Acta Catallactics

časopis za ekonomska i opšta društvena pitanja

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Acta Catallactics

Sadržaj

EUROPSKI ZELENI PLAN: SVRHA, PROVEDBA I BUDUĆE PERSPEKTIVE[1]

Pavle Jakovac[2]
Pregledni rad

SAŽETAK

Zabrinjavajuća količina stakleničkih plinova, zagađenje i degradacija okoliša, pretjerana eksploatacija prirodnih resursa, klimatske promjere te zagrijavanje zemljine atmosfere samo su neki od čimbenika koji potvrđuju da je krajnje vrijeme za promjene. Upravo je zato donesen Europski zeleni plan, kojemu je cilj pretvoriti Europu tj. EU u resursno učinkovito gospodarstvo, u kojem do 2050. godine neće postojati emisije stakleničkih plinova. Za samu provedbu Europskog zelenog plana planirano je korištenje različitih instrumenata u pogledu ulaganja i inovacija, regulacija i normizacija, konzultacija sa socijalnim partnerima te nacionalne reforme i međunarodna suradnja. Izrazito je važna digitalizacija svih sektora iz razloga jer pojednostavljuje proces transformacije. Najveća ulaganja biti će potrebna u sektoru energije, prometnom sektoru te u području zgrada. Također, potrebna su ulaganja i u drugim sektorima poput poljoprivrede, kako bi se smanjilo zagađenje, gubitak biološke raznolikosti te omogućila zaštita prirodnog kapitala. Temeljni cilj rada je predstaviti svrhu i ciljeve Zelenog plana te analizirati njegove strategije i politike. Kao važan segment, istaknuto je i financiranje tzv. Zelene tranzicije kao i predikcije o budućnosti Europe.

Ključne riječi: Europski zeleni plan, strategije i politke Zelenog plana, financianje Zelene tranzicije, EU (i RH)

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EUROPEAN GREEN DEAL: PURPOSE, IMPLEMENTATION AND FUTURE PERSPECTIVES[3]

ABSTRACT

Concerns about greenhouse gases, pollution and environmental degradation, overexploitation of natural resources, climate changes and global warming are just some of the factors that confirm that it is high time for change. That is why the European Green Deal was adopted, which aims to turn Europe, i.e., the EU, into a resource-efficient economy, in which there will be no greenhouse gas emissions by 2050. For the implementation of the European Green Deal, it is planned to use various instruments in terms of investment and innovation, regulation and standardization, consultation with social partners as well as national reforms and international cooperation. The digitization of all sectors is extremely important because it simplifies the transformation process. The largest investments will be needed in the energy sector, the transport sector and the building sector. Also, investments are needed in other sectors such as agriculture, in order to reduce pollution, loss of biodiversity and enable the protection of natural capital. The main goal of this paper is to present the purpose and goals of the EU's Green Deal and analyse its strategies and policies. Financing the so-called Green Transition as well as predictions about the future of Europe are highlighted in this paper.

Key words: European Green Deal, Green Deal's strategies and policies, Green Transition financing, EU (and Croatia)

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1. Uvod

Zdrav planet je ključan za budućnost Europe. Cilj EU-a je postizanje klimatske neutralnosti do 2050. godine, a za postizanje tog cilja potrebna je preobrazba europskog društva i gospodarstva koja treba biti troškovno učinkovita, socijalno uravnotežena i pravedna. Također, za postizanje navedenog cilja neophodno je dekarbonizirati energetski sustav, potaknuti inovacije, povećanti energetsku učinkovitosti zgrada, uvesti čišće oblike privatnog i javnog prijevoza te investirati u one tehnologije koje su prihvatljive za okoliš. Trenutno je potrebna suštinska transformacija financijskih, ekonomskih i socijalnih sustava koji potiču promjene ka jačanju ekološke, socijalne i ekonomske otpornosti. Za postignuće ciljeva Europskog zelenog plana, nije dovoljno samo donijeti mjere, nego se one trebaju provoditi i djelotvorno primjenjivati. Stoga će Komisija pokrenuti nove inicijative u tom smjeru i surađivati s članicama EU za što uspješnije provođenje Zelenog plana.

Plan ulaganja za održivu Europu je program ulaganja za Europski zeleni plan, kojim će se prikupljati privatna sredstava putem financijskih instrumenata, naročito putem instrumenta InvestEU, te mobilizirati javna ulaganja. Europski zeleni plan i njegov plan ulaganja mobilizirati će sredstva Europske unije te razviti okvir za poticanje i olakšavanje privatnih i javnih ulaganja, koja su potrebna kako bi se provela tranzicija ka klimatski zelenom, neutralnom, uključivom i konkurentnom gospodarstvu. Instrument za kreditiranje bit će dostupan regijama koje će najviše biti „pogođene“ tranzicijom. Zemljopisna pokrivenost obuhvatit će projekte u regijama koje imaju odobrene planove za pravednu tranziciju, ali i one projekte od kojih spomenute regije imaju direktnu korist. Pružanje potpora obuhvaća širok raspon, od prometne i energetske infrastrukture, mjesnih toplinskih mreža, obnove zgrada, sve do socijalne infrastrukture.

Uključivanje metoda Europskog zelenog plana u hrvatski program oporavka moglo bi potaknuti gospodarski razvoj, inovacije i aktivnosti. Preporuke se odnose na jačanje kapaciteta za provedbu i pripremu propisa, sprečavanje korupcije te učinkovit, stabilan i predvidiv regulatorni i pravni sustav koji osigurava i omogućava mehanizme za rješavanje sporova. Preduvjet za provedbu plana u Hrvatskoj, odnosno za tranziciju ka prosperitetnom i pravednom društvu s konkurentnim, resursno efikasnim i modernim gospodarstvom, jest upravo provedba tih preporuka.

Sukladno uvodnim napomenama, svrha ovog rada je objasniti i analizirati Europski zeleni plan tj. ukazati na (pozitivne) planove EU u u pogledu zaštite i očuvanja okoliša i prirodnih resursa, te u pogledu poticanja tzv. zelenog ponašanja za boljitak cjelokupnog stanovništva. Odnosno, temeljeni cilj ovog rada je elaborirati načine provođenja Europskog zelenog plana, njegove strategije i politike kao i (buduće) refleksije tog plana. Ovaj je rad koncipiran na sljedeći način. Nakon uvodnih napomena slijedi drugi dio koji daje teorijski uvid u povezanost ekonomije i ekologije (prvenstveno s aspekta ekoloških ekonomista) te suonod (kapaciteta) okoliša i ekonomskog rasta i razvoja. Potom slijedi treći dio u kojem su obuhvaćeni ciljevi i svrha plana, te njegove politike i strategije. U četvrtom dijelu analizirani su izvori financiranja tzv. zelene tranzicije dok je u petom dijelu navedena buduća perspektiva plana i (daljnje) razvojne strategije. U posljednjem dijelu iznesena su zaključna razmatranja.

2. Kapacitet okoliša vs. ekonomski rast i razvoj

Gospodarska struktura prilagođava se postavljenim gospodarskim ciljevima, koji su ponajviše uvjetovani potražnjom. Opći napredak i tehnološka revolucija, za veliki dio stanovništava, doveli su do visokog životnog standarda, koji također ima utjecaj na okoliš. Očuvanje prirode i okoliša, jedna je od najvažnijih vrijednosti svake zemlje. Odredbe ustava, obvezale su sve aktere da posvećuju izrazitu brigu zaštiti okoliša i prirode, da omogućavaju bolju kvalitetu življenja za sadašnje i buduće generacije. Postignut je dogovor, na međunarodnoj razini, da gospodarski rast i razvoj treba biti ekološki održiv (Udovičić, 2004).

