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# Mapping ‘Women in Technology’ Issue Networks across Bulgarian, Croatian, and Serbian National Google(s)

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*Abstract:* This article explores the intersection between women and technology with an experimental research design that uses online search engine data and digital methods (Rogers 2002, 2004, 2013). We respond to Blagojevic’s (2016) call for online mapping of gender equality stakeholders by incorporating the practice of ‘issue mapping’, which Rogers et al. (2015) conceptualise as a series of techniques that can be used to map the network of actors around a public issue, and to understand the ways they associate with one another. Specifically, we apply the software tool IssueCrawler and its co-link analysis of relevant queries to study national Google search result pages for Bulgaria, Croatia and Serbia. We ask, what types of stakeholders are prevalent around the topic of ‘women in technology’ in the local contexts (demarcated by the national Google result pages) of these three countries? Are they country-specific or do they cross national borders? To what extent do they associate with each other? Which actors are in the centre of the identified networks and which are on the periphery? The authors found that the issue networks of all three countries were heavily dominated by media and government actors, followed by business, entrepreneurial and non-governmental sites, and websites containing information on EU grants. The national specificity, however, was mostly embedded in the groupings of these actors; whether they were densely or loosely interlinked with each other, and whether they were present or absent from the maps.

*Keywords:* Women, technology, web epistemology, hyperlink analysis, issue network maps

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The aim of this experimental research is to gain a better understanding of the status of ‘women in technology’ by incorporating a multi-stakeholder approach and using online search data as our object of analysis. We set out to map the associations between stakeholders in the context of the Google search result pages of Bulgaria, Croatia and Serbia, thus making the informational structure and hierarchies of the national Google(s) visible. The topic of ‘women in technology’ has been widely studied by Bulgarian, Croatian and Serbian

scholars across multiple research fields. However, the potential of using web epistemology and online search data to study societal discussions around the topic, as well as to critically examine the role of technology (in this case, the search engine) in these debates, remains unexplored.

Our paper begins to close this gap, while taking into account the following considerations. Studies on women in engineering and computing in Central and Eastern Europe conducted in the 1990s still found near gender equality in the numbers of male and female graduates, which was (and still is) in stark contrast with prevailing worldwide trends (Durdell 1991; Durdell et al. 1997; Lenzer 2006; Schmuck 2017). During this post-socialist, ‘transitional’ period, however, the CEE countries ‘began to produce the same technological gender effects of their western mentors’ (Durdell and Haag 2002: 530). Recently, the focus of scholarship has shifted to issues of women and labour market transitions (Babovic 2008, 2010; Barkovic-Bojanic and Vinkovic 2006; Beleva 2008, 2016; Djuric-Kuzmanovic 2010; Dokmanovic 2016); the role of information and communication technologies (ICT) in determining current and future employability (Ilieva-Trichkova, Stoilova, Boyadjieva 2015); entrepreneurship and policy making (Keser 2014; Popovic-Pantic 2014a); as well as the effects of emigration and the deskilling of highly qualified female migrants (Beaumont et al. 2017; Beleva 2016).

It is necessary, however, to be critical of the methods typically used to study access to education, participation and representation of women in ICT. Statistical data is important for it makes gender inequality visible. At the same time, it can be a problematic source of information since it *quantifies* gender equality and measures it through gender indicators (Liebowitz and Zwingel 2014). This can be seen as an extension of the business logic of ‘countability’, now applied to the areas of social development and human rights. The articulation of gender equality through numbers and statistics is not reflective of the broader context of women’s rights and gender discourses. Similarly, Babovic (2010), recalling the feminist intervention in the sociological and economic sciences, stresses that economic indicators such as access to the labour market and education do not fully represent gender equality. Deeper knowledge of the contextual factors related to the economic participation of women, she argues, is needed and can be gained through qualitative research that examines both paid and unpaid work. Along similar lines, there is growing criticism of excessive policies and legislation concerning women (in terms of metrics and numbers) on the international, regional and national levels. It is argued, for example, that such policies use gender as an apparatus to ‘understand, measure, regulate, and optimise human fertility, economy, and life’, making women responsible for the reproduction and productivity, wealth and well-being of European societies (Repo 2016: 324).

One of the most extensive critiques of policy making in relation to gender equality comes from Blagojevic (2016). She argues for the need to understand and contextualise gender equality in a way that goes beyond the hierarchical and institutionalised approach of policies and legislation. This approach, she claims, often fails to acknowledge the local specificities of different countries, especially post-socialist ones. She sees the Web and new media as providing opportunities to facilitate less structural and formal relations between stakeholders in the field of gender equality through individualised associations that have expanding horizontal (in opposition to vertical) orientations. Online networks of gender stakeholders, Blagoje-

vic argues, have the potential to become larger and denser, resulting in a situation that simultaneously creates empowerment (by connecting national issues to transnational ones) and tensions (by including political agents that might not be supportive of an issue). Moreover, she states, the web of actors involved in the debate matters more for the issue to evolve and become (socially) accepted than policies that reinforce it from the top down and risk creating complacency. Building on Blagojevic's (2016) call for such an online mapping of gender equality stakeholders, this research asks: what types of stakeholders are prevalent around the topic of 'women in technology' in the national contexts (demarcated by the national Google result pages) of Bulgaria, Croatia and Serbia? Are they country-specific or do they cross national borders? To what extent do they associate with each other? Which actors are in the centre of the identified networks and which are on the periphery?

Considering all of the above, this article aims to contextualise and localise the issue of 'women in technology' and map the stakeholders and their associations (interlinking) using web search data. We use 'women in technology' as an overarching key phrase (Rogers 2017) that is used by governmental bodies (both national and regional), NGOs and media, broadly defined. This enables us to create a horizontal expansion of different types of stakeholders without limiting our research to keywords such as 'gender equality' that are often used in the realm of policy making. We further respond to Blagojevic's call by incorporating the practice of 'issue mapping' which Rogers et al. (2015) conceptualise as a series of techniques that can be used to understand which actors are active around an issue and how they associate with one another. The purpose of this approach is to make issues, actors and the connections between them visible. The theoretical backbone of issue mapping is Latour's (2005) approach to social issues as dynamic states in which actors assemble and reassemble and their associations (traces) become visible. This is especially the case on the Web where actor associations can be traced and measured by using, for example, digital methods that consider the specificity of the medium and that use (and repurpose) the methods embedded in the online platforms, or the ways platforms order and make online data 'ready' for analysis (Rogers 2013). In our case, we aim to locate, analyse and visualise the issue networks around 'women in technology' using the national Google search results for Bulgaria, Croatia, and Serbia and the IssueCrawler, 'a web-based tool that delineates topical formations online by crawling, analysing, and visualizing hyperlinks on the web' (Marres 2015: 658).

