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THE FOURTH INDUSTRIAL REVOLUTION IN THE CROATIAN CONTEXT: SCIENCE FICTION OR A NEW DEVELOPMENTAL PARADIGM?

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The article examines prospects of directing the development of Croatian society towards the Fourth Industrial Revolution or Industry 4.0. Relations among overlapping relevant concepts are clarified in the first section. The following analysis comprises results of the qualitative study based on 12 semi-structured interviews with representatives of the entrepreneurial sector, state officials and scientists closely connected with the development and application of AI and robots. The findings suggest that respondents advocate for fostering Industry 4.0 by recognising its potential, but also identify obstacles regarding its implementation. It is concluded that Industry 4.0 is most likely to emerge as a "localised" process, as: 1) the smart specialisation of specific technologically most advanced products; 2) a primarily regional phenomenon that will appear in the north-west counties.

Keywords: artificial intelligence, developmental paradigm, digital transformation, the Fourth Industrial Revolution, Industry 4.0, robotisation

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INTRODUCTION

Once what could only be seen in science fiction movies, now has become an integral part of everyday life: smart phones, smart bank automatic machines, diverse robots for material production, and numerous other devices and services based on artificial intelligence (AI), robotics and automated systems imitating human's intelligent actions (comp. EC, 2020a). Many scholars claim that new technologies are just visible signs of a broader and deeper shift – a new technological transformation (comp. Baumol, 2002; Brynjolfsson & McAfee, 2014; Goldfarb & Tucker, 2017), which is known as *The Fourth Industrial Revolution*.

While technical, economic and natural sciences have taken a leading role in explaining the new technological revolution, the same does not apply for sociology, which is lagging behind in understanding the social effects of new technologies. The sociological standpoint regarding this issue can be summarised in Boyd's and Holton's (2017) questions: does artificial intelligence and robotics really mean social transformation? What type of social transformations have been taking place? How can social and economic consequences implied by AI and robotisation be recognised?

The aim of this paper is to examine the social, political and economic features of AI and robotisation as possible development resources in Croatian society, i.e. to discuss the potentials that technologies anchored in AI and robotics present for a novel developmental trajectory. In order to assess the Croatian position in the Fourth Industrial Revolution landscape, a qualitative research was conducted, which includes the analysis of interviews with experts closely connected to developing AI solutions and robots. Firstly, four pivotal intertwined concepts (*digital transformation, the Fourth Industrial Revolution or Industry 4.0, artificial intelligence*, and *robotisation*) are examined.

CLARIFYING CENTRAL CONCEPTUAL CATEGORIES

Digital transformation, The Fourth Industrial Revolution, AI and robotisation

Castells' (2000) thesis on the emergence of *network society* intensified sociological interest for the research of world-wide digital transformation. From 2010 we witness a slow yet steady rise of *digital sociology*, mostly elaborated in the literature about digital transformation and its impact on human lives and work (Orton-Johnson & Prior, 2013; Lupton, 2014; Marres, 2017; Selwyn, 2019; also Helbing, 2019).

Diverse sociological explanations about the digitalisation[1] of society and economy are grounded in the thesis that "being

digital" has become a "total social fact" (Marres, 2017, pp. 12-17). Digitalisation has a strong impact on individuals, institutions, enterprises and collectivities, as well as on mutual relationships among distinctive actors at the national and international level (Floridi, 2014; Lupton, 2014; Williams & Schallmo, 2018; Ivanković, 2018).

Digital transformation (DT) is the adoption and use of digital technology in various aspects of human life (Selwyn, 2019). In economy, new digital technology serves as a business tool for enterprise operations and it may lead towards profound changes of modalities in which enterprises operate (Evans & Gawer, 2016; Tufekci, 2016; Spremić, 2017).

Digital economy represents the main source of digital transformation (Mondekar, 2017, p. 3). It is "a set of new models of making businesses, products, markets and fast-growing economy sectors, especially those ones based on digital technologies as key business infrastructure" (Spremić, 2017, p. 20). The social impact of new technologies is widely debated (Ford, 2015; Frey & Osborn, 2017; Standing, 2018; for Croatia see Butković & Samardžija, 2019).