Održivost je podijelila ekonomiste na dvije grupe: ekološki i neoklasični ekonomisti. Neoklasični ekonomisti odnosno tzv. tehnološki optimisti, stvoreni i prirodni kapital smatraju supstitutima. Vjeruju kako će se povećanjem oskudnosti resursa povećati i cijene ali i da će inovacije doprinijeti kvalitetnim supstitutima te na taj način ponovno sniziti cijene. I dalje vide potrebu da državnim regulatornim sistemima kontroliraju iscrpljivanje resursa i onečišćenja, dok s druge strane smatraju kako će daljnjim širenjem tržišta životni standardi nastaviti rasti, te da će se stopa stanovništva smanjivati i to sve unutar prihvatljivog omjera degradacije okoliša. Za razliku od neoklasičara, ekološki ekonomisti ističu kako je ekonomska svjetska globalizacija neodrživa te da daljnji ekološki sukobi poput rasta potrošnje i povećanje stanovništva pridonose stvaranju globalnih (ekoloških) problema. Ekološki ekonomisti odnosno tzv. tehnološki pesimisti, tvrde da stvoreni i prirodni kapital djeluju komplementarno, odnosno da se zajedno koriste u proizvodnji te da je stopa supstitucije niska. Oni smatraju da se iscrpljivanjem prirodnih resursa smanjuje ljudsko blagostanje.

Jedno od uzroka u mimoilaženju stavova klasičnih i ekoloških ekonomista je u strukturi, načinu i obimu kvantificiranja utjecaja na okoliš. Do zabrinutosti u vezi okoliša došlo je upravo zbog rasta stanovništva i rastućeg dohotka. Generiranje velike količine dobara i njihove raznolikosti imaju izrazit utjecaj na zagađenje i devastaciju okoliša. Zagađenje okoliša odnosi se na korištenje okoliša kao spremnika tj. aktivnosti izlijevanja, ispuštanja i bacanja različitih štetnih tvari u okoliš. Devastacija okoliša predstavlja aktivnosti koje se odnose na crpljenje prirodnog kapitala tj. resursa i korištenje okoliša kao izvora (Sundać i Šundov, 2018).

Ekološki ekonomisti skreću pozornost na važnost termodinamičkog zakona u svezi rasta tj. i odnosa / utjecaja istog na okoliš. Gospodarske funkcije okoliša očituju se u opskrbi prirodnim resursima (obnovljivi i neobnovljivi resursi) koji ulaze u proces proizvodnje. Također, funkcija okoliša je i asimilacija otpada tj. korištenje okoliša kao spremnika te pružanje usluga, bilo da su estetske ili prostorne. Prvi zakon termodinamike nalaže da se materija i energija ne mogu uništiti ili stvoriti. Postoji njihov fiksni ukupni iznos koji je uvijek sačuvan u jednom ili drugom obliku. Svi resursi koji ulaze u gospodarski proces, moraju iz tog procesa i izaći. Što je više resursa u upotrebi, više se otpada proizvodi. Prema Črnjar i Črnjar (2009), načini smanjenja unosa inputa tj. sirovina u proizvodni proces, a samim time i smanjenje otpada su: 1) reduciranje količine proizvodnje roba i usluga (pobornici „nultog rasta gospodarstva“ smatraju kako ovaj način može dovesti do smanjenih količina otpadnih tvari, ali s druge strane, rast stanovništva dovodi do veće potražnje za proizvodima i uslugama, a samim time dolazi i do rasta gospodarstva); 2) reduciranje količine otpada tj. otpadnih tvari koje su nastale u proizvodnom procesu (smanjenjem

količine sirovina koje se koriste u proizvodnom procesu, smanjuje se i proizvedeni otpad); 3) smanjenje otpada postiže se i povećanjem reciklaže te ponovnim vraćanjem u proizvodni proces (glavna intencija recikliranja je supstitucija dijela količine inputa tj. sirovina koje ulaze u proces proizvodnje - na taj način smanjuje se otpad dok se proizvodnja roba i usluga ne smanjuje).

Problemi u pogledu zaštite okoliša izrazito su kompleksni i međusobno povezani. Za njihovo rješavanje neophodni su veliki znanstveno-istraživački pothvati te mnogobrojna tehnološka rješenja. Uz sve prednosti, tehnološki razvoj prati onečišćenje, degradacija i devastacija okoliša i prirode. Zbog ekspanzije industrijalizacije, sve većeg broja stanovništva i njihovog visokog standarda, upravo (životno-radni) prostor postaje faktor ograničenja (Udovičić, 2004).

Održiv razvoj u ekonomiji odnosi se na postizanje gospodarskog rasta i gospodarske učinkovitosti. Ekološka održivost uključuje razvoj koji uvažava sposobnost okoliša da prihvati iscrpljivanje prirodnih resursa i onečišćenje. Društvena održivost ostvaruje se postizanjem zadovoljavajuće razine životnog standarda. Što se tiče ciljeva održivog razvoja, isti trebaju počivati na odgovornosti prema okolišu, gospodarskoj učinkovitosti te socijalnom napretku. UN promovira zelenu ekonomiju, ali tek manji postotak država to shvaća ozbiljno. Prva globalna konferencija UN-a, održana je 1972. godine u Stockholmu, na kojoj su bile predstavljene teme ekspanzivne urbanizacije, industrijskog zagađenja okoliša i nespremnosti za nagli rast populacije na globalnoj razini. Najveći napredak, u području održivog razvoja, ostvaren je na drugoj konferenciji UN-a o okolišu i razvoju 1992. godine u Rio de Janeiru. Konferencija je rezultirala Deklaracijom o okolišu i razvoju (Rio deklaracija) i Agendi 21 (Akcijski plan održivog razvoja za XXI. stoljeće). Zaključeno je da se pitanja u svezi okoliša moraju rješavati istodobno sa problemima dugova, nezaposlenosti, siromaštva i socijalnih problema najsiromašnijih zemalja, uz obvezu financijske pomoći razvijenih i bogatih zemalja u pogledu zaštite okoliša (Herceg, 2013). Na Milenijskom summitu 2000. godine Opća skupština UN-a usvojila je tzv. Milenijsku deklaraciju. Summit je okupljen kao odgovor na bojazan zbog rastuće stope stanovništva i daljnjeg tijeka degradacije okoliša koje, pogotovo u nerazvijenim zemljama, nije (bilo) pod kontrolom. Deklaracija sadrži osam milenijskih razvojnih ciljeva, koje su države članice UN-a (bile) obvezne ispuniti do 2015. godine. Ti ciljevi su: 1) smanjenje relativnog siromaštva; 2) jamstvo obrazovanja za sve; 3) ravnopravnost spolova i osnaživanja žena; 4) smanjenje smrtnosti novorođenčadi i djece; 5) poboljšanje zdravlja majki; 6) borba protiv HIV-a/AIDS-a, tuberkuloze i drugih bolesti; 7) održivost okoliša; 8) globalna suradnja za razvoj. Milenijski ciljevi predstavljaju globalnu inicijativu no do 2015. ostvareni su nekonzistentni rezultati (Tišma et al., 2017). Godine 2003. u Pragu donesena je tzv. Praška deklaracija koja zagovara da obrazovanje o okolišu postane obvezno na svim sveučilištima u Europi. Nastavno na Prašku deklaraciju, Ujedinjeni narodi su desetljeće od 2005. do 2014. godine prozvali „Desetljeće obrazovanja za održiv razvoj“. Cilj pak konferencije Rio+20 tj. „Rio Earth Summit on Sustainable Development 2012“, bio je omogućiti novo političko usmjerenje za održiv razvoj, procjenu napretka svih samita do tada i rješavanje novih izazova (Herceg, 2013).

