publishing platform opens a gateway to many new features. We believe that such systems in the future will use all sorts of machine learning algorithms and automated inference tools. It is essential that best practices are used for needed sustainable data pipelines for the system from its users. One unique feature of NID is the possibility of multimodal content co-creation in the right context, in the form of annotations.

NID offers many more novel and interesting features, some mentioned in the papers [13], [15] and [16]. A fuller presentation is left to other sources: Some of it is explained in the paper by the first author, who was the main driving force for many ideas and all of the implementation. His contribution is included in this special issue as a separate paper.

Let us just conclude this section with a few remarks concerning interfaces. First, when a NID document is opened the interface language (typically English or German, but others are also available) can be chosen. Furthermore, the complexity of the menu shown to users can be adjusted to the intended user group, providing either a full menu, a reduced version (“half menu”), or a very simple one only for anonymous users who can just turn pages, do a full-text search, look at the table of contents (if at all available, it is available with a click on every page), and a small set of other possibilities. If they decide to log in, the system will present a more sophisticated menu.

5. CONCLUSION

NID offers a completely new way of providing digital books or documents allowing users to interact with the material in unprecedented ways. Thus, the “passive studying” of some material is replaced with NID by “studying information with active participation”, and as a by-product is increasing the knowledge provided in the document. This is seen by many IT researchers as the future of consuming digital material.

Clearly, other systems are starting to appear. A major one is Hypothes.is [14]. It is a powerful tool for annotations, also for groups, yet lacks many of the advanced features of NID.

It is expected that the development of NID will deeply influence what future digital libraries will look like, yet the inertia to change existing systems to new ones will require several years of patience.
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Abstract: Modern digital library systems face challenges related to data analytics, interoperability, access control, and institutional and user collaborations. This paper presents the work done to add value to the conventional digital library workflows in a next-generation library system. Inherent capabilities to foster collaboration, content co-creation and AI interventions are among the desired features guiding the development of modern library systems. The work also highlights aspects of data transformation and access models in a more connected information ecosystem.

Index Terms: Digital Library, Content Curation, AI interventions, Indexing, Big Data, Interoperability

1. INTRODUCTION

Digital libraries are modern versions of conventional libraries having the same primary objective of information dissemination. The main features of a library include the ability of information cataloguing, easy access, circulation, content update, and record maintenance. At a more abstract level libraries promote education and culture in society. The digital face of libraries has all the traditional processes and services, but it additionally has certain features that are attributed to the digital nature of hosted information contents. A good digital library must provide a coherent view of the various types of media content it contains. Indexing and search capabilities of digital libraries make information access more precise. Contrary to service provision to immediate communities by conventional libraries, digital libraries tend to reach out to a larger and more diverse user base.

In the last decade, we have seen tremendous growth in digital content and the use of information technology in almost every field of life. Digital libraries now are a lot more than simple storehouses for organized digital documents. They are multimedia and structured information spaces running various services for their users. Digital libraries now are also platforms for communication, collaboration, learning and research. Knowledge seekers with access to fast internet and mobile devices look for immediate and precise information almost all the time. Digital libraries are expected to provide this type of access to their users and, also, a place to be more productive. As a result, we see changes in the architecture of digital libraries and the increasing use of new and innovative technologies.

The NMC Horizon Report 2017 Library Edition [1] suggests that the trends related to user experience improvements, cross-institution collaborations, and rethinking of library spaces are forcing digital libraries to use the latest technology. The challenges facing modern digital libraries in this evolution phase include accessibility, technology literacy, adapting to existing organization designs, and ongoing integrations. More complicated issues being faced by libraries during this transition are interoperability, intellectual property, rights management, and economic and political pressures.

The enormous size of digital content in libraries that tends to increase exponentially is now being treated as big data [2]. To effectively use such large information spaces, it is essential that, in addition to traditional data processing software, advanced computational methods are also used. The use of modern analytic tools will help to consume information in digital libraries more effectively. Furthermore, it will help to reveal patterns, trends, and associations that are linked to the human behavior of users and their interactions.

The research on the topic of how big data and user preferences are changing digital library services [3][4] highlights the fact that user data plays an important role in the new digital library ecosystem. User interactions captured by digital libraries not only help in fulfilling the information needs of users but also continuously add resources to the library. User-contributed resources build a broader understanding of desirable library resources. In the current information overload era, digital library users look for a personalized experience and access to relevant content from diverse media spaces. They are also more interested in autonomous tagging of
information contents for personal understanding and peer sharing. The ability to supplement library contents by adding annotations to source information is another desirable aspect of modern digital libraries.

Research work and studies [1][2][3][4] are highlighting futuristic trends and a way forward for the digital library systems but existing mainstream platforms are still using the conventional data processing, management, and publishing approach.

An experimental study evaluating digital libraries [5] reveals that users of digital libraries acknowledge the improvements in systems by modern technology interventions. The improvements in information retrieval mechanisms, usability, and access interfaces are acknowledged. However, at the same time users of digital library systems also feel the need for further improvements with cutting-edge data science and ICT usage. The commonly used claims of open-source digital library platforms [6] are to be extensible and increasingly allow the use of diverse media types, standard metadata, content management system, and multimodal access. There are also efforts made to cover challenging access management issues with copyrights and licensing implementations. Fast and reliable storage and hosting also complement the digital preservation agenda of digital libraries. Many digital publishing platforms started offering recommender systems based on content filtering or collaborative filtering approach. We also see increasing use of machine learning algorithms offering different analytics on library and user data. While all this development shows progression, there is still a lot of room for improvements in domains such as interoperability, user and institutional collaborations, and AI usage during content creation and consumption.

The author of this paper and his team started working on the development of a modular and extensible digital library platform that makes use of niche technologies [7][8]. The main objective of this development activity was to address the above-highlighted deficiencies in digital library systems. Over the past couple of years, our team deployed different instances of a next-generation digital library platform\(^1\) at the Institute of Interactive Systems and Data Science, Graz University of Technology Austria.