The concept of the Fourth Industrial Revolution (FIR) is adequate for analysing changes derived by digital technology. We use the following definition: "Industry 4.0 is digital industrial transformation which is based on automation, data exchange, cyber-physical systems, robots, artificial intelligence, the internet of things (IoT), 3D printing, nanotechnology, biotechnology, material science, energy storage, autonomous vehicles and autonomous industrial techniques made for the production of smart industries. The label 4.0 means that the Fourth industrial revolution can be regarded as an inheritress of the earlier three industrial revolutions which largely improved human productivity and human lives all around the world" (Družić & Basarac Sertić, 2018, p. 28; also WEF, 2020).

Artificial intelligence (AI) conceived as the broad domain of developing autonomous machine systems, which emulate cognitive and behavioural features of humans (Russell & Norvig, 2010, pp. 1-33; EC, 2020a), robotics and robotisation are central pillars of the FIR. Although often intertwined, these concepts differ. *Robotics* is the interdisciplinary research field and branch of engineering dealing with the design, construction, functioning, and usage of robots (Britannica, 2021; Ceccarelli, 2004). *Robotisation* means adoption and use of robots in various aspects of human and economic activities (Acemoglu & Restrepo, 2017; Böhlen & Karppi, 2017).

However, it is impossible to provide an unambiguous answer on the direction in which new development could lead, especially without empirical studies. The examination of these issues requires a multidimensional research programme that

would allow recognising its complexity and uncertainty, and thus the scope and limits of technological change (Boyd & Holton, 2017, pp. 12-13). This "perspective of complexity" has also been taken into consideration in our analysis of DT, robotisation and generally the FIR in the Croatian context.

EMPIRICAL RESEARCH

Research design and methodological approach

In order to gain deeper insights into the issue of a socio-economic and social transformation in the direction of DT, AI, robotisation, and generally FIR, an explorative research was conducted. Our research questions were:

Q1. How do representatives of enterprises, scientists and state officials understand concepts of Industry 4.0, AI and robotisation?

Q2. What is the potential of AI and robotisation for the re--industrialisation of the Croatian economy and what is the potential of Croatia for independent production of AI solutions and robots?

Q3. Who are the main promotors and opponents of AI and robotisation, and what are the central social obstacles concerning the use of AI and robots in Croatia?

Q4. What are the future challenges, dangers and threats of AI and robotisation for society?

Sample and interviews

Since the community of developers and practitioners of technologies such as AI and robotics in Croatia is relatively small, we used non-probabilistic purposeful sampling (Patton, 1990). Twelve interviews were conducted with 14 representatives (1 interview was conducted with 3 speakers, which in fact represents a multiview) of Croatian technological companies, scientists, experts and university professors working within the field of AI and robotics and state officials. The criteria for selecting respondents presumed that they are 'insiders' in the domain, i.e., that they have a rich working experience, detailed insights and understanding of the developmental dynamics of the field, or 'intensive' knowledge concerning these matters. On the other hand, we aimed to achieve certain *heterogeneity* in a sense that we interviewed actors from public and private spheres, and within the latter recruited respondents from small, medium and large business companies. Moreover, the sampling strategy to some extent included also a 'snowballing' logic as we asked respondents to identify further potential respondents in the field. Respondents were holding mostly managerial positions in private and public companies and

public institutions, developing or applying new technologies, or in the case of state officials were setting conditions for the business sector. Both business and public sector perspectives were obtained. What is interesting, as well as symptomatic is that all the participants in the sample were male.[2]

Interviews were conducted in February and March 2020. Three state officials expressed their views in one interview. The research was completed once the *conceptual saturation* emerged. The duration of the interviews ranges from 30 to 70 minutes. All conversations were digitally recorded after gained permission and afterwards transcribed.

Data analysis

In the qualitative analysis of the data, *thematic analysis* was applied. Some categories were already proposed by the interview protocol, but the themes were inductively located within the data (Morey Hawkins, 2017). Thematic analysis was conducted in the six stages according to Braun and Clarke (2006), with practical deviations in the process, specifically in the initial stages of organising the data in separate predefined categories. The predefined categories and themes are presented in italics. Coding and data analysis were performed in MAXQDA. The primary use of the software was to systematise parts of the interviews according to predefined categories (areas of research) and to generate initial codes, search for themes and for reviewing themes in relation to the coded segments. In the first step, all interview transcripts were imported in the software and prepared for generating initial codes by organising the data according to the areas of research. Analyses were conducted separately for five areas of research.