We locate, analyse and visualise these issue networks at particular moments in time: first, at the end of 2017 when the preparations for the Bulgarian presidency of the European Council centred around the priority of ensuring the full participation of 'women in the digital world'; second, in early 2018 when, in Serbia, a new gender equality law that was to ensure quotas for female employees was rejected; and third, also in early 2018 when the Istanbul Convention ratification vote caused uproar in both Bulgaria and Croatia. These shared tensions illustrate how all three countries have similar gender equality regimes, which necessitates a comparative study that maps the similarities and the differences in their issue networks. For Blagojevic (2009; Blagojevic-Hughson 2013, 2015) post-socialist societies are transitional societies in the 'semi-periphery of Europe' in which pre-, post- and modernity coexist as a mix of historical time layers. She uses the semi-periphery as an epistemic strategy, following standpoint theory (Harding 1998), to situate the post-socialist countries in a specific social setting, neither at the core nor on the periphery, but in-between a space of per-

manent transitioning. As a result, the gender regimes in ‘transitional’ countries are similar regardless of their level of transformation into modern democracies, and are marked by the ‘imported’ concepts of gender equality (Blagojevic 2009: 50; Blagojevic et al. 2003:33), and the countries structural dependence on but also resistance to Western institutions.

This exploratory research begins with a literature review of how the issue of ‘women in technology’ has been studied in the national contexts of Bulgaria, Croatia and Serbia. After outlining the stakeholders involved in the issue, we elaborate on the methodology and proceed with presenting the common patterns across the country-specific issue maps. We conclude with a discussion of our findings and the implications for further research.

### **Identifying the stakeholders in the discussion of ‘women in technology’**

The purpose of this section is to identify the types of stakeholders involved in ‘women in technology’ and contextualise the issue and related debates through a review of Bulgarian, Croatian and Serbian scholarly research, official statistics and governmental reports. Adopting a comparative approach, we outline the main considerations and topics that have emerged from these studies. However, an extensive literature review is beyond the scope of this paper since our contribution to these debates lies, predominantly, on the methodological level in respect to examining the potential benefit of studying the issue with a multi-stakeholder approach on the basis of online data.

‘Women in technology’ has been studied from multiple perspectives and across different fields related to the broader issue of gender equality, such as the status of women in the ICT sector (Gospic et al. 2014; Ipsos Puls 2010; Vatic 2017), the representation of women in digital media (Tranfic 2017), and the potential of digital technology for movement building, advocacy and activism (Antonijevic 2015; Grzinic 2015; Haralanova 2006; Jankovic 2009, 2012; Mihalec and Sudar 2004). Little research, however, has adopted a multi-stakeholder approach in combination with the use of online data and a critical reflection on the role of technology, for example search engines, and the informational order they perpetuate. We proceed by zooming into the specific types of stakeholders in each country, complementing the academic research with official statistics and reports. It is important to acknowledge that we do not categorise EU institutions as separate actors since their policies and documentation inform the activities of all the other actors, not only in the Bulgarian and Croatian contexts, but also in Serbia.

Statistics show that, concerning the employment of women in the ICT sector, Bulgaria is a clear leader with 27.7 percent compared to the EU average of 16.1 percent (EIGE 2017). In all three countries, women continue to be underrepresented in executive positions in ICT, where their numbers are significantly lower than in other sectors. In Serbia, for example, even though there are twice as many women than men with doctoral degrees in computer programming, they are less represented at the top managerial level. Furthermore, the average wage of women programmers is about €400 lower than men’s (Vatic 2017). In the ICT sector in Serbia, the gender pay gap is 15 percent compared to other sectors where it was found to be around 9 percent (Eurofund 2015). While in Croatia the ICT gender pay gap is the lowest in the South-East European region, it is among the highest in the EU (Honeypot Women in

Tech Index 2018). Research has correlated attainment of higher education with quality jobs, especially for women, motivating women to become highly educated to compensate for their unequal and discriminatory treatment in the labour market (Boyadjieva and Trichkova 2015). In Croatia, this has been exemplified in the higher representation of women in positions which typically have a more educated labour force, such as in financial services (Mrnjavec and Becic 2014).

Discussions on (ICT) education are tightly interwoven with these questions of employability, labour market demands and/or shortages and labour market skills. Governmental measures have been designed to regulate the anticipated trend of an ICT labour shortage in the region, linked to the negative demographic trends resulting from the 'brain drain' and aging population. With the help of the European Union Social Funds (ESF) Bulgaria and Croatia have developed 'educational reform instruments' – policing and monitoring mechanisms for aligning vocational and higher education with the needs of the labour market. Likewise, in Serbia, the 'Strategy of Higher System Development in Serbia by 2020' has set 'harmonisation of education with the labour market' as one of its key priorities. The current educational system has been criticized for being 'anachronistic' with weakly developed cooperation between higher education institutions and businesses, and consequently failing to provide the workforce with adequate qualifications for the labour market's needs (Kisic 2018, Matijevic and Solaja 2015). On the other hand, there is a growing number of private education entities providing training in ICT. In Bulgaria, programming academies (for example, Telerik Academy) are burgeoning and offer free ICT courses funded by private and/or EU funds. In Croatia, Algebra, a three-year pre-university study programme in ICT, ranks as one of the best in the country. Vojvodina Cluster Academy (CA) started in 2010 to fill the gap and connect education with labour market demands. So far, it has held one retraining workshop for women which was subsidized by the Serbian Ministry of Trade, Tourism and Telecommunications. Such initiatives are in line with WTO recommendations that have advised retraining and employability programmes for women in ICT as a corrective measure for the un- and underemployment of women in the Western Balkan region, and to remedy labour supply shortages (World Bank Group 2017). Yet, the marketization trend in education has been criticized. For example, the conceptualisation and implementation of gender-sensitive education in Croatia was questioned from the critical feminist perspective for being limited to goals shaped by neoliberal knowledge production and gender-regulation and for struggling to catch up with rapid technological changes (Kasic and Prlenda 2014).