This paper discusses the results of our experiments done to improve content creation, co-creation, management, and interoperability features in a digital library system. In the following sections of the paper, we will identify the focus area of the library administration portal, i.e. content preprocessing before publishing and its delivery to users. The system’s ability to engage users for content co-creation and digital access right management is also presented. We will also highlight measures taken to make the system more interoperable. We will conclude the paper by pointing out ways forward and the needed next steps toward a comprehensive and modern digital publishing platform.

2. CONTENT CURATION IN DIGITAL LIBRARIES

In modern times most of the general information and intellectual content created by individuals and institutions are in digital format. The term data or content curation is used for the creation, organization, integration, and value addition of the information in digital libraries. Due to the exponential growth of digital information, the managers of information stores and librarians that host this information look for innovative ways to preserve this knowledge.

Data curation is becoming an increasingly important domain because of its importance in information discovery, delivery, and re-use. A generic and comprehensive data curation life cycle model by Digital Curation Center [9] provides a high-level graphical overview of the steps involved in the complete process.

The actions presented in the data curation lifecycle (Fig. 1) are used by different digital library systems, starting from data object collection. Actions performed range from adding descriptions and metadata, preservation planning, engaging the user community, setting access mechanisms, and finally transforming data into suitable formats for storage and use.

![Fig.1: DCC lifecycle model](https://www.dcc.ac.uk/sites/default/files/documents/publications/DCCLifecycle.pdf)
There are additional steps involving data reappraisal, migration, conceptualization, and removal. Led by this holistic lifecycle and generic action categories, the management portal of the NID library system is designed to perform the following data curation steps using administrative accounts:

2.1 Data Addition

NID system allows uploading standard PDF documents using a simple interface with minimal description data and default access and use models. The advanced document addition allows detailed description entries with options to select access rights and settings related to community use, data transformation, and views. NID also allows the creation of library objects using high-resolution images. Support for documents in proprietary formats e.g. MS word can also be added for user-specific needs.

2.2 Additional Descriptors and Preservations Planning

Using the Manage Book options of the NID library system administrative users can edit book preservation and descriptor settings and also set view menu options and annotation addition behavior for a particular document.

2.3 Creation of Representation Information

A NID library offers, in addition to the specification of standard document metadata, the creation of an inverted index of documents. This allows fast full-text search of text contents of documents with the specification of the exact location in documents. The full-text search facility is complemented by various enhancements that include the detection of text and objects using Optical Character Recognition (OCR) technology, Natural Language Processing, and Computer Vision algorithms, more details on this are given in section 4.

2.4 Data Transformation

The information content added in the NID library is transformed into an image format for end-user delivery and consumption by other systems. The International Image Interoperability Framework (IIIF) standard\(^2\) is selected for the online delivery of high-quality, attributed digital objects at scale. The image-based transformation of conventional documents is done by keeping the text lookup feature intact while eliminating the easy possibilities of text copying without permission. The manifest metadata descriptor of IIIF helps in the specifications of page-level objects of the system. This transformation greatly helps in device-independent, cross-platform delivery of information contents in a library.

NID library offers to set display properties of a document at a page level. Librarians (administrators and editors) can set the display of pages in a particular order and choose to hide the pages from the display as well.

2.5 Access, Use and Re-use

Access, Use and Re-use: Content access management in NID administrative portal is done

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\(^2\) [https://iiif.io/](https://iiif.io/)
using a unique three-tier approach. The first access management mechanism is based on Digital Rights Management (DRM) levels. The default NID systems come with pre-defined three DRM levels i.e. 0/1/2. The DRM-0 selection means rights management is disabled and access is granted to all users including anonymous ones. DRM-1 access allows only registered/privileged users to access the library objects. The DRM-2 assigned objects can only be viewed by the editors and system administrators. These levels correspond to the pre-defined user categories in NID distribution i.e., anonymous, registered, editors and administrators. The NID library system can have more user categories and more corresponding DRM levels. The second tier of access management is based on license types. The NID system allows the addition and management of license types which in turn are assigned to objects being added to the library. The default system license types include different variants of Creative Commons license type, Public Domain, and Copy Right/All rights reserved. The license descriptor not only identifies the use, re-use, and sharing characteristics, but also compliments the NID user access layer mechanism. A license type in the NID system can be created with specific concurrent user access to limit its online use according to the allowed distribution rights of the library. A document in the library added with a Public Domain license type provides a download link to its source file. The third layer of access is invoked by privileged users, editors and administrators, with the console section of the main library portal. Access control at the user group level can be defined by creating a group of

![NID Library Access control options](image)

users and assigning exclusive access rights to selected library objects to a certain user group.

### 3. Collaborations and Interoperability

Digital Libraries in more interactive and interlinked online environments face the long-term challenge of user and institutional collaborations. While librarians and technologists both agree on the fact that digital content publishing platforms must have intuitive means of promoting user interactivity at both system level and across different systems, we see limited inherent capabilities of user collaborations and data interoperability across different platforms. The surveys done to access the capabilities of common digital library systems reveal that there are efforts made to promote standardized metadata generation and consumption for interoperability and syndication services [10]. The prevailing digital library systems are also increasingly making use of various external social media plugins to promote user collaborations. These efforts need to be complemented by adding built-in user interaction features in digital libraries and standard application programming interfaces (APIs) for sharing and consuming data.

To support the development of a digital library system in this positive direction we added the following collaborative and interoperability capabilities to the NID platform.

#### 3.1. Annotations, Discussions, Quizzes at Public and Group Levels

Going beyond passive consumer of information, NID library users can add comments, or contribute information in form of annotations, comments, feedback, quizzes, and even start a discussion at the document page level. The content co-creation by the user community must also include necessary moderation controls. NID implements this control by specifying the user interaction behavior at the base level where a librarian can specify whether the library object/document allows anonymous interactions or only logged-in registered users can contribute to discussions and annotations. The added contents are made available to general users of the library system unless the library objects’ content moderation is not enforced. The content moderation is enforced by specifying the moderator email of any document in a NID library. This moderation control can be applied at the page level but also allows adding multiple content moderators for specific sections of a document. This additional control allows visibility of user contribution only after approval/activations by the moderators or editors of the library system. The NID system also provides the facility to create user groups. The library users can create user groups and add document interactions (annotations, quizzes, and

3 https://creativecommons.org/
discussions) that are only visible to users of the intended group.