THE MAIN FINDINGS

Conceiving of Industry 4.0, AI and robotisation

Respondents identify the concepts of Industry 4.0, AI and robotisation as "the most important driving elements of the changes that are currently happening". These changes occurred as "the consequence of some desire for automation, for productivity growth" and "the tendency of companies to be more efficient". With these concepts they associate digital transformation, digitalisation, the Internet of things (IoT), (statistical) data analysis, cognitive analytics, prescriptive analytics and data science.

Industry 4.0. is generally perceived *as the umbrella term for new technologies*. It is being referred to as a "general term", "common denominator", "broad term" and a "symbiosis of all these technologies" which "includes all these things, artificial intel-

ligence, robotisation, IoT (Internet of things), as well as big data, automation and digital transformation". Industry 4.0 is perceived as "a new way of organising and managing systems which connects people, objects and systems with the possibilities that new technologies, especially digital ones, have opened up". It provides *new possibilities in the industry* which refer to increased efficiency and competitiveness of companies. Furthermore, it was mentioned that "the industrial revolution should be revolutionary, but nothing revolutionary is happening in the world", explaining that the term *industrial revolution* for Industry 4.0 is inadequate.

Artificial intelligence. Respondents addressed *misconceptions and tried to demystify AI* by stating that it is not "a comprehensive intelligence". AI is "nothing magical", but "a tool that solves a certain problem for us". At *the current stage of technological development and use*, AI is "trained and taught" to "do tasks better in some strictly defined scenarios", which means that the application is "very specialised" and "cannot be used for anything else". *AI in comparison with human intelligence and work* is limited, it is the narrow AI "able in certain scenarios, in niche scenarios, to do things better than a human". Its application is conceived as a help in "doing some repetitive tasks" and it "actually provides people with time to work on what they actually do best". In the work on these repetitive tasks it is *connected with robotics*, because it can be used for increased production. Some respondents refer to AI as "nothing new", although some see it as a "change of paradigm".

Robotisation. Respondents explain *robotics* as a "partner technology", *robots* as "simple" machines and *robotisation* as an automation process. Robotics is seen as an *assistance to human labour*, and not as "the substitution of human labour". The same as AI, robots assist people in "doing some repetitive tasks, whether through data processing, or through some physical doings, so through real robots". In comparison to humans, robots have some advantages:

> They do not get tired, they can work 24 hours a day and they are not dependent… they are the same no matter where you use them, so in the case of using robots in a clinical hospital you can get the same service either in Gospić, or in Zagreb, or in London, which is not the case at the moment.

Robotisation has *advantages compared to human labour* in increased efficiency and productivity, it ensures high savings, and is a precise, reliable, expeditious and a safer way of completing tasks. At *the current stage of technological development* there are *hardware and software robots*, of which the latter one is "an

application simulating the work of the user on a computer" or "a digital worker". Robotics has *connections with AI* because robotisation is "the new level of automation generally in production".

The potential of AI and robotisation for the re-industrialisation of Croatian economy

The potential of AI and robotisation for the re-industrialisation of Croatian economy is not univocally estimated. The views range from a complete rejection of the notion to a positive assessment by which the process of re-industrialisation is seen as already happening. The reason for differences might lie in a diverse understanding of the notions *industry* and *re-industrialisation*, as one respondent emphasised that "it is a question of what you mean exactly when you say industry". Here two themes appear: the *emergence of new companies and industry* and the *re-industrialisation of the previously existing industry.* For one respondent the term industry refers to "a set of economic activities which allow you to make money and pay taxes", but for the other one it is a narrower notion of "industry devastated during or after the Homeland War". Since they apply different definitions, their opinions differ as well.

Respondents who negatively perceive the potential for re-industrialisation mention that "the attempt at re-industrialisation is essentially irrelevant to Croatia" or "questionable", as articulated:

> I am skeptical because re-industrialisation is very difficult… It is a huge entropy. You cannot bring back what was. On the other hand, it is not even necessary because industrial production has changed significantly.

Respondents mention that "re-industrialisation is a bigger question than AI" in Croatia and they identify a lack of understanding in industries or deficit of human resources as possible obstacles.