Sve veća ekonomska neizvjesnost i kompleksnost života na Zemlji nameću uključivanje sve većeg broja aktera iz širokog područja društvenih događanja u pronalaženju najadekvatnijeg modela suodnosa zaštite okoliša i tehnološkog razvoja. Ranija ekonomska htijenja prema razvoju i profitu dovela su do prekomjernog iskorištavanja prirodnih resur-

sa, što dugoročno dovodi do tmurne perspektive življenja i neuravnoteženog razvoja na Zemlji. Preobrazbe u procesu planiranja poslovnih sustava određene su kriterijima zaštite okoliša, a u cilju povećanja kvalitete života i poštivanja potreba za razvojem. Nerijetko, gospodarski subjekti koji su ekološki odgovorni, proživljavaju posljedice tuđe neodgovornosti, što dokazuje neophodnost primjene usklađenog djelovanja, i to na svim razinama. Potrebno je razviti ekološku kulturu odgovornosti, provedbom zakona, te jasno definirati posljedice nepridržavanja zakona. Izrazito je važno podići svijest o važnosti ekologije i njen utjecaj na naš život, bez obzira radilo se o direktnim posljedicama tj. zagađenosti, klimatskim poremećajima i narušavanju ekosistema ili o indirektnim posljedicama tj. prilagodbi, reinženjeringu poslovnih sustava (Sundać i Šundov, 2018).

Razvoj industrije, poljoprivrede, transporta, turizma i drugih područja ovisi o okolišu i njegovoj mogućnosti da osigura razvojnu osnovu. Dok je sa suprotne strane rasipanje i neracionalno trošenje resursa doveo do krize okoliša (Herceg, 2013). Održiv razvoj, koji je ključna ambicija razvijenih zemalja, nije moguće ostvariti bez intenziviranja kontinuirane politike zaštite okoliša. Također, politika zaštite okoliša mora biti usklađena sa ostalim razvojnim politikama (Tišma et al., 2017).

3. Svrha i provedba plana

Europska komisija je krajem 2019. godine objavila novu strategiju rasta, Europski zeleni plan, u kojoj se EU nastoji transformirati u prosperitetno i pravedno društvo s resursno učinkovitim, konkurentnim i modernim gospodarstvom u kojem gospodarski rast nije direktno povezan sa uporabom resursa i u kojem do 2050. godine neto emisije stakleničkih plinova neće postojati. Nastoji se povećati, očuvati i zaštititi prirodni kapital te sačuvati dobrobit i zdravlje stanovništva EU od rizičnih faktora koji su povezani s okolišem. Prioritet moraju biti građani, te treba posebnu pažnju posvetiti industriji, regijama i radnicima koji će se suočavati s glavnim izazovima. S obzirom da će doći do značajnih promjena, od presudne su važnosti povjerenje u tranziciju i aktivno učešće javnosti kako bi nove politike bile prihvaćene i uspješne. (Europska komisija, 2019a). Kako bi se ostvario Europski zeleni plan, treba ponovo proučiti politike za opskrbu čistom energijom u cijelom gospodarstvu: potrošnji i proizvodnji, industriji, infrastrukturi, poljoprivredi, prometu, građevinarstvu, kao i socijalnim naknadama te oporezivanju. Poveća li se važnost koja se pridaje zaštiti i obnovi prirodnih ekosustava, boljem zdravlju ljudi i održivoj upotrebi resursa, mogli bi se postići ti ciljevi.

Preobrazba je najpotrebnija i najkorisnija za gospodarstvo EU, kao i za društvo i prirodu. Ključni za provedbu promjena su digitalna transformacija i alati, pa bi EU trebala ulagati u njihov razvoj. U zelenom će se planu provoditi slijedeći strategije: regulacija i normizacija, nacionalne reforme, ulaganja i inovacije, međunarodna suradnja i dijalog sa socijalnim partnerima. Djelovat će se tako da u socijalnim pravima svi budu ravnopravni i da ne bude zapostavljenih. Kako bi se postigli ciljevi Europskog zelenog plana, nije dovoljno samo donijeti mjere, nego se one trebaju provoditi i djelotvorno primjenjivati. Stoga će Komisija pokrenuti nove inicijative u tom smjeru i surađivati s članicama EU za što uspješnije provođenje Zelenog plana (Europska komisija, 2019a).

Glavni cilj tzv. EU Green Deal-a je da do 2050. godine Europa bude prvi kontinent koji je klimatski neutralan. Kako bi EU realizirala svoj cilj postizanja klimatske neutralnosti, ponajprije je potrebno „dekarbonizirati energetski sustav". Gotovo 75% emisija stakleničkih plinova u EU su izvor uporabe energije i proizvodnje u gospodarskim segmentima. Zato je nužno razviti energetski sektor koji se temelji na obnovljivim izvorima energije uz postepeno smanjenje uporabe ugljena te dekarbonizaciju plina. Istodobno, snabdijevanje energijom mora biti cjenovno pristupačno i ponajprije sigurno za potrošače. Da bi se to ostvarilo od izrazite je važnosti uvažavanje tehnološke neutralnosti te je presudno osigurati potpunu međusobnu povezanost, integraciju te digitalizaciju energetskog tržišta. (Obzor Europa, 2020). EU Green Deal obuhvaća akcijski plan u pogledu unaprjeđenja učinkovite uporabe resursa koji će se postići „prelaskom na čisto kružno gospodarstvo". Također obuhvaća smanjenje onečišćenja te revitalizaciju biološke raznolikosti.

Ostvarenje navedenih ciljeva bit će moguće jedino uz potrebno djelovanje svih gospodarskih sektora, među kojima su: ulaganje u tehnologije koje su prihvatljive za okoliš, stimuliranje industrijskih inovacija, uvođenje čišćih, jeftinijih i zdravijih oblika javnog i privatnog prijevoza, dekarboniziranje energetskog sektora, povećanje energetske učinkovitosti zgrada te međunarodna partnerska suradnja na unaprjeđenju globalnih standarda u području okoliša (Europska komisija, 2019a).

Europska komisija propisuje osam područja politika koje su u središtu Europskog zelenog plana: 1) Veće klimatske ambicije EU-a za 2030. i 2050. godinu, 2) Opskrba sigurnom, čistom i cjenovno pristupačnom energijom, 3) Mobilizacija industrije za čisto i kružno gospodarstvo, 4) Izgradnja i obnova uz učinkovitu uporabu energije i resursa, 5) Brži prelazak na održivu i pametnu mobilnost, 6) Od „polja do stola", 7) Očuvanje i obnova ekosustava i biološke raznolikosti, 8) Cilj nulte stope onečišćenja za netoksični okoliš.

3.1. Veće klimatske ambicije EU-a za 2030. i 2050. godinu

Europska komisija iznijela je viziju kako će se do 2050. godine postići klimatska neutralnost. Komisija je u ožujku 2020. godine dala prijedlog europskog propisa o klimi kao bitnog dijela europskog Zelenog plana, a u rujnu iste godine donijela je prijedlog o izmjeni prijedloga iz ožujka. U izmjeni svog prijedloga, Komisija je dala revidirani cilj smanjenja emisija stakleničkih plinova u EU za najmanje 55% do 2030. godine kao i komunikaciju o planu za postizanje tog cilja i prilog o sveobuhvatnoj procjeni učinaka.

Obvezujući cilj EU za neto smanjenje stakleničkih plinova za 55% do 2030. godine u odnosu na 1990. godinu, Europsko vijeće potvrdilo 10. i 11. prosinca, a 17. je prosinca 2020. godine donijelo opći pristup. Nakon toga su Vijeće i Parlament dali niz prijedloga kako bi se postigao konačni tekst (Europsko vijeće, 2021). Nakon što je Europski parlament podržao Europski zakon o klimi, politika Europskog zelenog plana o klimatskoj neutralnosti EU do 2050., postaje obveza. . Reforme politika utjecat će na određivanje cijena ugljika čime će se promijeniti potrošačke i poslovne prakse i olakšati veća održiva javna i privatna ulaganja. Zbog svega navedenoga, potrebna je međusobna suradnja svih međunarodnih partnera sa EU.