3.2. Interoperability

Seamless data sharing at the system level is very critical to maintaining a robust and extensive information ecosystem. Digital libraries must be capable of sharing information contents in addition to exchanging metadata. The NID library system makes use of the IIIF standard to extend the seamless content delivery and syndication services. NID data representation is based on a simple design principle reducing the use of any proprietary data format and specific technologies. It uses image formats that can be used on any platform and device. The IIIF image representation is complemented by link data in JSON-LD format. This web standard link data uses an open standard file format and data interchange format. The context of original data and use of link data is presented in human-readable text. The JSON manifest files store and transmit data object references consisting of attribute-value pairs and arrays.

NID system provides ways to access, view, search, and share digital library objects in form of images, audio, and video. To support digital library synergy the NID system provides multiple APIs that allow sharing of information and content aggregation. This includes search API, Presentation API, Image API, and data services APIs.

The front-end operational example of content sharing and digestion APIs include a “transclusion function” for URL shared contents and import of IIIF-compliant information objects from other libraries.

4. Big Data and AI Applications in Digital Library Systems

Big data is mainly characterized by Volume, Variety, Velocity, Variability and Value [11]. The data in modern digital libraries fit this characterization to a great extent. Increasing use of conventional and mobile computing devices, improved ICT infrastructure, internet applications, and convenient digitization of legacy data are what cause exponential and speedy growth of data in libraries. The variety of sources and content types add to the variability in library data. Contrary to general user data available on social platforms and common information systems, the data available in digital libraries is of greater intellectual value as it generally comes from credible sources. Libraries in the big data era need to shift focus from conventional data processing applications and employ tools more suitable and designed exclusively for big data. The challenges associated with massive datasets are capturing and storage of data, searching for the desired information, selective sharing and transfer, visualization, querying, privacy etc. Artificial Intelligence (AI) works very well in data analytics, thus making AI and big data seemingly inseparable. To exploit the full potential of data volumes in digital libraries, the NID library makes extended use of machine learning algorithms in several areas as follows.
4.1. Computer Vision (CV)

NID uses Tesseract\(^4\) - one of the most accurate open-source OCR engines. It helps in indexing processes by extracting machine-readable text from image-based documents. This feature is very practical for libraries that archive historical documents through a scanning process. The seamless integration of the inherent Optical Character Recognition (OCR) engine automates the indexing tasks. It saves time and eliminates the use of expensive external software. Long short-term memory (LSTM) based techniques are used by the OCR engine supporting up to 116 languages including experimental support for old manuscripts. The NID platform has supplemented the OCR processing with additional image pre-processing features. Our experiments yielded greater text detection accuracy when scanned document images were pre-processed with grey scaling and brightness and contrast adjustments. This temporary intermediate backend processing is useful for documents with text having colored or image backgrounds.

Another AI application tested in the NID library system is in the computer vision domain using Object Detection techniques to supplement a conventional text index of a document. The NID library added the YOLO\(^12\) algorithm to its data analytics toolbox. The Object Detection function applied to an object in the NID library detects and recognizes various image objects on a document page. It stores the location and label of the detected object to the standard text search index of that document. At present NID system uses the COCO\(^5\) training dataset capable of detecting 80 object classes.

4.2. Natural Language Processing (NLP)

NLP-based AI algorithms help machines understand human language. Its use gives insights into text available in various documents of a digital library. A NID library contains the experimental feature of “Topic Detection”. Topic modelling in NID is done using Latent Dirichlet Allocation (LDA), an unsupervised approach by extracting the patterns of word clusters and frequencies of words in the document\(^13\). The output of this AI application gives us the gist of contents available in a document. The NID topic detection features make use of detected topics to find similarities among pages of the same document and pages of other documents. The topic modeling can also be used for the automated classification of document clusters in large libraries.

5. Conclusion

In this paper, we discussed how digital libraries must evolve in the wake of mass digitization and the prolific use of the internet. Our initial efforts to introduce inherent collaborations and content co-creation features improve user involvement with the system. The experiments related to data transformation and contemporary as well as unorthodox access mechanism also adds value to interoperability and intellectual property rights areas. We also established that present-day digital libraries are seen as sources of big data. The use of artificial intelligence techniques for seeking meaningful insights from this data is inevitable. We see great potential for further experiments for the applications of cutting-edge natural language processing and computer vision algorithms on conventional library data.

\(^4\) [https://en.wikipedia.org/wiki/Tesseract_(software)]

\(^5\) [https://cocodataset.org/]

Fig. 9.: Search facility of objects without any text description

Fig. 10.: Experimental feature of topic modeling and detection of similar pages.
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Abstract: This paper addresses the topic of the ongoing digitization of previously analog knowledge collections, primarily libraries, i.e., mainly but not exclusively written materials in text format and additionally materials in image, video, and audio formats. A short introduction to digital books explains the extended ways of using them in contrast to their analog predecessors and their incorporation into various systems such as NID (Net Interactive Documents). In one section, the topic of digital libraries is reviewed. A few of the most important representatives are briefly introduced. The 3.2 chapter applies to the software, which can be used for digital libraries. In the main part, an introduction is given to NID (Net Interactive Documents) and its current applications as well as projects planned for the future. Finally, different features of NID are compared with a similar system - Hypothes.is, and the advantages and disadvantages are explained.

Index Terms: digital books, digital libraries, Greenstone, Hypothes.is, IIIF, NID

1. INTRODUCTION

As an after-effect of the immense technological progress that happened in the last twenty years, a large quantity of analog objects are being superseded by digital ones. This includes, but is not limited to, books, photos, and documents.