A strand of literature in educational science and sociology in Croatia found that Croatian female secondary school students perceive especially physics-related programmes (and, to a lesser extent, mathematics), as 'male domains' (Jugovic 2012), which is explained by socialisation that diverts them from STEM fields, and gender-role stereotypes perpetuated in family life, media and the educational system (ibid.). Cultural stereotypes of gender roles have, in fact, been institutionalised in the curricula; textbooks continue to emphasise 'female' maternal and household duties (Baranovic 2000; Knezevic 2012). At the same time gender stereotypes as well as gender expectations in mathematical achievement are less prevalent among today's younger age groups, compared to those of three decades ago (Arambasic, Vlahovic-Stetic and Severinac 2005).

Nonetheless, gender stereotypes are strong across the region and are identified as one of the most significant barriers for the development of female entrepreneurship. Women entrepreneurs are perceived with scepticism (Popovic-Pantic 2014a), especially rural women who remain in a particularly precarious position (Babovic 2012; Blagojevic 2010, Blagojevic-Hughson 2013; Fidanska 2009). Economic necessity, job security and financial gain (defined in the literature as 'push factors') have been the major motivational drivers for female entrepreneurs in Bulgaria, Croatia and Serbia (Fosic, Kristic, Trusic 2017; Radovic-Markovic 2015; Yordanova and Davidkov 2009). Self-employment is the most common type of female entrepreneurship in transitional countries motivated by necessity, which is why female entrepreneurship has long been treated as a social rather than developmental category and as a contribution to economic growth (Popovic-Pantic 2014b). Most female ventures in all three countries are small, 'micro-ventures' (Radovic-Markovic 2015), limited in their financial and human resource potential (Popovic-Pantic 2012a). Female entrepreneurs report financial constraints prevent them from investing in ICT innovation (ibid.).

Recently this trend has started to change as pull factors, i.e. perceived opportunities for starting an enterprise, have become more prominent (ibid.). The sectoral structure of female entrepreneurship has been changing as well. Women have been entering new sectors traditionally dominated by men, including ICT (Popovic-Pantic 2014b; Radovic-Markovic 2009). Statistical data, however, shows that in Croatia and Serbia, women still have the highest share in service sectors (especially trade), social welfare and care sectors (Dokmanovic 2016; Forsic, Kristic, Trusic 2017) while in Bulgaria the highest shares are found in trade, health and social work sectors, followed by professional, scientific and technical activities (EU Commission 2012). An estimated 67 percent of all female enterprises in Bulgaria are in wholesale and retail, the highest share in the EU (GEM 2017). More participation of women in the IT sector is not an indication of knowledge economy (IT technological innovations), but a consequence of bookkeeping services traditionally considered 'female domains' (Babovic 2012: 53). The ICT sector for women has been highlighted for its untapped potential (Keser 2014; Ilieva-Trichkova, Stoilova, Boyadjieva 2015). In Croatia, policy analysts have pointed to the need for a systematic approach to the entrepreneurial education of women, especially in the field of technical science where women lack technical knowledge and expertise (Keser 2014). Furthermore, the creation of a virtual learning network could enhance entrepreneurship education in transitional countries (Radovic-Markovic et al. 2009; Radovic-Markovic 2012). Technological potential is yet untapped and there is a lack of awareness and technological skills among Serbian female entrepreneurs. New technologies could support creative and innovative forms of learning and teaching. However, to achieve this form of education, a synergy between women's organisations, educational and governmental actors is needed (ibid.).

In addition to access to finances, complex administrative procedures present major obstacles for female entrepreneurs in Croatia and Serbia. To address this issue, the first 'Virtual Female Entrepreneurial Centre' in southeast Europe opened in Croatia as a platform that provides female entrepreneurs with legal advice and educational training and serves as a channel to facilitate their promotion (Nedovic, Ivankovic, Cabarkapa, 2016). The burgeoning entrepreneurial literature in Serbia thus far tends to lack a gender perspective. Feminist economics could shed more light on the possibilities and constraints for gender emancipation and struc-

tural changes in the context of a neoliberal, market-driven state at the semi-periphery of Europe (Djuric-Kuzmanovic 2018).

In the context of women's movement activism, ICT has a long history in the region. One of the early examples of cyberfeminism was the anti-war campaign 'Zamir Transnational Net' (ZaMir), a bulletin board system utilized by peace activists across Yugoslavia to exchange emails and files that later developed into 'Zamir Transnational Network' with 'nodes' in most of the major cities of the former Yugoslavian republics. More than 50 percent of Zamir users were women (Grzinic 2015). In Bulgaria, during the early 2000s, the not-for-profit organisation 'Gender Education Research and Technology Foundation' (GERT) provided regional training for women in the strategic use of ICTs (e.g. open software) (Haralanova 2006). ICT has also made it possible for feminists in Bulgaria to connect to women's rights movements regionally (ibid.). 'Women's Information Technology Transfer' (WITT) launched a web portal in Eastern and Central Europe in 2010 to connect women's organisations and feminist advocates. WITT has its roots in trainings organised by the 'European and North American Women Action' organisation (ENAWA). The training included editing images, web design, online communication and introduction to the Free Software (FS) concept and were mainly held in Zagreb (Croatia) and Belgrade (Serbia). Recently, a local chapter of the 'Global Women in Technology' was established in Bulgaria. The Bulgarian Centre of Women in Technology (BCWT) focuses on bringing together various stakeholders to support women's education, employability and entrepreneurship in the ICT sector, and to develop and promote local and regional innovative tech products and projects (BCWT 2018). In Serbia, NGOs with a specific focus on 'women in technology' are 'Women in Tech' and 'Equal Opportunities'. The latter is an especially active actor that engages in the topic such as through panel discussions, mentoring events and online courses in gender equality.

Furthermore, a prominent women's association in Serbia called 'Women's Platform for Development of Serbia' has placed 'women and technology' on their list of priorities. The organisation defines main indicators for 'gender in IT' and identifies the main challenges at the structural level, for example the lack of governmental support for female ICT entrepreneurship, inadequate utilization of ICT in achieving gender equality and enforcement of gender equality via legislation and specific measures (Nikolin and Vladisavljevic 2016). Croatia has especially active feminist web portals: Vox Feminae, Libela and Muf. In 2016, the 'Vox Feminae Festival' organised 'Knitting Code' workshops for women. These were free backend and frontend programming workshops during which women learned to design an application to create and send e-postcards. Other recent examples of women's activist ICT projects include FemWiki (addressing the gender bias in Wikipedia pages written in the Balkan's languages) and the 'Safe' mobile app for women developed by the Autonomous Women's Centre Serbia to fight violence against women.