3.2. Opskrba sigurnom, čistom i cjenovno pristupačnom energijom

Da bi se postigli ciljevi vezani za poboljšanje klime do 2030. odnosno 2050. godine, potrebna je daljnja dekarbonizacija energetskog sustava. Naime, od proizvodnje i uporabe energije u gospodarstvu nastaje više od 75% stakleničkih plinova u EU. Nakon što je Europska komisija u prosincu 2020. godine predstavila strategije za čistu energiju, ministri iz područja energetike EU-a usvojili su zaključke o energiji iz obnovljivih izvora na moru i vodiku. Također, raspravljali su o „strategiji EU-a za integraciju energetskog sustava", koja je od iznimne važnosti za smanjenje gubitaka topline diljem Europe i povećanje energetske učinkovitosti.

Energetski sektor u EU treba se temeljiti na obnovljivim izvorima uz postupno smanjivanje uporabe ugljena i dekarbonizacije plina, a opskrba energijom mora biti sigurna uz pristupačnu cijenu za fizičke i pravne osobe. Za ostvarenje navedenog, potrebno je osigurati cjelovitu digitalizaciju, integraciju i međupovezanost energetskog tržišta EU pri čemu treba voditi računa o tehnološkoj neutralnosti. U sklopu Zelenog plana, države članice EU će 2023. godine početi ažurirati svoje nacionalne energetske i klimatske planove, koji uključuju uklanjanje rizika od energetskog siromaštva za kućanstva koja si ne mogu priuštiti ključne energetske usluge i pametnu infrastrukturu (Europska komisija, 2019a).

3.3. Mobilizacija industrije za čisto i kružno gospodarstvo

EU se fokusira na europsku industriju te će ista biti pokretač u prijelazu na klimatsku neutralnost i digitalno vodstvo. Prioritet je učiniti europsku industriju pokretačem inovacija, promjena i rasta. Europsko vijeće je u ožujku 2019. godine pozvalo Europsku komisiju da prezentira viziju industrijske politike. Vijeće je zatim u svibnju iste godine usvojilo zaključke te predstavilo viziju europske industrije koja se odnosi na 2030. godinu. Komisija objavljuje novu industrijsku strategiju, u ožujku 2020. godine, a u studenome te iste godine Vijeće je prihvatilo zaključke o novoj strategiji u kojima se definira kako bi se oporavak od krize koja je uzrokovana virusom COVID-19 trebao upotrijebiti kao poticaj za otporniju, konkurentniju i dinamičniju industriju EU. Naglašeno je kako se oporavak treba temeljiti na načelima integracije, konkurentnosti, kohezije, održivosti, solidarnosti, uključivosti i zaštite okoliša te da se u okviru njega treba poštovati pravednost te socijalni standardi.

Kako bi se postiglo klimatski neutralno i kružno gospodarstvo, neophodno je potpuno mobilizirati industriju. Naime, potrebna je jedna generacija ili 25 godina za transformaciju industrijskog sektora i svih lanaca vrijednosti. Zbog velikih globalnih ekstrakcija resursa i njihove prerade, dolazi do velikih emisija stakleničkih plinova (približno 50%), kao i više od 90% gubitka biološke raznolikosti i nestašice vode. Unatoč promjenama, emisije stakleničkih plinova iz industrije EU iznose 20% i stoga je industrija više „linearna" nego kružna. Zbog toga je potrebna transformacija, dekarbonizacija i modernizacija cjelokupnog sektora energetski intenzivnih industrija koje se moraju temeljiti na politici održivosti i koje će uključivati više recikliranja i smanjivanja otpada (Europski parlament, 2020).

3.4. Izgradnja i obnova uz učinkovitu upotrebu energije i resursa

Za izgradnju, obnovu i upotrebu zgrada potrebne su velike količine energije i građevinskog materijala poput šljunka, pijeska, cementa. Energetske karakteristike zgrada imaju bitnu ulogu u Europskom zelenom planu. Od ukupne potrošene energije, 40 % čini potrošena energija za zgrade, što nije čudno ako se zna da je čak više od 85% zgrada na području EU izgrađeno prije 2001. godine.

Članice EU obnavljaju građevinski fond i sadašnja stopa obnove iznosi od 0,4% do 1,2%, a samo 0,2 % građevina se obnovi tako da im se potrošnja energija smanji za barem 60%. Da bi se ostvarili ciljevi EU o energetskoj učinkovitosti, ta bi se stopa obnove trebala barem udvostručiti. Trenutno oko 50 milijuna stanovnika EU ima poteškoća s adekvatnim zagrijavanjem domova, jer zgrade u kojima žive i rade nisu energetski adekvatne. Za hlađenje i grijanje koriste uglavnom fosilna goriva i stare nerentabilne uređaje, a velik dio energije se gubi zbog loših fasada i starih prozora. Da bi se poboljšala energetska učinkovitost uz pristupačnu cijenu, države članice EU bi trebale pokrenuti „val obnove" kako privatnih tako i javnih zgrada te provoditi zakonodavstvo koje se odnosi na energetska svojstva zgrada. S povećanjem iznosa stope obnove građevinskog fonda, smanjit će se računi za energiju kao i energetsko siromaštvo. To je prilika za poticanje građevinskog sektora, podupiranje malih i srednjih poduzeća, te povećanje zapošljavanja na lokalnoj razini (Europska komisija, 2020a).

Također, potrebno je obnoviti škole, bolnice i socijalne stanove. Time će te zgrade biti energetski učinkovite, pa će se uštediti znatna sredstva koja će biti namijenjena potpori obrazovanja i javnog zdravstva. Energetskom obnovom socijalnih stanova pomoći će se obiteljima koje imaju financijskih problema pri podmirivanju računa za energiju (Munta, 2020).

3.5. Brži prelazak na održivu i pametnu mobilnost

Za gospodarstvo i društvo koje planira imati nultu stopu neto emisija, sektor prometa tj. mobilnosti mora biti pametniji i održiviji. Kako bi EU postigla klimatsku neovisnost do 2050. godine, emisije iz prometnog sektora moraju se smanjiti za 90 %. Naime, u EU promet proizvodi velike količine stakleničkih plinova (25%) i one stalno rastu. Stoga je Europska komisija početkom prosinca 2020. godine predstavila novu „Strategiju o održivoj i pametnoj mobilnosti" s ciljevima, planom i jasnim mjerama da prometni sustav EU bude održiv, pametan i otporan. Spomenuta Strategija uključuje povećanje učinkovitosti prometnog sustava na način da se potiče multimodalni prijevoz tereta, automatizirana i povezana multimodalna mobilnost, reguliranje cijena prijevoza koje će odražavati njihov utjecaj na okoliš i zdravlje, povećanje proizvodnje i upotrebe održivih alternativnih goriva u prometu, te smanjenje onečišćenja iz prometa.

U toj istoj Strategiji dani su konkretni ciljevi po etapama: za 2030.godinu predviđeno je da će u EU prometovati barem 30 milijuna vozila s nula emisija, da će 100 gradova EU biti klimatski neovisno, da će se diljem Europe udvostručiti željeznički promet, da bi kolektivna putovanja na relacijama manjim od 500 km trebala biti ugljično neutralna, da će

u velikoj mjeri biti zastupljena automatizirana mobilnost i da će na tržištu biti plovila bez emisija. Nadalje, 2035. godine bi veliki zrakoplovi bez emisija bili spremni za tržište, a 2050. godine bi gotovo sva vozila prometovala bez emisija, teretni željeznički promet bi se udvostručio, a prometna mreža bi bila u potpunosti operativna, multimodalna i transeuropska (Ministarstvo mora, prometa i infrastrukture RH, 2020).