This process of digitization, from analog to digital objects, allows a user to use an object in a wider and far more versatile way than originally possible, or conceivable. For instance, books are no longer restricted by language barriers or even literacy. Most digital books can be directly translated with as little effort as a mouseclick. In the case of illiteracy, a read-aloud option can be found and used nearly everywhere nowadays. Another advantage of digital books is their availability in the digital realm. There is no hassle of driving to a library or a store, where you have to check if the desired book is even stocked. For digital books it is sufficient, most of the time, to just type the name into a search bar. This is just one of the many reasons why digital libraries are emerging all over the web and slowly succeeding their analog predecessors.

The simplest definition of a digital library is to see it as a container for digital books. A more detailed definition is discussed in later sections. But it is important to know this simple definition, to be able to exclude various www pages and all kinds of databases since these can be containers for various kinds of data and not, as discussed in this paper, digital books, documents, and libraries.

In summary, this paper will focus on digital books, digital libraries, and NID. In addition, examples of software used and a comparison between NID and Hypothes.is will also be presented in the following chapters.

2. DIGITAL BOOKS

A book or document can be simply seen as a medium for conveying information. This includes, but is not limited to, informative facts, educational material, discursive writings, and fiction. An e-book is its digital alternative. A medium in which information is organized and structured to be presented to the reader.[1]

Therefore the definition of an e-book in the Oxford dictionary is as follows: "a book that is displayed on a computer screen or on an electronic device that is held in the hand, instead of being printed on paper".[2]

The earliest e-books were manually typed by volunteers. This process has been almost entirely replaced by digitization or scanning followed by optical character recognition (OCR) to create text that can be edited and viewed on screen.[3] Another approach would be the pure digital creation of a book, without a previous version existing on paper. The term "born-digital" therefore came into existence.[3]

Consulting a book, including e-books, involves the following basic actions: Browsing, searching, extracting, comparing, and evaluating the relevance and quality of the presented information.[1]

Other than reference materials, most books in print form are meant to be read linearly. In
contrast, computer-mediated reading and writing involve opening several windows and skipping from one to another to pursue a line of thought. Some e-books, especially those created for this medium, can exploit this multi-layered nature. For example, additional windows can pop up with more information, movie and audio clips can be inserted into the text, or a reader can navigate an e-book to follow a topic or idea that spans multiple chapters. It may even be possible to make annotations or send a message to the author.[3] All these ideas and applications are incorporated into NID and they are described in chapter 4.

3. **Digital Libraries**

Digital libraries are defined as Internet sites dedicated to the creation and preservation of electronic collections of books and other materials without requiring end-users to purchase the materials they wish to view and read.[4]

Digital libraries include a broad range of materials, from books to depictions of three-dimensional artefacts. Content is either digitally generated or digitally converted from a multitude of analog sources.

The creation of digital libraries has been accompanied by vast digitization efforts to turn the abundance of traditional scholarly and cultural resources held in libraries, archives, and museums into a digital format.[5]

3.1. **Digital Libraries Examples**

3.1.1. **World digital library**

The World Digital Library, established in 2009, was a collaborative project of the U.S. Library of Congress, with support from UNESCO and contributions from libraries, archives, museums, educational institutions, and international organizations from all over the world. The goal of WDL was to preserve and share access to some of the world's most important cultural treasures and significant historical documents to enable discovery, scholarship, and use.[6]

3.1.2. **Project Gutenberg**

Michael Hart created Project Gutenberg in July 1971 to offer free electronic access to public domain literary works. A forerunner in many areas, Project Gutenberg was the first supplier of information services on the Internet and the oldest digital library. With 55 languages and 40 mirror sites across the globe, thousands of books are downloaded each day. Project Gutenberg encourages digitization in "text format," enabling a book to be copied, indexed, searched, analyzed, and compared with other books.[7]

3.1.3. **Universal digital library**

Universal Digital Library (UDL), also known as Million Book Project, is an online information database developed by Carnegie Mellon University School of Computer Science and other university libraries. A number of other universities and government institutions from China, India, the United States, and Europe are also partners in this project.[8]

3.1.4. **The Bavarian State Library & The Munich Digitization Center**

The Munich Digitization Center (MDZ) has been making the extensive collections of the Bavarian State Library (BSB) available on the Internet since 1997. The MDZ is the BSB's central innovation and production unit for the development, testing and realization of new products and processes related to the diverse and extensive topic of digital libraries. With around 2.7 million digitized titles from the collections of the Bavarian State Library and the provincial state libraries in Augsburg, Bamberg, Regensburg and Passau, the Digital Collections are now the biggest service of its kind in Germany, with over 355 million digitized pages.[9]

3.2. **Software Examples Used by Digital Libraries**

3.2.1. **International Image Interoperability Framework format (IIIF) [10]**

IIIF is a technique to universally distribute images, audio, and video data from servers to various Web contexts where they can be viewed and used in a variety of ways.

Modern Web browsers can show file types like .jpg and .mp4 up to specified sizes, but they are limited in most other aspects. The IIIF specifications follow common Web standards that outline how each browser functions to allow using more advanced features outside merely viewing images and audio/visual files. This entails providing deep zoom, comparison, structure (for an object like a book, the structure is defined as the page order), and annotation for images. It involves being able to give complicated structures for audio/visual materials, including many film reels that together make a single movie, along with other elements like captions, transcriptions/translations, annotations, and more.

These things are made to function consistently via IIIF. This makes it possible for materials to be portable across viewers, to connect and unite them beyond institutional borders, and for many other things.
3.2.2. Greenstone [11]

Software called Greenstone is used to create and share digital library collections. It offers a method for compiling data and releasing it online or on portable storage devices like DVDs and USB flash drives.

The University of Waikato's New Zealand Digital Library Project created and circulated Greenstone, which was built in collaboration with UNESCO and the Human Info NGO. It is a multilingual, open-source software distributed in accordance with the GNU General Public License.