All that was discussed above has been informed by various governmental frameworks and legislation at the global, regional and national levels. The EU and its respective bodies (EU Commission; European Institute for Gender Equality) and other leading European organisations (the European Centre for Women and Technology; The Council of Europe) have enacted United Nations road maps dating back to the mid-1990s that tackle the role of women in the media and seek to increase their role in the digital world by prioritising access to education and training programs, gender balance, reducing stereotypes in the portrayal of



women, increasing gender equality and empowerment, removing barriers to ICT education and training for young girls, encouraging female-driven entrepreneurship and innovation, increasing participation in decision-making on and design of the Information Society, uprooting all forms of discrimination and promoting equal rights and opportunities for leadership.

At the national level, the issue of gender difference in STEM fields has gained attention, largely driven by the Europe 2020 strategy adopted in 2010 which aims to close the gender gap and increase the share of female graduates in these fields in order to support sustainable development. Bulgaria, Croatia and Serbia have also developed an elaborate legislative framework to align with EU legislation in respect to gender equality, anti-discrimination, fighting human trafficking and domestic violence. Bulgaria, in fact, has positioned its 2018 Presidency of the Council of the European Union around the role of women in the digital world. The latest overarching frameworks for gender equality in Serbia are the National Strategy for Gender Equality for the period 2016–2020 and the Strategy of Prevention against Discrimination. These documents define strategic measures to be taken, among others, around improvement of women's status in the labour market, legislation concerning equal pay, stimulation of entrepreneurship, empowerment of rural women, and, with regards to the women in technology issue, empowering young girls, improved access to traditional men's occupations in science, technology, mathematics and engineering, increasing participation of women in these fields and the inclusion of women in decision-making on technological development.

The literature review outlined in this section has identified the following dominant stakeholders around the issue of 'women in technology': the labour market, educational, entrepreneurial and governmental actors as well as NGOs. We further noted that a multi-stakeholder approach towards the issue is missing in the Bulgarian, Croatian and Serbian academic research. Moreover, there was a lack of use of online data as part of the research corpora, as well as a lack of critical evaluation of specific online media technologies and the ways they intervene in the discussion. We proceed with proposing an experimental research approach in which 'women in technology' is studied using the technique of issue mapping through hyperlink analysis.

## **Methodology**

In her call for research that maps transnational gender issue stakeholders Blagojevic speculates about the potential of the Web as a space with 'less formal and more individualistic ties' as opposed to the 'institutionalised and hierarchical' ties found on the ground where 'gender policies are being defined according to the set of prevailing influences of different organisations and donors' (Blagojevic 2016: 12). Blagojevic assumes that the Web might invite different actors than the EU and governmental bodies, as 'new ideas and approaches develop from the web itself, from different encounters of different stakeholders, from different knots in the web of communication' (Blagojevic 2016: 11). Our research experiment is thus an exploration of how such a 'web of stakeholders' could be produced by deploying digital methods, in particular the IssueCrawler, and what the possibilities and the limitations are of such mapping.

For many online ethnographers, hyperlinks have a symbolic meaning: they can imply authority, connectivity, and have other contextual functions (Beaulieu 2004, Kleinberg 1999). Various forms of hyperlink analyses investigate online communities by focusing on linking as a marker of sociality, while others use it to diagnose the status of an issue. The latter is based on citation analysis methods (webometrics) which treat links similar to academic citations signifying relevancy and importance. Online tools, such as the Issue Crawler, crawl the lists of websites for outgoing hyperlinks (so-called 'outlinks'), locate the hyperlinks between them (inter-actor analysis) or between them and beyond them (co-link and snowball analyses) and visualise the corresponding interlinking. The visualization of this interlinking shows the directionality of the links as well as the absence of links in the form of network graphs (Venturini 2010).

The automated hyperlink analysis captures only websites that share the hyperlinks (as a signifier of their association); it omits in-text references, although these can also be indicative of their relations. In addition, links might be broken and other technical difficulties can obstruct the collection of data, such as server problems or JavaScript errors. Consequently, searching websites 'internally' for relevant 'keywords' and a more in-depth qualitative analysis is advised to complement the crawling (Rogers 2017). A further limitation of the hyperlink analysis is that it captures the pages or hosts on the web, but not hosts on social media platforms (user profiles and pages). Instead, it only points to the social media platforms themselves.

In our analysis of the national actors and their associations around the issue of 'women in technology', we depart from the following considerations. We employ the digital methods framework for issue mapping in which the search engine is repurposed for social research and the hyperlink analysis enables us to make visible the presence and absence of actors to understand 'societal formation and conditions on the web' (Rogers et al. 2015: 30). Secondly, we capture how national multi-stakeholder issue networks are constituted through the national Google search engine domains (Google.bg, Google.hr, Google.rs). Here, national domain Googles were used as a method of demarcating online 'national' spheres (Rogers et al. 2009). When conducting analysis with a search engine to locate actors through search terms, it is necessary to be attentive to search engine optimization bias in the ranking of actors (e.g. non-optimized websites might be excluded from the results). Defining the issue space is contingent on the very devices we are using and our own input. Therefore, we used the advanced settings to enable national results in national languages and set up a 'research browser' to avoid personalisation bias. To demarcate the issue, we started inductively from querying the national Google(s) for relevant keywords in the corresponding languages. From the generated results we then built lists of URLs by combined queries and country. We further cleaned the lists by removing the Google related URLs, duplicates and large national media sites since their clustering was 'polluting' the issue network.

The cleaned URL lists were used to initiate crawls (as 'starting points' or 'seeds') in the IssueCrawler to perform the co-link analyses. The total number of starting points for all three countries was 136 page URLs. The tool crawled the outlinks of the seeds and their outlinks for a set number of two iterations resulting in a corpus of 21.415 URLs that were analysed based on the measure of the co-link. The resulting map constituted a network of actors (sites) that interlink or have two links in common in the issue network for each country. The co-link

analysis is performed by selecting a 'page' option that enables us to follow the directionality of links as a means to trace the selective associations between actors (Rogers 2004). The way these sources interlink with each other (and other sites) has directionality and intent, and could be seen as a demarcation of an issue space (Rogers 2012; Rogers et al. 2015). This space can then be visualised in network graphs that render not only the actors but also their associations visible (their strength and directionality), as well as their position (central, peripheral, or part of a cluster) in the issue space.