3.6. Od „polja do stola: osmišljavanje pravednog i zdravog prehrambenog sustava koji je prihvatljiv za okoliš“

Strategijom „od polja do stola” nastoji se pomoći Europi da postigne klimatski neutralan kontinent do 2050. prelaskom s trenutnog prehrambenog sustava EU-a ka održivom modelu. Uz sigurnost i opskrbu hrane, glavni ciljevi strategije su: osigurati dostatnu, hranjivu i cjenovno pristupačnu hranu; osigurati održivu proizvodnju hrane znatnim smanjenjem upotrebe antimikrobnih sredstava, pesticida i gnojiva te fokusiranjem na ekološku poljoprivredu; promicati zdravu prehranu te održivu potrošnju hrane; smanjiti rasipanje hrane; iskorijeniti prijevare koje su povezane s hranom u opskrbnom lancu; povećanje dobrobit za životinje.

U listopadu 2020. godine Vijeće je usvojilo zaključke o navedenoj strategiji u kojima se podupire razvoj europskog održivog prehrambenog sustava od faze proizvodnje hrane do faze potrošnje. Zaključci sadržavaju dogovor država članica EU da će osigurati: pristup cjenovno pristupačnoj i dostatnoj hrani; snažnu potporu i pravedan prihod za primarne proizvođače; konkurentnost poljoprivrede EU na svjetskoj razini (Europsko vijeće, 2020a).

Poljoprivredno-prehrambena industrija, kao jedna od glavnih gospodarskih grana EU, snabdjeva hranom više od 400 milijuna stanovnika. Proizvodnja hrane je važna usluga i izvor prihoda. Poljoprivredno-prehrambeni sektor znatno djeluje na okoliš onečišćujući tlo, vodu i zrak pridonoseći klimatskim promjenama, smanjenju bioraznolikosti kao i prevelikoj potrošnji resursa, te nedjelotvornoj raspodjeli kao i razbacivanju viškova hrane dok približno trećina emisija stakleničkih plinova na svjetskoj razini dolazi iz poljoprivredno-prehrambenog sektora (Europska komisija, 2019b).

Osim toga, pandemija COVID-19 potaknula je razmišljanje o važnosti jakog i otpornog prehrambenog sektora kao i o međusobnoj povezanosti ekosustava, zdravlja, ograničenja planeta, lanaca opskrbe i načina potrošnje. Sve češće pojave elementarnih nepogoda poput poplava, suša i šumskih požara upozoravaju na ugroženost našeg prehrambenog sustava i da on treba postati održiviji i otporniji. (Europska komisija, 2020a).

Stoga EU nastoji ići ka promjeni načina proizvodnje i potrošnje hrane s ciljem smanjenja ekološkog otiska prehrambenih sustava, ojačanja njihove otpornosti na krize te osiguranju dostupnosti zdrave i cjenovno pristupačne hrane za današnje stanovništvo i buduće naraštaje. Strategija „od polja do stola“ je nova prilika za poboljšanje zdravlja, načina života i kvalitete okoliša. Stvaranje povoljnijeg prehrambenog okružja, doprinijet će poboljšanju kvalitete života i zdravlja te pomoći u smanjenju troškova povezanim sa zdravljem (Europska komisija, 2020a).

3.7. Očuvanje i obnova ekosustava i biološke raznolikosti

Zdrav ekosustav bitan je za kvalitetan život i preduvjet za pitku vodu, čist zrak i zdravu hranu. Treba spriječiti smanjenje biološke raznolikosti kako bi se suzbile bolesti i nametnici, regulirala klima te ublažile prirodne katastrofe. Da se u svijetu smanjuje biološka raznolikost, utvrđeno je u Globalnom izvješću o procjeni bioraznolikosti i ekosustavu objavljenom 2019. godine od strane Međunarodne znanstveno-političke platforme za biološku raznolikost i usluge ekosustava. To smanjenje biološke raznolikosti direktno utječe na iskorištavanje prirodnih resursa i promjenu klime, a uvjetovano je promjenom korištenja mora i zemljišta (www.ipbes.net).

O prirodi ovisi više od polovine svjetskog BDP-a. Sektori koji ovise o prirodi uključuju poljoprivredu, prehrambenu industriju i građevinarstvo. Krizu izazvanu COVID-om treba što prije premostiti investiranjem u očuvanje okoliša, vodeći računa o očuvanju ekosustava i bioraznolikosti. Povećavajući prekograničnu suradnju, države članice EU mogle bi učinkovitije obnoviti i zaštititi područja pokrivena tzv. mrežom Natura 2000 (Europska komisija, 2020b).

U tom smjeru potrebno je provoditi politike održivog pošumljavanja, očuvanja i obnove šuma u Europi kako bi se bolje apsorbirao CO2, a više proizvodio kisik, te kako bi se smanjile pojave i širenje šumskih požara. Također, treba smanjiti uporabu gnojiva i pesticida u poljoprivredi, nastaviti smanjenje štetnih utjecaja ribarstva na ekosustave, te održivije upravljati pomorskim područjem, kao što su iskorištavanje energije iz obnovljivih izvora na moru (Europska komisija, 2019a).

3.8. Cilj nulte stope onečišćenja za netoksični okoliš

Borba protiv svih vrsta zagađenja i povratak na čist i netoksičan okoliš, jedan je od ciljeva Europskog zelenog plana. Da bi se ostvario taj cilj, treba prije svega djelovati preventivno, raditi na sprječavanju zagađenja, ali i provoditi mjere za uklanjanje onečišćenja kao i mjere za provedbu čišćenja. EU treba pratiti, sprječavati, prijavljivati i uklanjati onečišćenje vode, zraka, tla i potrošačkih proizvoda. Time će zaštititi svoje stanovnike i ekosustave. Iako su kemikalije dio svakodnevnog života i pridonose unaprjeđenju kvalitete našeg života i dobrobiti, mogu onečistiti okoliš i ugroziti naše zdravlje (Europska komisija, 2015).

Kao glavni rezultat Europskog zelenog plana, Komisija je u svibnju 2021. donijela „Akcijski plan za postizanje nulte stope onečišćenja zraka, vode i tla“. Ovaj plan, zajedno s „Strategijom o održivosti u području kemikalija“, vodi ka postizanju cilja nulte stope onečišćenja (Europska komisija, 2019c). U ovom planu su postavljeni ciljevi za smanjenje onečišćenja do 2030. godine kao i cilj tzv. zdravog planeta za zdrave ljude do 2050. godine. To se odnosi posebno na poboljšanje kvalitete zraka za 55%, na poboljšanje kvalitete vode tako da se smanji količina otpada i plastičnog otpada za 50% i mikroplastike za 30%, na poboljšanje kvalitete tla za 50% smanjenjem uporabe kemijskih pesticida, smanjenjem za 25% ugroženih ekosustava zbog onečišćenja zraka, smanjenjem za 30% broja osoba koje su izložene buci uzrokovanoj prometom, te smanjenjem od 50% proizvodnje otpada (Europska komisija, 2021b).

4. Mehanizam za pravednu tranziciju

Neophodnom tranzicijom prema klimatskoj neutralnosti povećat će se dobrobit svih građana, ali i europska konkurentnost. Ipak, tranzicija će biti zahtjevnija za građane, sektore i regije koji se više oslanjaju na fosilna goriva. Upravo je njima namijenjena (solidarna i pravedna) potpora iz mehanizma za pravednu tranziciju kojim će se poticati ulaganja te iz kojeg će se izdvajati financijska i praktična potpora u vrijednosti od najmanje 1 bilijun eura (Europska komisija, 2020c).

Iz proračuna EU osigurati će se 503 milijarde eura za rashode za okoliš i klimu, uključujući izdatke za zaštitu okoliša u svim programima u skladu s 25% ciljnom vrijednosti za rješavanje klimatskih pitanja na način kako je predloženo za „Višegodišnji financijski okvir“ od 2021.do 2027. godine. Na taj način će se potaknuti dodatno nacionalno sufinanciranje za okoliš i klimu od 114 milijardi eura.