The Greenstone program intends to give users the tools they need to create their own digital libraries, especially at academic institutions, libraries, and other public service organizations. In the domains of education, research, as well as cultural heritage around the globe, digital libraries are fundamentally altering how information can be accessed and shared, especially in developing nations.

Creators hope that this software will promote the efficient use of digital libraries to spread knowledge and make it accessible to all.


NID is an innovative system, which allows networking of materials and networking of users with users, experts, and providers.

The term networking materials, as it is understood in this context, is the ability to access additional, referenced, information at any time. This can be a passage in the same or another book, or a contribution to the World Wide Web, regardless of whether it is a text, an image or a multimedia clip. It can be one's own contribution or even be a piece of software offering interesting material. Some of these additions and explanations could even be made specifically to the user's specifications.

This free annotation feature leads to a few basic issues that need to be addressed. The first required and implemented element is a hierarchy of rights. For example, any user (A) can add any annotation for himself, called a private annotation; or for a group (G) of users, also called a group annotation, who have agreed to see A's annotations. Annotations for a wider public are controlled by an editor with special rights, who can share them either only with user A or with the whole group G, or with the public.

A further important aspect is that these annotations are not part of the material itself, but additions to it.

The material itself cannot be edited after it has been uploaded as a NID document. Annotations can also be edited, deleted, or made available to user groups other than the one originally defined, by authorized persons.

Through these annotations, a document in a NID collection can acquire increasing amounts of available information over time. Therefore it is an interesting task to automate or semi-automate this linking between books and other material of interest. In this context, semi-automated means that the system suggests relevant links, but a user decides whether they are useful or not.

At least as important as the aforementioned networking of materials is the networking of users with other users, specialists, and providers. It can be considered a particularly valuable feature of NID that a user (1) can send feedback on any page to the person responsible for the page/document and (2) expect a response. Since any user can start a discussion on any page, NID offers on all sections of the website the possibility that a user contacts the responsible expert, either anonymously or by name, with a request for feedback or comment, or help.

Another quite useful feature of multimedia materials managed using NID is the ability to conduct full-text searches. This is not restricted to real texts, but also covers texts that are part of images. The reason for that is that NID is based on the IIIF standard.[10]

Especially important is to be able to apply the full-text search not only to one book but to multiple books simultaneously. With the majority of full-text search engines, you have to run the full-text search on each item individually. In NID, on the other hand, an entire "category" of documents can be searched with a single request. Besides full-text search, another possible and useful way to search a NID library or category is by author, title, or area.

With NID, multiple pages from different NID or IIIF compliant servers can be displayed on the screen at the same time. This allows a user to view descriptions in different documents simultaneously.

NID software is designed using state-of-the-art programming tools, platform-independent frameworks and components. This means that the software can be used on all major server operating systems. This also includes Windows-based server platforms (also client OS) and Unix/Linux.

5. Hypothes.is is a Short Introduction

The following section focuses mainly on the Hypothes.is web app, open-source software that
anyone can use, it just needs to be installed via a plugin. Hypothes.is lets the user create annotations, not only in documents but anywhere on the web. For this, each user is required to create an account.

Creating annotations via Hypothes.is is quite simple. One only needs to mark a desired word or sentence segment and then choose between the highlighting or annotation functions. When using annotation functions, one can freely choose what kind of annotation, i.e. plain text, links or images, one wants to incorporate. Additionally, tags can be created for this annotation. Tags are single words that should make it easier to search for the annotation. The annotation can be published either privately, within a group, or publicly. To publish annotations within a group, one must either have created the group or have been invited to the group.

6. **NID VS HYPOSES.IS**

There are some similarities between NID and Hypothes.is, however, they perform differently in individual categories and offer various applications.

Hypothes.is is universal, when the software is installed for the browser, one can annotate on any website. In NID, annotations are only possible in NID documents. However, NID has the advantage, as mentioned in chapter 4. that it is not needed to be installed and does not require registration to use it.

Additionally, these two systems differ in the annotation verification process. In NID documents, it is possible, if desired, to use a feature that forwards annotations to a respective expert of the document before they are published. The annotations are then reviewed and if they do not meet requirements determined by the expert, they are not published. Through extensive testing of the Hypothes.is software, it was concluded that there is still no automatic verification of created annotations. That is if a user posts an annotation that doesn't meet the experts' requirements, that is useless, inappropriate, or offensive, it cannot be verified in advance by an authorized person. Such an annotation can only be reported after posting with the report icon to be deleted by the admin, who may not necessarily be an expert in the field. This scenario does not arise when using NID.

Another important aspect is the annotation capabilities. With Hypothes.is, it is possible to annotate the entire web, but this only applies to text paragraphs. One can't mark up images or text in images. With NID, one can annotate anywhere in the specialized NID documents, be it an image or text. This wide range of annotation options is made possible by the IIIF format in NID documents.

Another interesting point is the interactivity between users as well as the validity of comments. In Hypothes.is, users can reply to public comments of any person. There is no certainty that these responses are correct because there is no verification of the responses. On the other hand, in NID, there is no way to reply to annotations. Instead, there is a possibility to start a discussion feature. However, a user can ask a question directed to the expert of the document using annotations, in order to receive a professional and direct answer. With this feature, a certain level of professionalism and validity can be guaranteed. These are two factors, which are very important to the operators of NID.

These were only some differences between the two annotation programs, which were pointed out here. Both offer many more features, but discussing all of them requires a separate paper.

7. **CONCLUSION**

In summary, it can be said that the digital advance will be unstoppable and will accompany us in every area, be it technology, information, or life itself. Therefore, it is important to use a system for digital libraries that is clearly designed, easy to use and can maintain a certain minimum level of quality.

A well-thought-out interaction of the software in systems like NID thus creates a hitherto unique element of high-quality knowledge transfer, not only between digital materials but also between different users and corresponding experts. In addition, the accumulated knowledge can be distributed in a simple way among all interested users. In the age where all the knowledge and ignorance of mankind is just a mouse click away and should be filtered accordingly, this is an important milestone. High-quality collections of scientific material bring a variety of benefits that previous analog collections could not offer. Therefore, it is important to develop and expand unique projects such as NID in order to make the accumulated knowledge available to mankind according to the current needs of users.