Data was recorded separately for each country and iteratively at different points in time (in October 2017 and in January 2018) to see if and how the issue had changed during the time period. As discussed above, several important events took place at the end of 2017 and the beginning of 2018. No major effects in the composition and the hierarchy in the search results over time were found. We also compared the results collected with different search settings in Google (e.g. 'no time preference'; over the 'last year'; 'last week'; 'last month) to compile the most complete list of results. However, we did not find a significant difference in the returned results, except that they were more media and news site-driven when set to more recent results.

## Results

The first co-link analyses in all three countries returned overshadowing grouping around a few types of actors: national and specialised media (that share common ownership and heavily interlink within each other), governmental and EU actors. To be able to follow the multi-stakeholder approach, we removed the major media and government sites from the list of seeds and performed the crawl again. We removed these seeds to lessen the effects of Google as a platform with a specific information order that prioritises mainstream and search-optimised sources 'at the expense of scope of representation and exposure to a range of arguments' (Rogers 2004: 164). The second map again revealed a strong presence of media and government sites, but also included business, entrepreneurial and educational actors, and a (sparse) presence of NGOs across the issue networks of all three countries. We rely on Venturini's framework (2015) for analysing the issue network maps through the characteristics of clusters, sub-clusters, density, centrality and periphery of the maps.

For all three countries, we found that the types of stakeholders included media, governmental, business and entrepreneurial actors, EU grants sites and non-governmental sites. Media and national governmental and EU actors dominated all three issue networks. The national specificity, however, was mostly found in the composition of the maps and the ways the actors were grouped or clustered (i.e., whether they densely or loosely interlink with each other). We proceed with the analysis of the maps guided by our research questions regarding the type of actors (the literature review suggested the dominance of labour market, educational, entrepreneurial, NGO and governmental actors), the associations among them and their position in the issue networks, and their national, cross-border or EU-specificity.

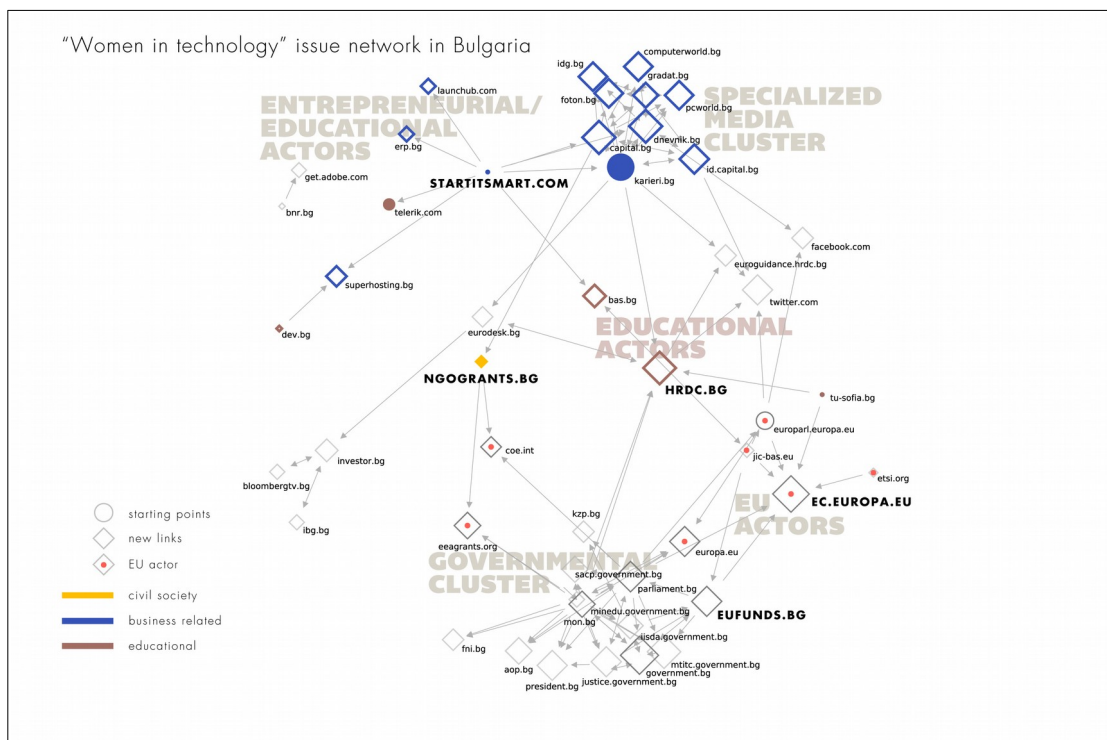
### Types of actors

The types of actors present in all three national issue spaces follow the categorisation of prominent stakeholders identified in the literature review. In all three countries, the topic of 'women in technology' strongly resonated through ICT specialized media sites, and there is a presence of institutional actors, specifically EU and governmental actors. This corresponds to the issue topology described by Blagojevic (2016) with respect to semi-peripheral countries: the agenda and the discussion around an issue is often top-down driven and enforced from the core (that is, EU institutions).

Yet, we observed some level of specificity to each national issue network. The Bulgarian issue network (see Figure 1) prioritises EU (ec.europa.eu; europa.eu), governmental actors (government.bg; parliament.bg; president.bg) and grants sites (from the governmental eu-funds.bg to the non-governmental sector's ngorgrants.bg). Furthermore, there are traces of the knowledge economy: the Bulgarian Academy of Science (bas.bg) functions as a connector between the educational and the entrepreneurial actors.