Those with a positive standpoint emphasise that re-industrialisation is already taking place, as newly emerged companies are big enough in order for us "to really start accepting them as the new Croatian industry". This is based on the view that "Croatia has a number of quality companies, manufacturing companies, technology companies" which "provide a very nice perspective and that tomorrow they will become the bearer of Croatian industry". However, they also indicate multiple obstacles such as *financial resources of companies, employment taxes* and *problems with human resources.*

The potential of Croatia for the independent production of AI solutions and robots

There is a disagreement on *the capacity of Croatia for the independent production of AI solutions and robots*. Some respondents underline the lack of resources as an earnest limiting factor. We identified three themes: *the potential of Croatia for production of specialised solutions and robots, but with no potential for production of serial robots and hardware, while the third theme refers to the obstacles regarding limited human, financial and material resources*.

According to the respondents, Croatia has *the potential for the production of specialised solutions and robots* such as developing software, customising solutions, integrating robots into systems or developing highly specialised robots. Adaptation and customisation refer to "combining a specific business problem and the advanced technology to solve it" which could be done with the help of "local companies". The production of industrial robots is not relevant for Croatia, but there is a potential for producing "extremely specialised robots such as Gideon Brothers" which are, e.g., "specialised robots for automated warehouses". The identified potential for independent production implies the need for smart specialisation in Croatia, as one respondent proposed:

> Google or Facebook will certainly not develop a specific solution for agriculture and artificial intelligence in tourism – in some of these narrow scenarios they will not interfere. They will do these big things like translating and so on. There we cannot fight the big ones, but we can fight for a simple smart specialisation.

Respondents do not see *the potential of Croatia for the production of serial robots and hardware* and their opinion is that Croatia is lacking the potential for developing them, but is also lacking places for their possible application. There is an opinion that Croatia is "simply not competitive" in the field where global "competition is tremendous".

The third major theme which appears connected to independent production are *obstacles regarding limited human, financial and material resources*. There are "challenges with a great shortage of computer scientists" and emigration of skilled IT workers: "we do not currently use the potential we have, that is, we are losing it". In preventing brain-drain, companies that employ skilled workers should be capable of "keeping these people, giving them benefits that are comparable to companies abroad, without costing them three times as much". Despite resource issues, some respondents share the optimism that "we have the potential and we have a tendency of young people developing in that area".

Promotors, opponents and social obstacles

Promotors

Three main types of promoters were detected. The first of them are *actors in business driven by profit* which were mentioned as companies (new innovation-oriented companies, commercial companies "always interested in whatever brings them better efficiency" and inside of these companies especially heads of sales, marketing or controlling), the production lobby, capital owners who are "trying to improve their profits by implementing new technologies", as explained:

> The main driving force for the implementation of new technologies is profit. And the owner of the capital is not interested in removing a woman from difficult working conditions and then putting in a robot – he does it because that robot will bring in more profit than that worker.

The second type of promoters are *faculties* and the third one *professional associations*. The latter ones, for instance, include the ICT association within the Croatian Employers' Association (CEA) and Croatian AI Association (CroAI).

Opponents

Although some respondents pointed out that no one is opposed to AI and robotisation and there is a shared understanding that "there is a technological train going and you have to jump on it", an issue could be a "great level of misunderstanding" by some actors. *Specific actors in business* such as workers, certain professions, and sectors and companies in unclear ownership relations could be opposed due to misunderstanding or for their own benefit. Workers can have certain fears regarding the security of their employment. Respondents mentioned "the middle class working in companies" which "are required to have new knowledge, new skills and people generally refuse it". Certain professions such as lawyers whose jobs in part could be automatised and sectors such as the "banking lobby", which are interested in importing solutions and products, are identified as opposing forces too. Furthermore, companies in unclear ownership relations and some state-owned companies are identified as potential opponents seeing that "the problem of the state bureaucracy is that it feels threatened by these models because the structure of the workplace, the structure of the obligations will change if these repetitive jobs are performed by a computer". The second type of opponents, identified by state officials, are *trade unions* which are perceived as "living in the past, not up to date with global trends", although they "have their purpose and meaning when they fight for influence in creating policies which will help workers".