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Fuzzy Logic for Educational Purposes
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Abstract: Fuzzy logic is a popular logical system used in many applications in real life. The aim of this article is to briefly explain the basic concepts of fuzzy sets and fuzzy logic. We define an architecture of fuzzy logic systems and their parts. In an example of an air-conditioning system, we show how formal definitions of fuzzy logic are represented in an implementation.

Index Terms: Fuzzy logic, fuzzy sets, fuzzy system architecture, air-conditioning

1. INTRODUCTION
At the beginning of its history, fuzzy logic was the object of scepticism, because the word fuzzy was usually used in a pejorative sense. Logicians often underestimated it, but engineers often used it without considering the logical system of fuzzy logic. Nowadays, fuzzy logic is a subject of intensive studies. The word fuzzy corresponds to what fuzzy theory deals with. It tries to cover reality in its inaccuracy, uncertainty and imperfection. In particular, fuzzy logic can add to existing theories the ability to work with information that we often tell in natural language or perception-based information. In real life, we often encounter vague terms, which we can handle quite well and intuitively.

Fuzzy logic enables to express some vague properties of objects using the concept of the truth degree of some sentence. At present, the systems based on fuzzy logic are widespread in many areas, such as regulation, aviation, automotive systems, and electrical engines of everyday life.

In our paper, we shortly introduce the basic concepts of fuzzy sets and fuzzy logic. We define the syntax of fuzzy formulas and their semantics, where some degree of true in the range $[0, 1]$ is stated. Then we show a typical architecture of a fuzzy system. At the end of our paper, we present a simple example of an air-conditioning system that can help the students to comprehend the principles of fuzzy logic and how they are reflected in the implementation of the fuzzy systems. Our aim is to show how theoretical principles of fuzzy logic can be implemented on a system.

2. BASIC CONCEPTS OF FUZZY LOGIC
In this section, we present basic notions regarding the fuzzy logic that are necessary for the further work.

2.1. Fuzzy Sets
Fuzzy logic is based on the concepts of fuzzy sets. Zadeh [10] introduced the theory of fuzzy sets and fuzzy logic in order to provide a system for solving various problems in which uncertainty plays an important role [2]. A fuzzy set can be considered an extension of classical sets. In a classical set, an element either belongs to the set or does not belong. A fuzzy set is a set that has different membership degrees for elements of a given set. It can be full membership, partial membership and even no membership [11]. Partial membership contains elements that have different degrees of membership in the set [8]. Membership levels lie in the interval between 0 and 1 [6].

Suppose we have a set $X$. A fuzzy subset $A$ of the set $X$,

$$A \subseteq^* X,$$

is characterized by assigning to each element $x$ that belongs to the set $X$ (we write as $x \in X$) its degree of membership in the subset $A$. For example, assume we have a set $X$ that denotes all people and $A$ as a fuzzy set of old people. Everyone is from a certain age-old, but is a 45-year-old? It appears from this example that all the elements of set $X$, humans, have a certain degree of ageing, but it is not precisely determined. Fuzzy logic allows expressing fuzzy terms such as slow, fast, small, large, heavy, low, tall, medium, etc. Thus, if we consider the set $X$ as a universe, we can assign a certain degree of truth to each element of this set. Let $X$ be a universe, that is, a set of objects we work with. A fuzzy subset $A$ of $X$, $A \subseteq^* X$, is defined as an ordered pair

$$A = \{(x, \mu_A(x)) : x \in X\},$$

where

- $x$ is an element of $A$,
- $\mu_A : X \to (0, 1)$ is a function,
- $X$ is a universe, a set of objects we work with.

The fuzzy subset $A$ in a universe $X$ is determined by a membership function $\mu_A$. In fuzzy set
theory, the notation $x \in^* A$ is interpreted by using the membership function in such a way that the degree of membership of the element $x \in X$ in the fuzzy set $A$ is determined by the value $\mu_A(x)$. Therefore, we can say that the degree of membership expresses whether a given element belongs or does not belong to the set and to what degree [5].

As mentioned above, fuzzy sets represent linguistic variables such as slow, fast, small, large, heavy, low, tall, medium, and so on. An element can be a member of more than one fuzzy set at a time. Fuzzy set $A$ with a universe $X$, can be represented as a set of ordered pairs. Each pair in a set consists of a generic element $x$ and its degree of membership. For the element $x \in X$, we define the degree of membership $x$ in $A$ as $\mu_A(x)$, where

$$\mu_A(x) = 1$$  \hspace{1cm} (3)

means full membership of element $x$ in a set $A$, and

$$\mu_A(x) = 0$$  \hspace{1cm} (4)

means that $x$ is not a member of $A$ [9].

2.2. Basic Fuzzy Operators

Operations on fuzzy sets are defined using their membership functions with values in a closed interval $[0, 1]$. Assume again, that $X$ is a universe, $A$ and $B$ are fuzzy sets, where $\mu_A$ and $\mu_B$ are their membership functions, then the basic operations on fuzzy sets [3] are:

- **Intersection** – intersection of fuzzy sets specifies a set whose elements belong to both considered fuzzy sets. The degree of membership is a lower membership value in both sets of each element, therefore the membership function is defined for $x \in X$ as:

$$\mu_{A \cap B}(x) = \min\{\mu_A(x), \mu_B(x)\}.$$  \hspace{1cm} (5)

- **Union** – union of fuzzy sets consists of all elements that belong to $A$ or $B$. The degree of membership will be the greatest membership value and is defined for $x \in X$ as:

$$\mu_{A \cup B}(x) = \max\{\mu_A(x), \mu_B(x)\}.$$  \hspace{1cm} (6)