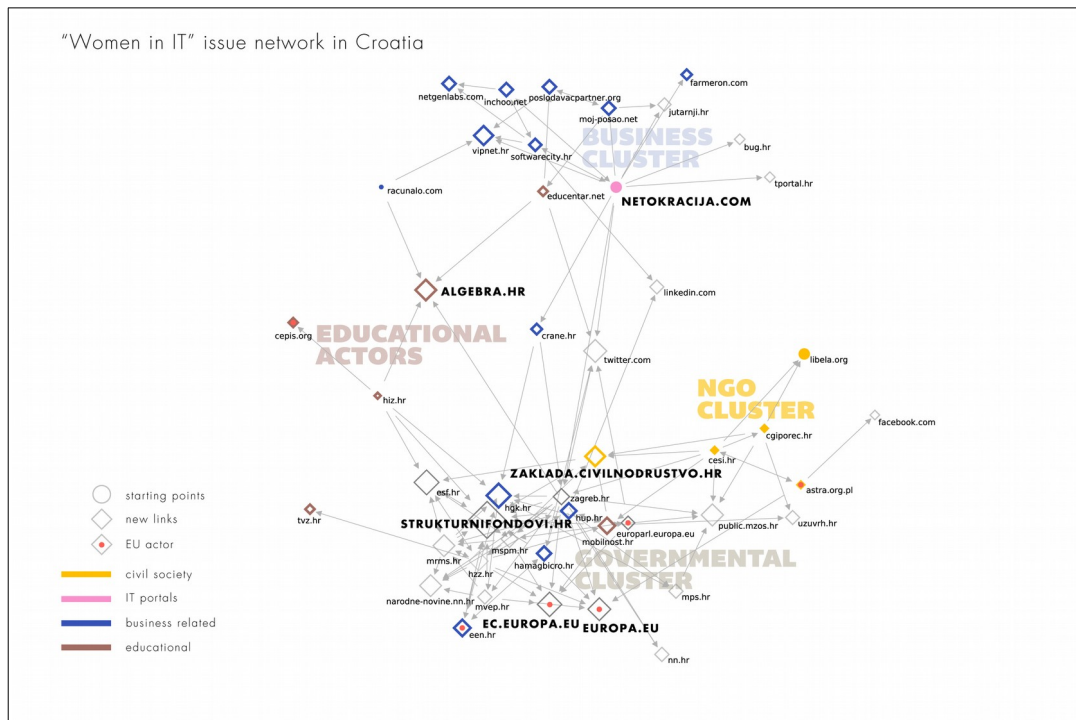
The entrepreneurial scene is located on the periphery of the network (top left corner of the map) and does not associate itself with funding and EU grants sites, nor with each other or other types of actors. Similar to the Bulgarian map and also the Serbian map, as will be discussed below, the issue network in Croatia (see Figure 2) is dominated by governmental actors, which are heavily interlinked among themselves but loosely connected to other actors such as non-governmental organisations, educational and business sites.

**Image 1.** 'Women in technology' issue network generated on the basis of Google.bg results



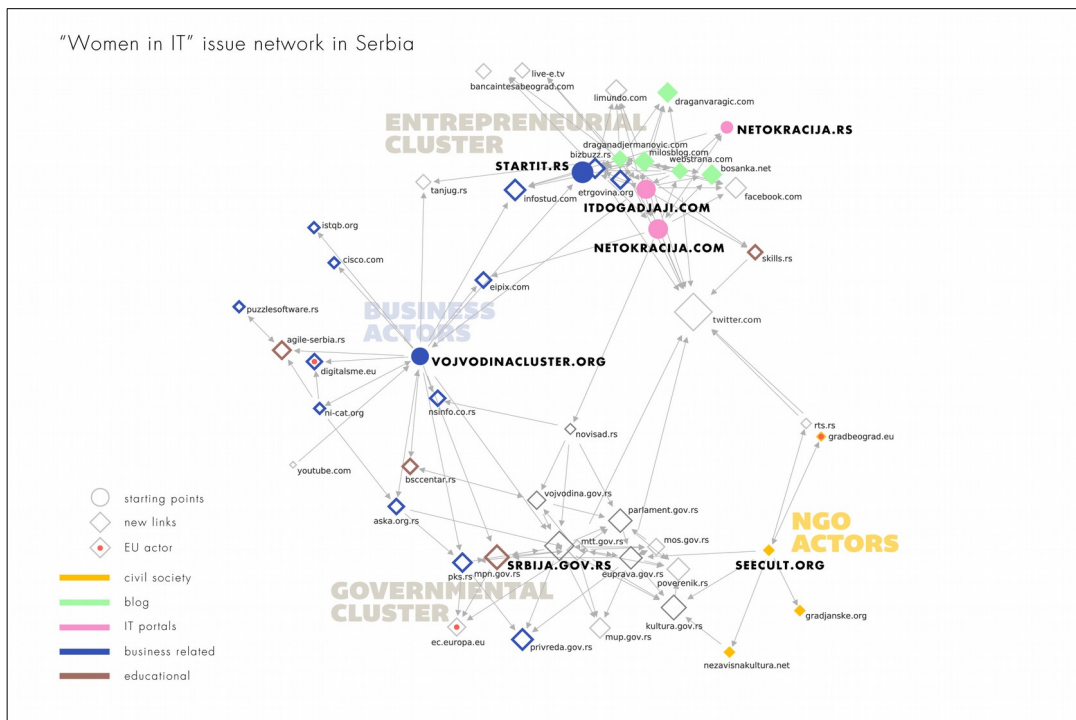
Source: IssueCrawler

**Image 2.** ‘Women in Technology’ issue network generated on the basis of Google.hr results



Source: IssueCrawler

**Image 3.** ‘Women in Technology’ issue network generated on the basis of Google.rs results



Source: IssueCrawler

One of the most prominent nodes in the Croatian network is [zaklada.civilnodrustvo.hr](http://zaklada.civilnodrustvo.hr), the 'National Foundation for Civil Society Development', which is the leading public institution for the cooperation, linking and financing of civil society in Croatia. Next to it, there is a small, peripheral NGO cluster comprised of a few nodes including the Centre for Education Counselling and Research ([cesi.hr](http://cesi.hr)), a Croatian NGO dedicated to protecting women's and minority rights, and Libela ([libela.org](http://libela.org)), the feminist media portal on gender and democracy mentioned earlier. The other prominent actors in the network are local and regional government sites: The Ministry of Demography, Family, Youth and Social Policy ([mspm.hr](http://mspm.hr)), the Croatian Chamber of Commerce ([hgk.hr](http://hgk.hr)) and the main portal of the European Union ([europa.eu](http://europa.eu)).