Fond InvestEu dodatno će potaknuti javna i privatna ulaganja za područje okoliša i klime za razdoblje 2021.-2030. godine u iznosu od oko 279 milijardi eura, odnosno 30% vrijednosti programa InvestEu. U okviru „Mehanizma za pravednu tranziciju“, mobilizirat će se ulaganja u iznosu od 100 milijardi eura, u razdoblju od 2021.-2027. godine , što „ekstrapolirano“ na period od 10 godina daje iznos od 143 milijardi eura za omogućavanje pravedne tranzicije.

Iz „Fonda za modernizaciju“ i „Fonda za inovacije“, osigurat će se minimalno 25 milijardi eura za tranziciju klimatske neutralnosti. Navedeni fondovi nisu dio proračuna Europske unije, ali se djelomično financiraju od dražbi emisijskih jedinica u okviru sustava trgovanja emisijama (Europska komisija, 2020d).

4.1. Plan ulaganja u održivu Europu

Za tranziciju Europe prema klimatski neutralnom gospodarstvu potrebna je politička obveza i velika ulaganja. Zeleni plan potvrda je predane borbe protiv klimatskih promjena, a poduprijet je i planom financiranja. Sredstvima iz proračuna EU-a privući će se privatna sredstva za zelene projekte u cijeloj Europi te poduprijeti regije i građane koje će tranzicija najviše pogoditi. Odgovarajućim regulatornim poticajima povećat će se zelena ulaganja, a javnim tijelima i sudionicima na tržištu pomoći će se da prepoznaju i razviju takve projekte.

U borbi protiv klimatskih promjena, upravo je priroda najvažniji saveznik jer je izvor bioraznolikosti, regulira klimu te pohranjuje i apsorbira ugljik u močvarnim područjima i šumama. Održivim i kružnim upravljanjem poboljšati će se životni uvjeti, održati će se zdrav okoliš, bioproizvodi te održiva proizvodnja hrane i energije. Novi modeli koji podrazumijevaju klimatski prihvatljivo gospodarenje zemljištem, omogućiti će povećanje dohotka za poljoprivrednike i šumare. Uredbom o prenamijeni i korištenju zemljišta te šumarstvu doprinijet će se obnovi narušenih ekosustava, održivoj proizvodnji hrane, otpornosti na klimatske promjene, promicanju biogospodarstava i očuvanju bioraznolikosti.

Održiva bioenergija doprinosi smanjenju i postupnom prestanku korištenja fosilnih goriva te ima izrazito važan utjecaj u postizanju klimatski neutralne EU do 2050. godine. Još 2018. godine postrožili su se kriteriji održivosti jer su uvedene dodatne mjere za klimu i bioraznolikost. Tri godine kasnije kriteriji su se dodatno postrožili zbog zdravlja šuma, a neki od tih kriterija su (Europska komisija, 2021): a) zabrana nabave biomase za proizvodnju energije iz prašuma i močvarnih područja; b) od 2026. godine ukidanje potpore za šumsku biomasu za ona postrojenja koja su namijenjena isključivo za proizvodnju električne energije; c) sva postrojenja za proizvodnju toplinske i električne energije iz biomase dužna su poštovati minimalne pragove smanjenja emisija stakleničkih plinova; d) zabrana nacionalnih financijskih poticaja za proizvodnju energije iz trupaca za piljenje i trupaca za izradu furnira, panjeva i korijenja.

EU obvezala se provoditi „Program UN-a za održivi razvoj 2030." unutar i izvan granica EU te pomagati onim zemljama kojima je pomoć najpotrebnija. Spomenuti Program uključuje tri dimenzije održivog razvoja: ekonomsku, socijalnu i zaštitu okoliša.

Plan ulaganja za održivu Europu je program ulaganja za Europski zeleni plan kojim će se prikupljati privatna sredstava putem financijskih instrumenata, naročito putem programa InvestEU, te mobilizirati javna ulaganja. Ukupna ulaganja iznose najmanje bilijun eura kao što je ranije spomenuto. Premda, sve države članice, sektori i regije moraju pridonijeti tranziciji. Određene regije biti će osobito pogođene i suočiti će se sa značajnom socijalnom i gospodarskom transformacijom. Europski zeleni plan i njegov plan ulaganja mobilizirat će sredstva EU i razviti okvir za poticanje i olakšavanje privatnih i javnih ulaganja, koja su potrebna kako bi se provela tranzicija ka klimatski zelenom, neutralnom, uključivom i konkurentnom gospodarstvu. Plan obuhvaća tri komponente (Europska komisija, 2020d):

1. Financiranje – u ovom desetljeću mobilizirat će se ulaganja koja su održivo prihvatljiva u vrijednost od minimalno bilijun eura. Glavnu ulogu imati će Europska investicijska banka , te će se za djelovanje u području klime i okoliša, iz proračuna EU, izdvojiti najveći dio dosad. Europska investicijska banka postati će Europska banka za klimu upravo zbog cilja da udvostruči svoj udio financiranja, s 25% na 50% do 2025. godine, koji je namijenjen djelovanju u području klime te okolišne održivosti.
2. Uvjeti pogodnosti – dodjeljivati će se poticaji za preusmjeravanje i privlačenje ulaganja iz privatnog i javnog sektora. EU davati će prednost održivom financiranju i olakšati će održiva ulaganja za javna tijela poticanjem implementacije zelene javne nabave i zelenog proračuna. Također, pojednostaviti će postupke za dobivanje državne potpore, posebice za regije u kojima je neophodno omogućiti pravednu tranziciju.
3. Praktična potpora – Europska komisija pružiti će pomoć nositeljima projekata i javnim tijelima u osmišljavanju, planiranju i provedbi održivih projekata.

4.2. Mehanizam za pravednu tranziciju

Mehanizam za pravednu tranziciju je najvažniji instrument za provođenje klimatski neutralnog gospodarstva. Premda će financijska pomoć biti potrebna svim regijama, kako je i definirano planom ulaganja, u okviru Mehanizma za razdoblje 2021. – 2027. godina, najmanje 100 milijardi eura će se mobilizirat za ublažavanje socioekonomskih posljedica tranzicije u najugroženijim regijama. Stimulirati će se potrebna ulaganja kako bi se pomoglo zajednicama i radnicima koji uvelike ovise o industriji fosilnih goriva. Glavni izvori financiranja mehanizma za pravednu tranziciju, a koji se podupire iz proračuna EU, jesu „Fond za pravednu tranziciju", „Program za pravednu tranziciju u okviru programa InvestEU" i „Instrument za kreditiranje u javnom sektoru" uz uključivanje Europske investicijske banke.

4.2.1. Fond za pravednu tranziciju

Države članice EU moraju zajedno s Europskom komisijom kreirati teritorijalne planove i njima utvrditi kojim teritorijima je pomoć potrebna kako bi mogle povući svoj dio sredstava iz Fonda za pravednu tranziciju, a za čije će se potrebe izdvojiti 7,5 milijardi eura.. Iz Fonda za regionalni razvoj i Europskog socijalnog fonda plus dostupno im je još više sredstava, a omogućiti će i dodatna sredstva na nacionalnoj razini u ukupnoj vrijednosti od 30-50 milijardi eura. Bespovratna sredstva iz ovog Fonda namijenjena su ponajprije regijama. Potpora će se isplaćivati radnicima za razvoj kompetencija i vještina za tržište rada budućnosti, a novoosnovanim poduzećima i inkubatorima pomoći će u kreiranju novih gospodarskih prilika. Poticat će se i ulaganja glede prijelaza na čistu energiju, npr. ulaganja u energetsku učinkovitost. Osim navedenih 7,5 milijardi eura, Komisija predlaže dodatna sredstva od 2,5 milijardi eura u okviru dugoročnog proračuna EU te 30 milijardi eura iz instrumenta Next Generation EU. Ukupan iznos Fonda za pravednu tranziciju iznositi će 40 milijardi eura. Sredstva će se koristiti za ublažavanje socioekonomskih posljedica za najugroženije regije uzrokovane zelenom tranzicijom. Ulaže se u budućnost navedenih regija i to putem pomaganja malih i srednjih poduzećima, podupiranja prekvalifikacija radnika te diversifikacijom gospodarske aktivnosti (Europska komisija, 2020e).