Social obstacles

Five themes were identified:

1) *Bureaucratisation and a restrictive legal framework*. Bureaucratisation in the EU and in Croatia is identified as the obstacle which reduces the effects of policies for implementation of new technologies. For Croatia, it is viewed that this process contributes to general inefficiency. A restrictive legal framework and regulatory standards (e.g. security compliance, GDPR) protecting "the lifestyle and quality of life we have in the European Union" are perceived as obstacles. European human-focused policies are viewed as persisting in achieving and sustaining quality of life on the one hand, but on the other hand they "inhibit innovation".

2) *Social inertia, fear and lack of entrepreneurial initiative*. The "natural social inertia" is slowing down technological progress primarily because of social reasons and it was indicated that the technological progress "will happen in some kind of natural way" after the change of generations occurs. It was explained that "the biggest resistance is provided by ourselves, who in some ways try to resist changes which are extremely fast". Social inertia could be connected with the fear of change and the fear of being replaced by a robot. Such fear appears as a reaction to the novelty, because "AI is relatively new in Europe", and "will always have this sphere of the mystical". Stigmatisation of failure in business and the negative perception of entrepreneurs are perceived as obstacles influencing entrepreneurial initiative regarding the use and development of new technologies. As indicated referring to Croatian entrepreneurs and society in comparison with the USA "we are much worse in that self-confidence and in that kind of entrepreneurial mentality, passion" and there is a greater tendency to follow trends:

> [W]e pretty much like, let's say, following trends, but we are not changing because we have noticed that it came as our need, but because it is a hit now. Just like artificial intelligence is a hit and now everyone is buzzing about it, so we want to do something in that area (…) You know how our companies think? When the Germans use it, then we will use it as well.

3) *Lack of interest and productive communication among key actors*. One of the company representatives mentioned that they are "in general alone in establishing this issue, which is not discussed in a serious enough way" meaning the introduction and use of new technologies, which can be followed by observations that the "society is not interested at all, except only declaratively" and that "Industry 4.0 is mentioned only as a

buzzword in some political circles", but not as a "systematic category you would need to enter into a broad social transformation". Other problems are poor media coverage of the economy, science and technology, issues which arise from the "inability to understand the process" and lack of clear state or company strategies and plans on how to digitally transform the economy.

4) *Gap between scientific and economic sector*. The AI industry requires the inclusion of scientific staff for its development, but respondents mention "the separation of the scientific, that is, the academic sector and the economic sector". Better cooperation between academia and technological companies is required, but "the academia on the one hand writes papers and theorises, big companies sit on the data, but they are burdened with compliance" and small companies "do not have the data large companies have and do not have access to the academia". Although needed, establishing cooperation is difficult because these sectors are seen as "two different worlds".

5) *Lack of human and financial resources*. A lack of human resources is perceived as an important issue, since there are "challenges with a huge shortage of IT specialists" who receive job offers in companies outside Croatia, meaning that there is a "large outflow of labour". For companies in Croatia, it is difficult to keep employees, to provide them with benefits that they might receive abroad. There are also issues with financial resources such as the fact that "the cost of the robot is the same for a German, British person and a Croat" and therefore the decision to robotise part of the production is not easy.

Future challenges, dangers and threats

The following themes are identified as future challenges, dangers and threats.

1) *Deepening the differences*. It is implied that technological lagging behind is a serious issue which can lead to enlarged economic and technological differences. Respondents indicated that countries such is Croatia "have to be aware that the risks are very serious and that lagging behind will deepen problems", because "new technologies will create losers as well as winners".

2) *Human mistakes and biases implemented in algorithms*. One of the major threats identified is implementing gender bias, racial bias and other types of biases and mistakes in AI algorithms which can "have impact on all people in the world and can do terrible damage". Although these mistakes can be unintentional, their wide reach can pose a threat.

3) *Privacy issues and use of technology to influence human perception*. One of the biggest dangers of AI is the question of

awareness "what the creator of artificial intelligence really wanted to achieve" implying questions of purposes for collecting and using data. Data misuse is posing a threat because "where people have access to the technology which influences a large enough number of people around the world, they can in some ways actually manipulate their perception of that world and decisions they make in life". Examples are face recognition algorithms, fake news, deep fake videos, and other manipulations.

4) *Humans too accustomed to the technology*. There is a perception of fast changes in technology which have an impact on society and for which it is demanding to deduce "how it will end". Getting too accustomed to technology poses an issue because it can set people into "one commotion where we will simply lose critical thinking and we will go astray". Technology and applications which solve problems such as mathematical ones can be "a blessing and a curse", but the important question is who is the leader in the process.