Compared to Serbia, the Croatian map has more international actors, primarily EU institutions and organizations such as [europa.eu](http://europa.eu), the European Commission, the European Parliament, Enterprise Europe Network, Council of European Professional Informatics Societies and European Social Funds Croatia. However, at a higher crawl depth, the World Trade Organisation (WTO) also emerged as an actor and this was unique to the Serbian issue map. Furthermore, there are many other government actors among the 20 most prominent nodes of the Croatian network: the Croatian Employment Service ([hzz.hr](http://hzz.hr)), the Ministry of Science and Education ([public.mzos.hr](http://public.mzos.hr)), the Ministry of Labour ([esf.hr](http://esf.hr)), the EU Structural and Investment Funds ([strukturnifondovi.hr](http://strukturnifondovi.hr)) and the Enterprise Europe Network ([een.hr](http://een.hr)), funded by the European Commission to support business innovation and the development of local business.

In addition to the government and the EU, educational actors are prominent, including the University of Applied Sciences in Zagreb ([tvz.hr](http://tvz.hr)), a specialized educational portal ([educentar.net](http://educentar.net)) and the Croatian Information Technology Association ([hiz.hr](http://hiz.hr)). Mostly they are grouped around Algebra ([algebra.hr](http://algebra.hr)), which is a leading Croatian private ICT educational institution. Lastly, there is a prominent business or IT-related cluster. The IT portal [netokracija.com](http://netokracija.com) is high in the actor rankings (it also appears in the Serbian map, see Figure 3). [Netokracija](http://netokracija.com) is interlinked with [inchoo.net](http://inchoo.net) and [softwarecity.hr](http://softwarecity.hr), an e-commerce business and a business association of IT companies in Osijek that, combined, form the IT sub-cluster (here we see 'geographically motivated' hyperlinks demarcating a region in Croatia). The business cluster is networked with a group of IT companies ([vipnet.hr](http://vipnet.hr), [netgenlabs.com](http://netgenlabs.com)) and job-search and recruitment portals ([my-job.net](http://my-job.net), affiliated with [almacareer.com](http://almacareer.com)). The Croatian and Serbian maps notably include the presence of funding actors, such as Hamag-Bicro ([hamagbicro.hr](http://hamagbicro.hr)) and 'BankaIntesa' ([bankaintesabeograd.com](http://bankaintesabeograd.com)). Both of these target women (and other 'small') entrepreneurs.

Although there is no prominent presence of international IT companies in the Serbian issue network, there are local IT companies and national and EU business associations in the network, e.g. [puzzlesoftware.rs](http://puzzlesoftware.rs) and [eipix.com](http://eipix.com) (game design companies), and the European Digital SME Alliance, which is the largest network of ICT small and medium sized enterprises in Europe. Furthermore, there is a sub-cluster of bloggers and digital entrepreneurs in the Serbian issue map: [draganadjermanovic.com](http://draganadjermanovic.com) (blog about PR, new media and communication), [webstrana.com](http://webstrana.com), [jasnakamatovic.com](http://jasnakamatovic.com) (tech-blog).

In contrast to the Croatian and Serbian issue networks, the Bulgarian map did not return any women-related non-governmental actors, even though the seeds included the Bulgarian Centre for Women in Technology ([bcwt.bg](http://bcwt.bg)) and the Centre of Research and Politics of

Women (cwsp.bg). The only notable NGO presence is ngogrants.bg, a joint funding program of Open Society Sofia and the Foundation of Citizen Initiatives that offers grants for civil initiatives and is associated with the media cluster in the map. We further investigated the absence of the topical ‘women in technology’ NGOs from the Bulgarian map by looking at the inter-actor associations from the starting points (the list of URLs from the Google.bg search results). Unlike the co-link analysis that crawls and maps based on outlinks that have at least two starting points in common, the inter-actor analysis shows the interactions between the starting points (seeds) only. The two NGOs that were located this way, and were absent from the co-link map, were located on the periphery of the inter-actor network (the central actor was the media outlet capital.bg). However, it is important to note that the Bulgarian Centre for Women in Technology (bcwt.bg) actively associates and embeds itself in an entrepreneurial sub-cluster by linking to pages on how to code platforms, networks for co-sharing workspaces, and through several competitions targeting young female entrepreneurs.

The Serbian issue network, on the other hand, did reveal a group of NGO actors, albeit peripheral to the network and with loose associations. Here, seecult.org appeared as an unexpected actor in the issue space. SEECult positions itself as a regional cultural portal for southeast Europe and has been a promoter of cultural integration in the region for the last fifteen years.

#### *Types of association between the actors and positions on the issue networks*

The three national maps show that most of the clusters of governmental, EU, business and entrepreneurial actors are located on the periphery of the issue networks. The node that has some centrality on the Bulgarian issue map is hrdc.bg, a site for students’ mobility under the Erasmus+ program. On the periphery, at the bottom and at the top of the network, there are two clusters formed around Bulgarian government sites and media outlets specialised in technology and business. On the top left periphery of the issue map there is a grouping of entrepreneurship and training start-ups, venture capitalists and software companies that do not fully cluster or position themselves centrally to the ‘women in technology’ issue space. The central actor there is startitsmart.com, an entrepreneurial franchise that is also present on the Serbian issue network. It is interesting to note that this grouping has a direct association with the Bulgarian Academy of Science (bas.bg) which functions as a connector between the educational and entrepreneurial actors, making explicit the push for a better match between the skills of the graduates and the labour market needs identified in the literature.

The densest cluster on the Serbian map had the following prominent nodes: vojvodina-cluster.org, netokracija.rs, netokracija.com, startit.rs and itdogadjaji.com. They are all focused on the issue of women and ICT from an entrepreneurial perspective. Startit.rs is an organization that supports start-ups in Serbia. IT Events (itdogadjaji.com) is an ICT information hub. Netokracija.com (and netokracija.rs) is a popular regional IT portal, labelled by TechCrunch as the ‘TechCrunch of Southeast Europe’ (Biggs 2013), that also supports digital businesses and start-ups, and is an organiser of the ‘Ladies of New Business’ conference and the ‘Digital Karanfil’ mentoring conference which takes place in Belgrade, Ljubljana and Zagreb to encourage cross-regional female (tech) entrepreneurship.

In the Croatian issue network educational actors are more sizable and prominent, when compared to the Serbian map, including the University of Applied Sciences in Zagreb (tvz.hr), educentar.net (a job-search portal offering various training courses) and hiz.hr (the Croatian Information Technology Association). Mostly they are grouped around algebra.hr, a private educational institution that is almost centrally positioned in the network and functions as a connector of the two main business and government clusters.