- **Complement** – complement of fuzzy sets is denoted as $\bar{A}$. Complement contains all elements $x \in X$, which are not in the set $A$. The membership function is defined as:

$$\mu_{\bar{A}} = 1 - \mu_A(x)$$  \hspace{1cm} (7)

2.3. Syntax and Semantics of Fuzzy Logic

The syntaxes of classical propositional logic and fuzzy propositional logic do not differ. It is defined by a production rule. The fuzzy formula, which we will call $\varphi$, can have one of the following forms:

$$\varphi ::= p \mid T \mid \bot \mid \neg \varphi \mid \varphi \lor \psi \mid \varphi \land \psi \mid \varphi \Rightarrow \psi,$$  \hspace{1cm} (8)

where

- $p$ is an elementary proposition,
- $\bot, T$ are logical constants,
- $\neg$ is unary logical connective, negation,
- $\lor, \land, \Rightarrow$ are binary logic connectives, disjunction and conjunction, respectively,
- $\varphi, \psi$ are formulas,
- ( ) parentheses, auxiliary symbols.

An elementary proposition is a simple sentence in which it makes sense to ask whether it is true or not.

In the practical part of this paper, we use input values as variables and we describe some properties or relations on them. Therefore we have to extend the syntax of fuzzy logic by predicates, The production rule is now as follows:

$$\varphi ::= p \mid T \mid \bot \mid \neg \varphi \mid \varphi \lor \psi \mid \varphi \land \psi \mid \varphi \Rightarrow \psi \mid P(t, ..., t),$$  \hspace{1cm} (9)

where

- $P$ is a predicate symbol,
- $t$ denotes a term.

Each predicate symbol has defined its arity, which is a natural number. The predicate $P(t)$ is an unary predicate with arity 1 and it expresses the property $P$ for a term $t$. The predicate $P(t_1, t_2)$ is a binary predicate expressing a relation between the terms $t_1$ and $t_2$. All predicates with arity at least 2 express relations. Such logic with predicates is also called relational logic [7].

Terms are defined by:

$$t ::= x \mid f(t, \ldots, t),$$  \hspace{1cm} (10)

where

- $x$ is a variable,
- $f$ is a function symbol applied to the terms.

The difference between fuzzy logic and classical propositional logic is in their semantics. The standard set of truth values of fuzzy logic is the interval $[0, 1]$ of real numbers with the ordering relation $\leq$. In fuzzy logic, the semantic domain is called G-algebra and is referred to as:

$$\mathbb{[0,1]}_G$$  \hspace{1cm} (11)

where the index $G$ means Gödel. The evaluation function $v$ returns a truth degree of fuzzy formula and it is defined by:

$$v : Prop \rightarrow \mathbb{[0,1]}_G,$$  \hspace{1cm} (12)

which assigns to each formula $\varphi$ a degree of truth

$$v(\varphi) \in \mathbb{[0,1]}_G.$$  \hspace{1cm} (13)
We are talking about absolute truth, if \( v(\varphi) = 1 \) and absolute false, if \( v(\varphi) = 0 \). Generally, for a fuzzy formula \( \varphi \), we denote its degree of truth as

\[
[\varphi]_G.
\]

(14)

Fuzzy formulas are represented as fuzzy sets and the degree of truth is represented as fuzzy membership of these sets in a universe.

3. Fuzzy Logic System Architecture

In practical applications, properties, relations and actions are expressed by fuzzy rules. We introduce them in the first subsection. Then, we can define the architecture of a simple fuzzy system and we describe the process of preparing the applications.

3.1. Fuzzy Rules

Fuzzy rules form the important parts of defining practical applications. They describe on which condition some actions shall be performed. A fuzzy rule expresses an implication, where premise of implication describes conditions and the consequence of implication describes an action. In practical application, these implications are written in the form of if-then rules. A rule has a form:

\[
\text{IF premise THEN consequence.}
\]

where

- the premise is a fuzzy formula expressing some assumptions. It can often be a complex formula containing predicates and logical connectives as a conjunction, AND disjunction, OR or implication, \( \Rightarrow \). A premise is also referred to as an assumption under which some action shall be performed;
- consequence is a fuzzy formula expressing an action, which shall occur when the premise of a rule is satisfied, and which action shall be performed.

Simple examples of the rules can be:

\[
\text{IF (cold) AND (cooling) THEN (heating)}
\]

\[
\text{IF (hot) AND (warming) THEN (cooling)}.
\]

Fuzzy rules describe a problem and provide the ideas on how to solve the real situations, when the following conditions are satisfied:

- We would like to control a given process, so we would like to perform different actions.
- We can define the conditions under which particular actions shall be performed. The conditions are defined based on the relevant area of solved problem, or they are generally known information. For example, it is summer and it is warm in the apartment. If the room temperature is too high, the air-conditioner will turn on and decrease the temperature.
- Input data (input variables) can be measured, computed, or observed. For example, input variables expressing system dynamics can be derivatives, integrals, temperature, time, and many others.
- A system should work automatically, i.e. under valid conditions it should perform desired actions [4].

3.2. Fuzzy Logic Architecture

The fuzzy logic architecture consists of the four parts illustrated in Fig. 1. We shortly describe these parts of the architecture.

1) Rule base – it consists of a large number of if-then rules prepared by experts who manage decision-making in a fuzzy system. Also, fuzzy logic formulas appear in the rule base.

2) Fuzzification – in this part inputs are managed. It allows to process incoming inputs, which are measured by sensors, observed, or computed and transformed to fuzzy sets. These raw inputs are then sent to the control system for further processing.

3) Control system – this part of the system makes decisions, it uses if-then rules for the input data set, and it controls which rule will apply to a given entry. Subsequently, the applied rules are combined to determine the fuzzy value of the output action. So we can say that it simulates a human reasoning process by making a conclusion on given inputs and if-then rules.

4) Defuzzification – it transforms the fuzzy set obtained by the control system into a sharp value [1]. A sharp value serves for a decision on which output action shall be performed.