Potpore će biti dostupne svim državama članicama, a najviše će se izdvajati za regije koje imaju više emisije ugljika kao i regije u kojima je značajan udio stanovništva zaposlen upravo u industriji fosilnih goriva. Kao što je spomenuto, članice EU moraju sastaviti teritorijalne planove za razdoblje do 2030. godine i utvrditi one teritorije kojima je potpora potrebna. Upravo u tim planovima utvrditi će se najbolji načini rješavanja ekoloških, socijalnih i gospodarskih problema. Mehanizmom za pravednu tranziciju građani će biti zaštićeni kroz mogućnosti prekvalifikacija, olakšavanjem zapošljavanja u sektorima u tranziciji i u novim sektorima, ulaganjem protiv energetskog siromaštva, poboljšanjem energetski efikasnog stanovanja, olakšavanjem pristupa sigurnoj, čistoj i cjenovno pristupačnoj energiji.

Kada govorimo o poduzećima, ona će biti zaštićena kroz omogućavanje atraktivnih uvjeta za ulagače iz privatnog i javnog sektora, zatim kroz investiranje u osnivanje novih te malih i srednjih poduzeća, omogućiti će se jednostavniji pristup financijskoj potpori

i zajmovima te ulaganju u inovacijske i istraživačke aktivnosti. Nadalje, omogućiti će se tranzicija prema tehnologijama koje imaju nisku razinu emisija ugljika. Što se tiče država članica EU i regija, doći će do otvaranja radnih mjesta u „zelenom gospodarstvu", ulaganja u obnovljive izvore energije, unapređenja energetske infrastrukture, osnaživanja digitalne povezanosti, ulaganja u održivi javni prijevoz. Omogućiti će se pružanje tehničke podrške i pristupačnih zajmova javnim lokalnim tijelima te tranzicija za aktivnosti s niskim razinama emisija ugljika koje su otporne na klimatske promjene. (Europska komisija, 2020f).

4.2.2. Program InvestEU

U lipnju 2018. godine predložen je program InvestEU kao dio (budućeg) dugoročnog proračuna EU. Ovaj Program ujedno je i dio Europskog zelenog plana te ga i nadopunjuje. Cilj Programa je pridobiti ulaganja upravo iz privatnog sektora, obuhvaćajući ulaganja u promet i održivu energiju, kako bi se u tim sektorima omogućili novi izvori rasta. Ovim Programom mobilizirat će se 30% ulaganja za projekte koji su povezani s okolišem i klimom. Ujedno se doprinosi i Mehanizmu za pravednu tranziciju na način da se u okviru ovog Programa mobiliziraju održiva ulaganja u iznosu od 45 milijardi eura u regijama koje su tranzicijom najviše pogođene. Također, Program će imati važnu ulogu i u promoviranju održivih praksi kod privatnih i javnih investitora na način da će se postaviti kriteriji za nadgledanje ulaganja koji su povezani s klimom i procjenu utjecanja takvih projekata na društvo i okoliš.

Program InvestEU služi za pružanje savjetodavne i tehničke pomoći posredovanjem savjetodavnog centra. Time će se privatnim i javnim pokroviteljima projekata omogućiti razvoj, utvrđivanje i provedba zelenih ulaganja. Portal InvestEU će pružati jednostavan i besplatan internetski alat kojim će se poduzećima i promotorima projekata iz EU, a koji su u potrazi za financiranjem, omogućiti umrežavanje i vidljivost s ulagačima iz cijelog svijeta (Europska komisija, 2020c). Potpora koja je usmjerena na gospodarski održiva ulaganja javnih i privatnih subjekata provodit će se putem financijskih proizvoda programa InvestEU koje predlože provedbeni partneri tog programa kao što su nacionalne razvojne banke ili npr.Europska investicijska banka. Smjernice za ulaganja za program InvestEU će uključivat odjeljak o programu za pravednu tranziciju te načinima na koji se on provodi (Europska komisija, 2020e).

4.2.3. Kreditiranje javnog sektora

Instrumentom za kreditiranje javnog sektora omogućit će se bespovratna sredstva u iznosu od 1,5 milijardi eura iz proračuna EU, s ciljem da se financijskim partnerima omogući davanje potpore za one projekte koji doprinose prevladavanju izazova u aspektu tranzicije. Europska investicijska banka, jedan od financijskih partnera, izdati će zajmove od 10 milijardi eura koji će mobilizirati ulaganja u vrijednosti 25-30 milijardi eura za najpogođenije regije (Europsko vijeće, 2020b).

Komponentu zajmova u tom instrumentu osiguravat će Europska investicijska banka, a komponentu bespovratnih sredstava Europska komisija u skladu sa svojim politikama, pravilima i postupcima. Sastavnice bespovratnih sredstava bit će raspoložive za prihvatljive projekte u državama članicama EU putem tzv. nacionalnih omotnica koje će biti izdvojene do prosinca 2024. godine (Europska komisija, 2020e). Također, Komisija će preko platforme za pravednu tranziciju pružati tehničku podršku ulagačima i državama članicama EU te će uključiti lokalna tijela, nevladine organizacije i socijalne partnere.

Zemljopisna pokrivenost ovim Instrumentom obuhvatit će projekte u regijama koje imaju odobrene planove za pravednu tranziciju, ali i one projekte od kojih spomenute regije imaju direktnu korist. Pružanje potpora obuhvaća širok raspon, od prometne i energetske infrastrukture, mjesnih toplinskih mreža, obnovu zgrada, sve do socijalne infrastrukture. Također, i drugi sektori mogu biti uključeni. U okviru Instrumenta za kreditiranje javnog sektora biti će financirani oni projekti u okviru kojih se ne stvaraju dovoljni vlastiti prihodi i koji se ne bi financirali po tržišnim uvjetima, te će to biti nadopuna proizvodima ponuđenima u okviru fonda InvestEU (Europska komisija, 2020c). Kompletna ulaganja u okviru Instrumenta za kreditiranje u javnom sektoru moraju biti u suglasju s politikama, pravilima i postupcima kreditiranja Europske investicijske banke, te se moraju provoditi na temelju teritorijalnih planova za pravednu tranziciju.

5. Što nosi budućnost?

Europska unija napravila je ozbiljne promjene u u borbi protiv globalnog zatopljenja i uvela prvi sveobuhvatni paket mjera za smanjenje emisija stakleničkih plinova. Cilj ugljično-neutralnog gospodarstva do 2050. godine zahtijevat će potpuno drugačiji razvojni put u odnosu na sadašnji. To će, između ostalog, značiti veću trgovinu unutar EU-a i manje vanjske trgovine, usmjerenost prema lokalnih proizvoda te manju mobilnost. Vlahinić Lenz i Fajdetić (2021) ukazuju na važnost društvene i političke globalizacije i spremnost na usvajanje ekološki i klimatski prihvatljivih politika i međunarodnih sporazuma. To dodatno opravdava odabranu razvojnu strategiju EU-a (tj. Zeleni plan), a koji EU čini globalnim liderom tzv. klimatski neutralnog razvojnog programa. Međutim, zemlje EU su otvorene, ovisne o trgovini i osjetljive na vanjske šokove, dok većina njihovih trgovinskih partnera još nije objavila svoju strategiju dekarbonizacije. To bi moglo značajno zakomplicirati ispunjenje ambicioznih planova EU-a za klimatsku neutralnost do 2050. godine (Vlahinić Lenz i Fajdetić, 2021).