Another important find is the smaller sub-cluster of NGO actors that appear in the Croatian issue network. Significantly, the highest ranked NGO in the cluster is libela.org, the Croatian media portal specialised in gender and democracy.

### *Local, national and cross-border specificities*

We found that the Serbian issue network for 'women in technology' has the most national actors from different Serbian regions, and the lowest presence of EU actors. The one that stands out is the cluster connected to Vojvodina (it forms a 'star' on the map on the left, around vojvodinacluster.org), and a smaller and less prominent Nis-related sub-cluster around niscat.org, a business organisation of ICT companies in the city of Nis. The Vojvodina ICT Cluster (vojvodinaictcluster.org), that describes itself as 'a single point of contact with the best ICT companies', was started through a bottom-up initiative by the local ICT companies. As mentioned earlier, it has an IT College (ICT Cluster Academy), which received funding from the Ministry of Trade, Tourism and Telecommunication for retraining women for ICT jobs. It is the most connected and the most prominent actor in the Serbian issue network as seen through the number of outlinks. Additional local specificities in the Serbian map are centred around the presence of national and EU business associations and the sub-cluster of digital entrepreneurship bloggers.

The presence of specialised NGO actors, especially a feminist media portal (libela.org), is specific to the Croatian issue map. An interesting cross-border EU related actor is the Polish ASTRA Network (astra.org.pl), a Central and Eastern European Women's Network for Sexual and Reproductive Rights and Health, which is interlinked with the Centre for Education, Counselling and Research (cesi.hr), a Croatian NGO dedicated to protecting women's and minority rights.

The Croatian and Bulgarian maps have more European-level actors than the Serbian network, primarily EU institutions and organizations (European Commission; European Parliament; Enterprise Europe Network; Council of European Professional Information Societies). The most prominent actor in the Bulgarian map, in fact, is not a national but a transnational one: the European Commission portal ec.europe.eu, which received 4,540 links from the crawled population. The links were directed from an NGO site for information technology protocols and standards (etsi.org), a Bulgarian government site that lists EU structural subsidies (eufunds.bg), the Bulgarian Parliament (parliament.bg), the Centre for Innovation of the Bulgarian Academy of Sciences (jic-bas.eu) and the University of Technology (tu-sofia.bg). Even though the European Commission portal ec.europe.eu received the most commonly shared links from the network, it did not send any links back to the network. Additionally, we found two more actors that cross the national borders: Startitsmart has franchises in Bulgaria and Serbia while Netokracija.com is present in both the Croatian and Serbian maps.



To summarise, the actors in the issue networks of Bulgaria, Croatia and Serbia generally follow the typology of gender stakeholders identified in the literature review. Zooming into the similarities between the three national maps, we found the dominance of governmental and media actors that are on the peripheries of the networks, a weak presence of non-governmental organisations active on issues related to ‘women in technology’ and an increasing importance of business and entrepreneurial actors. At the same time, the differences across the issue networks stem not from the types of actors but from the ways they associate (or not) with each other: the prominence of educational actors in Croatia that connect the government and business clusters, versus the clustered regional grass-rooted ICT entrepreneurship in Serbia, and the website of the Bulgarian National Academy of Sciences that bridges the educational and the entrepreneurial groupings in the case of Bulgaria.

## Discussion

This article proposes to study the issue of ‘women in technology’ following a multi-stakeholder approach, utilising online data and critically addressing the role of online technologies (search engines) in the ways they stage the discussion around an issue. Taking the issue of ‘women in technology’ as represented across the national Google search result pages of Bulgaria, Croatia and Serbia we were able to respond to Blagojevic’s (2016) call for mapping the gender stakeholders by using the IssueCrawler and its co-link analysis option. We found that in terms of types of actors (labour market, educational, entrepreneurial, NGOs, governmental) the actors identified in the issue networks follow the general categorisation known from previous studies. However, we were able to augment this categorisation with a further understanding of how actors associate (or not) with each other via hyperlinks; the positions they occupy in the issue networks (centre or periphery); and the similarities and the differences between the three national maps (the prevalence of governmental and EU actors). Moreover, we made visible the horizontal expansion of gender stakeholders that Blagojevich (2016) refers to with the finding of two unexpected actors: SEECult (regional culture and art NGO) and ASTRA (the Central and Eastern European Women’s Network for Sexual and Reproductive Rights and Health).

We were also able to identify absences from the national issue networks: the Serbian network returned few educational actors; the specialised ‘women in technology’ NGOs were included among the starting points, but were not returned in the Bulgarian and Serbian maps; international IT companies that have local initiatives and projects such as Microsoft were generally absent (except for Cisco), as were the voices of women who actually work in this sector. We did not encounter a strong feminist or women’s rights movement either, even though they have an online presence and a long history in the region. These absences can be interpreted in two ways: first they are indicative of a lack of association with the issue online through hyperlinks (Antonijevic 2013), for example, has noted that women’s organisation websites rarely interlink and encourages them to do so). Second, they may point to a limitation of our experimental design to study the issue via a co-associative hyperlink analysis.

Zooming into the limitations of the study, our starting points were a set of generic queries in the national Google domains of Bulgaria, Croatia and Serbia. An alternative approach

would have been to begin with a list of specialised actors and follow their associations. We decided to do so in order to also further investigate the role of Google rankings in national search engine result pages since the company is heavily implicated in 'alleged' discrimination against female computer scientists and engineers. The way Google becomes an actor is by privileging the familiar and the establishment (media and government) and rendering other online spaces (connected to, for example, local initiatives and activist groups) less visible. The predominance of news sites, news aggregators and specialised media that we found across all three national search result pages may significantly affect how the topic is viewed by those who use the search engine to access information. Simultaneously, our findings provide further insights about those online media spaces that are highly optimised, click-driven, and focused on ad revenue (and therefore are ranked highest in the list of search results).

Finally, there are limitations to the ways we generally read and interpret network maps (Venturini 2015). Therefore, it is important to restate that we have aimed to understand how the issue of 'women in technology' materialises in a specific moment in time in the context of the national Google search result pages of Bulgaria, Croatia, and Serbia. The nature of these networks is a dynamic one; therefore, we call for further studies positioned in a multi-stakeholder setting that employ online data and critically reflect on the role of (online) technologies in the shaping of this issue.

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