5) *Loss of jobs and mass unemployment* (predefined issue). Respondents do not see that the application of AI and robotisation will lead to mass unemployment, albeit they share the opinion that some jobs will disappear. Mass loss of jobs is more connected with economic downturn and the perception that "low level of automation leads to long-term lagging behind". The loss of some jobs is conceived as part of a *normal* or *natural* process, as "a normal process that we have gone through so many times (…) in the past". However, *the need for adjustment* of the workforce to the changes emerges as a great part of these societal and economic changes. Some respondents mentioned that people "need to reorient", "to adapt" themselves and the workforce should be flexible. *The disappearance of (specific) jobs and creation of new jobs/knowledge* will inevitably take place. Jobs which will be eliminated "were until recently connected to human work exclusively", these jobs can be "filled with the work of robots, sensors, automation" and are usually the "lowest paying jobs", those which "people may not even need to do today".

DISCUSSION

The presented results uncovered some of the features about the likeliness that ongoing technological transmutation is a relevant factor of a comprehensive economic and social transformation in Croatia. *At the conceptual level, there is a lack of consensus, among analysts (as it was previously presented) as well as among practitioners, about the labels for naming the current economic and social shifts implied by AI, robotisation, and digitalisation*. Despite diverse terms and overlapping concepts, there is a

kind of agreement that all the elements are relevant features of the FIR (Industry 4.0). The proliferation of terms signals that further conceptual refinements[3] and clarifications ought to be done.

TABLE 1
Themes identified for the five predefined areas of research

Predefined areas of research	Themes	
1. Assessment of key concepts	Industry 4.0	Umbrella term for new technologies New possibilities in industry Not an industrial revolution
	Artificial intelligence	Misconceptions and need for demystification Current stage of technological development and use Comparison with human intelligence and work Connection with robotics
	Robotisation	Robotics as an assistance to human labour Advantages comparing to human labour Current stage of technological development Connection with AI
2. Potential of AI and robotisation for the re-industrialisation of Croatian economy		Emergence of new companies and industry Re-industrialisation of previously existing industry Obstacles (financial resources of companies, employment taxes, issues with human resources)
3. Potential of Croatia for independent production of AI solutions and robots		Potential of Croatia for production of specialised solutions and robots No potential for production of serial robots and hardware Obstacles regarding limited human, financial and material resources
4. Promotors, opponents and social obstacles	Promotors	Actors in business driven by profit Faculties Professional associations
	Opponents	Specific actors in business Trade unions
	Social obstacles	Bureaucratisation and a restrictive legal framework Social inertia, fear and lack of entrepreneurial initiative Lack of interest and productive communication among key actors Gap between scientific and economic sector Lack of human and financial resources
5. Future challenges, dangers and threats		Deepening the differences Human mistakes and biases implemented in algorithms Privacy issues and use of technology to influence human perception Humans too accustomed to the technology
	Loss of jobs and mass unemployment	Normal/natural process Need for adjustment Disappearance of (specific) jobs and creation of new jobs

Particular components of FIR are present in Croatia in firms that are developing and using advanced technologies. *Some data suggest that digital transformation has taken place in Croatia, primarily within the IT sector, which has been continuously increasing*. Although small in European proportions, the Croatian IT sector that has grown in the last 10 years is relatively important (Žitnik, 2018, pp. 40-78; Petrović et al., 2019,

pp. 13-18). In 2017 the number of employees within the Croatian IT sector reached 28.347, and from 2008 to 2017 it increased by 11.549 employees. These data confirm the thesis about the steady yet slow growth of the Croatian IT industry. Moreover, according to the DESI index, Croatia ranks 20th out of the 28 EU Member States in progress towards a digital economy and society (EC, 2020b). Furthermore, there are already existing infrastructure, stakeholders, institutional actors, research facilities, R&D and investments incentives, institutional support, dealing with and developing Industry 4.0, as well as successful and acclaimed companies like 'Gideon Brothers', 'HSTec', and 'H2O-Robotics' (MEEC, 2019).