We note that the whole described process performed by the system is empirical. It needs many tests, debugging, deep experience, and good knowledge of the environment, where the system should work. In the next section we present this process in a simple example of air-conditioning.

4. An Example of Air-Conditioning Using Fuzzy Logic

In this simple example, we illustrate the process of using fuzzy logic for the system of air-conditioning. The simplicity of this example enables students to understand the theoretical principles and their usage in an implementation. First, we consider the environment, where air-conditioning works: a room, an office, a warehouse, a production hall and so on. We present a typical personal situation: we return home from work and we want a certain temperature in our room. Thanks to fuzzy logic, it is possible, so we can come home and feel comfortable.
measure temperature using some sensor(s), and these data are inputs to the system. Now, we need to design our system to achieve desired results.

Consider an air-conditioning system based on a fuzzy logic system. This system sets the air-conditioning temperature by comparing room temperature with the target temperature. The target temperature is set by the user. If we consider a room at home, and it is winter, the desired target temperature could be 23 degrees of Celsius. The air-conditioning system compares the current room temperature with the desired temperature, and it can perform an appropriate action. If the room temperature is 17 degrees, the air-conditioning will heat. If the room temperature is close to 23 degrees, the air-conditioning should not start, and if is 28 degrees, the air-conditioning should cool. Therefore, we can say that the target temperature is a constant which we try to reach to make our environment enjoyable.

In Fig. 2, we present the architecture of the air-conditioning system. As shown in the previous section, we design the air-conditioning system and we show the interconnection between theoretical concepts of fuzzy logic and practical usage. The process of designing a system consists of four parts: fuzzification, rule base, control system and defuzzification.

1. Rule base

We consider a universe $T$, a set of temperatures. We define linguistic variables and terms. Linguistic variables are input and output variables in the form of simple words or sentences. The measured temperature $t$ is our input value. We consider five levels of measured temperature:

- very low,
- low,
- medium,
- high,
- very high.

Our target temperature is 23 degrees, and desirable temperature should be between 20 and 25 degrees. Upon this considerations, we create corresponding fuzzy formulas, that express different temperature levels:

- very-low = $t \leq 12$,
- low = $(t \geq 10) \wedge (t \leq 18)$,
- medium = $(t \geq 16) \wedge (t \leq 25)$,
- high = $(t \geq 23) \wedge (t \leq 28)$,
- very-high = $t \geq 25$.

These ranges are overlaid, they describe fuzzy membership in the universe $T$ and they can be optimized depending on the actual situation, desired results and environment. Our output values describe the actions to be done:

- cool,
- no change,
- heat.

Now, we formulate if-then rules:

- IF very-low THEN heat,
- IF low THEN heat,
- IF medium THEN no-change,
- IF high THEN cool,
- IF very-high THEN cool.

2. Fuzzification

In this part of the system, we specify input and output parameters and their semantics. These values (membership degrees) depend on the actual environment, meteorological situation, and experience. Our input parameters are:

- $t$ is the measured/actual room temperature;
- $c$ is the target temperature.

Fuzzification assigns semantics to formulas. Predicates defined at the syntactic level are represented as a fuzzy subset of the universe $T$. Thus, their semantics is a corresponding fuzzy subset of $T$.

Now, we determine the truth degree of the output parameter:

$[\text{cool}]_G = 0.2,$
$[\text{no-change}]_G = 0.8,$
$[\text{heat}]_G = 0.4.$

These values again come from the actual situation and can be modulated to achieve right results.

3. Control system

In this part of a system, the rules are evaluated on the base of input temperature. Then a degree
of membership (degree of truth) of the temperature in the respective fuzzy subset is determined. Let the actual measured temperature be 15 degrees. Based on the fact that we design an air conditioning system for a home with an optimal temperature range of 20 to 25 degrees, we get the following degrees of membership (degrees of truth) for each formula:

\[
\begin{align*}
J_{\text{very-low}} & = 0.0, \\
J_{\text{low}} & = 0.0, \\
J_{\text{medium}} & = 0.8, \\
J_{\text{high}} & = 0.5, \\
J_{\text{very-high}} & = 0.0.
\end{align*}
\]

Then the control system combines the results of each rule. Based on the combination of the results of the environmental assessment and the probability of occurrence of the event, the control unit determines the fuzzy value of the output action. Let it be:

\[
\begin{align*}
[J_{\text{cool}}] & = 0.0, \\
[J_{\text{no-change}}] & = 0.6, \\
[J_{\text{heat}}] & = 0.5.
\end{align*}
\]

4. Defuzzification

This part of the system of air-conditioning calculates a sharp value of the output action based on the truth degrees obtained in the fuzzification and the values determined by the control unit:

\[
\text{sharp-value} = \frac{\sum (m \cdot o)}{\sum o}
\]

where

- \( m \) is the degree of truth determined by fuzzification,
- \( o \) is the degree of truth obtained by the control system.

The sharp value for our parameters is computed as:

\[
\begin{align*}
\text{sharp-value} & = \frac{0.2 \cdot 0.0 + 0.8 \cdot 0.6 + 0.4 \cdot 0.5}{0.2 + 0.8 + 0.4} \\
& = \frac{0.0 + 0.48 + 0.2}{1.4} \\
& = \frac{0.68}{1.5} = 0.48
\end{align*}
\]

This value is closer to the output value of warm, which means that the room starts to heat up.

This simplified example serves only for educational purposes, the real design of air-conditioning system is more complex. Every change in the environment requires re-evaluating all the parameters to achieve desired results.

5. Conclusion

Fuzzy logic enables work with fuzzy notions. Its usefulness is observed in many applications in industry, human sciences and everyday life. Understanding the principles of fuzzy sets and fuzzy formulas require some simplification, especially if we teach young engineers. Therefore we presented a short theoretical base of fuzzy logic and we showed how these principles are represented in concrete practical implementations. The students are able to implement routines in programming languages, try to design the implementations, and modulate truth degrees depending on the
actual environment so that their implementation produces desirable results.

REFERENCES


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