Albeit the Croatian economy could hardly compete with more powerful players at the global scale in developing industrial robots, a smart specialisation focused on innovation of specialised robots and software is a realistic and preferred scenario. From the conducted interviews we may deduce that the invocated re-industrialisation of Croatian economy is taking the form of introducing new technologies or the form of a novel industrialisation. Therefore, the respondents are anticipating and advocating for a restructuration of the Croatian economy currently marked by the secondary sector (20.4% of GDP) and particularly services (59% of GDP) (NordeaTrade, 2020), out of which tourism is especially important. Also, the new technological advancements should be incorporated in the health-care system, traffic systems, educational system and other domains.

However, it is not likely to expect that the recent EU strategy of re-industrialisation (Moczadlo, 2020) will be implemented at national level, as some analyses clearly suggest that re-industrialisation is primarily a *regional phenomenon* (emphasis ours) which occurs in regions that are not capitals of states, urban areas, not exposed to tourism, with denser population, in geographic terms closer to the developed European countries with a direct flow of foreign investments (Aralica, 2020a, 2020b). Aralica (2020a, 2020b) also confirms these prerequisites in the case of Croatia as only Međimurje county in the outmost north-west records a certain re-industrialisation while other counties retain tendencies of de-industrialisation commenced already in the 1980s. The expected re-industrialisation in north-west Croatia opens up space for introducing Industry 4.0, which inevitably requires an educated workforce (Aralica, 2020a, 2020b).

Representatives of private companies, and scientists who engage in the development of AI and robotics can be considered as crucial advocates of FIR, together with contingents of more educated citizens (the responses in the interviews rein-

force the findings of Poljanec-Borić, 2021). However, the position and attitudes of the latter require more research which we propose to further continue. Opponents of FIR are mostly identified as workers afraid of losing employment. The transformation of workplace tasks and loss of some types of employment are very likely to happen in the future. In addition, our respondents identify barriers for FIR transformation: complicated administrative framework; discrepancy between science and industry, i.e. incapability to successfully transfer innovations in industry, which is an issue that has been already detected before (Švarc, 2009, 2011); lack of communication and coordination among actors who should systematically act towards digital transformation; shortage of financial and material resources and insufficiency of human resources. The lack of human resources, i.e. the *brain-drain process* (scientists, professionals, experts and skilled workers) seriously undermines the capabilities for a desired technological and socio-economic shift (Potočnik & Adamović, 2018; Župarić-Iljić, 2016).

We would also like to emphasise inertia and lack of readiness to innovate and embrace innovation. This feature of the dominant cultural value system is fairly evidented in sociological studies in Croatia (Švarc & Lažnjak, 2017) and it is part of a cultural complex labelled *egalitarian syndrome* (Vuković et al., 2017; Štulhofer & Burić, 2015). In brief, a shift of general attitudes towards innovation and technological transformations is needed, as well as public sensitiveness to the advantages of new technologies to which also media could contribute. Paradoxically, the COVID-19 pandemic has indicated the relevance of advanced technologies in social practices, as well as demonstrated how the economy centred around services is vulnerable. That may be considered a precious lesson learned in a tough way.

Finally, we need to note important self-reflection remarks. Although small samples are an inherent feature of qualitative methodology, a relatively small sample of interviews (N=12) (in fact, 14 gathered in 12 interviews) in this particular research represents a certain limitation. Having in mind their background and attachment to the most advanced technologies, such a purposive sample is also somewhat "biased" (also in terms of gender, as underlined before) in a sense that the respondents have dominantly a positive standpoint. Hence, such relative 'homogeneity' of profiles of respondents is perhaps more contentious than the size of the sample itself. Therefore, in the upcoming research there is a need to gain perspectives and arguments of other social stakeholders such as the managerial staff in the business sector besides technological companies, health-care employees, workers in the branch of

tourism, agriculture, etc. Especially useful would be to conduct qualitative research with trade union representatives, where the resistance towards introducing novel technologies might be present. Moreover, quantitative research on the Croatian population concerning the general attitudes about developments towards Industry 4.0 would be of tremendous value.

CONCLUSION

Digital transformation, AI and robotisation as driving features of the deeper technological revolution are not science fiction in Croatia. Instead, elements of new technological developments are already present, with a wide-spreading infrastructure and its proponents, mainly actors of the IT sector and branches of digital economy. However, it cannot be said that the FIR or Industry 4.0 currently represents a novel developmental paradigm in Croatia, but it might one day in the future. Consequently, favourable is the officially proclaimed "green and digital transition" as one of the 4 main developmental directions in the national developmental strategy until 2030 (Government of the Republic of Croatia, 2020). Within this, "digital transition of society and economy" is a strategic goal which comprises the digitalisation of public administration, development of a broadband communication network, development of digital competencies and digital work places (Government of the Republic of Croatia, 2020, pp. 120-125). In addition, Croatia signed the declaration about cooperation in the field of AI (HUP, 2019, p. 4), which demonstrates that at the policy level there exists at least a nominal awareness that is promoted by the Croatian Association of Employers: "the application of artificial intelligence should be accelerated as much as possible in order to generate maximum positive effects on the Croatian economy and society" (HUP, 2019, p. 3).

It should be stressed that rather than to expect that Industry 4.0 will represent the single general developmental paradigm in Croatia, it is more realistic to anticipate that it will emerge as a *localised process* in two senses: 1) a smart specialisation of technologically advanced products; 2) a regional phenomenon appearing in the north-west counties of Croatia. Industry 4.0 might be conceived as one of the elements within a diversified economic texture within which also other branches (like tourism or agriculture) are being fostered in other regions.

The shift towards Industry 4.0 requires redefining some attributes in the cultural sphere, primarily in terms of changing attitudes towards it, which assumes overcoming the fear of new technologies. Moreover, a great emphasis in providing suitable education for a digital environment should be given, to properly educate a competent workforce that could be in-

tegrated in a digitally/technologically restructured economy. In view of this, it is a burning challenge to prevent further brain-drain. Only by accomplishing this goal can the Croatian economy be competitive, otherwise it will remain in the European semi-periphery.

Ethical considerations

This research was approved by the Ethical Committee of the Department of Sociology of the Faculty of Humanities and Social Sciences of the University of Zagreb (08-2019/20 issued on February 10, 2020).

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NOTES

[1] It is important to shed some conceptual clarity distinguishing the terms *digitisation* and *digitalisation* which are often used interchangeably. The former refers to the process of conversion of data from analogue to digital format, while digitalisation addresses the embracing and application of digital technologies by organisations, different branches of industries, and generally its widespread usage. Furthermore, *digital transformation* points to the restructuration of entire social domains around digital communication and infrastructure (Gorenšek & Kohont, 2019).

[2] Gender bias of the sample represents one of the limitations, but it simultaneously indicates that the field of AI and robotics is a male-dominated one. We assume that the reasons for the underrepresentation of women are: 1) traditionally the field is regarded as male-dominated; 2) it is a reflection of the wider entrepreneurial context in Croatia attributed to a lower rate of women's inclusion in this field's entrepreneurial activities – according to 'Global Gender Gap Index' for 2019 Croatia is ranked 60 out of 153 countries (Alpeza et al., 2020). Gender gap deserves a more detailed attention in future studies.

[3] The same holds for the need to reconceptualise the notion of *innovation* as in the current digital environment the existing concept of innovation is not proper anymore (Švarc, 2021).

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Četvrta industrijska revolucija u hrvatskom kontekstu – znanstvena fantastika ili nova razvojna paradigma?

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Članak tematizira perspektive usmjeravanja razvoja hrvatskog društva u pravcu *Četvrte industrijske revolucije* odnosno *Industrije 4.0*. Prvi dio rada razmršuje odnos između relevantnih koncepata. Nastavak donosi analizu nalaza kvalitativne studije bazirane na 12 polustrukturiranih intervjua provedenih s predstavnicima poduzetničkog sektora, javnih službi te znanstvenicima u neposrednom doticaju s razvijanjem i upotrebom umjetne inteligencije i robota. Nalazi indiciraju da se sugovornici zalažu za razvoj *Industrije 4.0* pri tom ističući njezine prednosti, no ujedno detektiraju zapreke koje priječe takav razvojni pravac. Zaključuje se da će se *Industrija 4.0* izgledno pojaviti kao "lokalizirani fenomen" u dvojakom smislu: 1) kao pametna specijalizacija određenih sofisticiranih tehnoloških proizvoda; 2) kao primarno regionalna pojava u pojedinim županijama.

Ključne riječi: umjetna inteligencija, razvojna paradigma, digitalna transformacija, *Četvrta industrijska revolucija*, *Industrija 4.0,* robotizacija