Objektivno gledano, prijelaz na niskougljično gospodarstvo predstavlja i značajnu priliku i ogroman izazov. Postoji prilika za implementaciju više čistih izvora energije kao što su obnovljivi izvori energije i čiste tehnologije koje mogu dodatno potaknuti transformaciju energetskog sektora. Istodobno, tranzicija je ogroman izazov zbog nedostatka znanja, prisutnosti ekonomske nesigurnosti i potrebe za značajnim kapitalom za transformaciju gospodarstava, posebice onih čiji je energetski sustav u velikoj mjeri oslonjen na fosilna goriva. Uspješna tranzicija zahtijeva ravnotežu između politike, kapitala i tehnologije, uz partnerstvo između zemalja. Dakako, izazov je i podjela "sjever-jug" te "zapad-istok" koja postoji među državama članicama EU, a koja i mogla biti prepreka postizanju europske energetske tranzicije zbog višestrukih i divergentnih interesa. Još jedan izazov mogao bi

biti otpor ljudi koji energetski prijelaz vide kao potencijalnu prijetnju svom poslu (Hafner i Raimondi, 2020).

Dodatno, pandemija COVID-19 ukazala je povezanost između degradacije okoliša, zdravlja ljudi i utjecaja klimatskih promjena. Učinci klimatskih promjena već sada utječu na zdravlje, živote i egzistenciju svih, posebno najugroženijih slojeva stanovništva. Oporavak nakon pandemije trebao bi biti prilika za stvaranje zelenijih društava te gospodarstava. Youssef (2021) navodi tri glavne značajne klimatske dividende COVID-19. Prvo, mjere i ograničenja mobilnosti za sprječavanje širenja COVID-19 rezultirali su smanjenjem globalnih emisija u 2020 za 5,8%. Međutim, kako se gospodarske aktivnosti pokušavaju vratiti u normalu, postoji rizik odtzv. odskočnog (engl. *rebound*) efekta. Drugo, politike plana oporavka i paketi poticaja mogli bi pozitivno utjecati na radnje u vezi s klimatskim promjenama i mogli bi dovesti do boljeg i održivog obnavljanja. Treće, došlo je do značajne promjene u ponašanju ljudi tijekom krize, što je rezultiralo poboljšanjem kvalitete zraka i smanjenjem emisija. Sukladno tome, Youssef (2021) navodi da treba promicati ekološki prihvatljive akcije kako bi se održalo takvo ponašanje i osigurala održiva budućnost.

U tom kontekstu, NextGenerationEU je privremeni instrument za poticanje oporavka EU, za kojeg je izdvojeno više od 800 milijardi eura, a kako bi se otklonile neposredne socijalne i gospodarske štete prouzročene pandemijom COVID-19. Ujedno je najveći paket poticaja koji je ikad financiran u Europi. Poboljšana fleksibilnost mehanizama omogućit će interveniranje u nepredvidljivim okolnostima. Navedeno implicira da je proračun namijenjen i (potencijalno) nestabilnoj budućnosti, a ne samo trenutnim okolnostima.

Glavni elementi ovog instrumenta su modernizacija putem inovacija i istraživanja unutar programa „Obzor Europa“, zatim digitalne i klimatske tranzicije unutar „Fonda za pravednu tranziciju“, programa „Digitalna Europa“ te otpornosti i pripravnosti u okviru „Mehanizma za oporavak i otpornost“, sustava „RescEU“ i zdravstvenog programa „EU za zdravlje”. Posebna pozornost je usmjerena ka modernizaciji tradicionalnih politika, poput borbe protiv klimatskih promjena, zaštite bioraznolikosti i rodne neravnopravnosti, te zajednička poljoprivredna i kohezijska politika da bi se što više povećao njihov doprinos prioritetima Unije (www.europa.eu).

Zajedničko ulaganje od spomenutih 800 milijardi eura odnosi se na sljedeće aktivnosti:

Neka bude zeleno

NextGenerationEU omogućuje financijska sredstva za potrebe ulaganja u nove tehnologije koje su prihvatljive za okoliš poput korištenja javnog prijevoza i zelenijih vozila, poboljšanja energetske učinkovitosti svih javnih prostora i stambenih objekata. Neophodno je očuvati prirodni okoliš i umanjiti količine otpada, (pogotovo plastičnog otpada), oživjeti staništa pčela i zasaditi značajne količine drveća te unaprijediti kvalitetu mora, rijeka i voda, podrediti poljoprivredu zahtjevima okoliša te uzgajati zdraviju hranu, povećati korištenje energije iz obnovljivih izvora.

Europa bi trebala biti lider u aspektu klime, a tome svaki građanin može doprinijeti recikliranjem i ponovnim korištenjem proizvoda, upotrebom javnog prijevoza ili vožnje biciklom, upotrebom rabljene robe, izborom prehrane s umanjenim količinama mesa i sl.

Neka bude digitalno

Budućnost Europe bazirati će se na tehnologiji, upravo zato je ovo digitalno desetljeće EU. Instrumentom NextGenerationEU biti će omogućen daljnji razvitak umjetne inteligencije (koja će pridonijeti unapređenju obrazovanja, prometa i zdravstva te u borbi protiv klimatskih promjena), pametnih i učinkovitijih gradovova, pristup 5G mreži te ultrabrzom širokopojasnom internetu na području cijele EU, sigurna online kupovina, digitalni identitet (koji omogućuje lakši pristup internetskim uslugama – elektronička osobna iskaznica).

Europa financijski podupire edukacijske programe za osposobljavanja i unaprjeđenje digitalnih vještina za sve dobne skupine, olakšava malim i srednjim poduzećima u poslovanju na internetu te povećava dostupnost e-obrazovanja.

Neka bude zdravo

Pandemija virusa COVID-19 potresla je svijet na razne načine bilo utjecanjem na zdravstveno i duševno stanje ili socijalni život. Sada se namjerava stvoriti zdravija i sigurnija Europa te se bolje pripremiti za svaku potencijalnu buduću krizu. U tom kontekstu, instrumentom NextGenerationEu osigurati će se angažman svih država Europe radi zaštite zdravlja, moderniziranje zdravstvenog sustava u svim bolnicama EU kako bi imale bolji pristup medicinskoj opremi i novoj tehnologiji, sredstva za subvencioniranje usavršavanja medicinskih i zdravstvenih djelatnika diljem Europe, investiranje u istraživanje i novitete za razvoj cijepljenja i dijagnosticiranja te liječenja svih bolesti ne uključujući samo COVID-19.

Neka bude snažno

Primarni zadatak je stvoriti otporniju i snažniju Europu, a korištenjem instrumenta NextGenerationEu osigurati će se podrška naukovanju i daljnjem obrazovanju, osiguranje bespovratnih sredstva zajmova mladim poduzetnicima, poticanje na daljnje školovanje u području znanosti i tehnologije (a koje otvaraju vrata zelenim i digitalnim radnim mjestima budućnosti).

Europa pridonosi stabiliziranju mnogih sektora. Primjerice, povisuje potpore za sektore turizma te umjetnosti i kulture na području cijele Unije i stimulira digitalizaciju i njihovu održivost.

Neka bude jednako

Osnovni zadatak je omogućiti jednake pogodnosti za sve građane Europe te podupirati raznolikost u svim aspektima. Instrument NextGenerationEu osigurati će osnaživanje žena te promicanje i razvijanje rodne ravnopravnosti, borbu protiv svih diskriminacija i zaštita prava LGBTIQ+ zajednice, unaprjeđenje prava EU u području govora i zločina iz mržnje, borbu protiv ksenofobije te svih oblika rasizma.

Ravnopravnost uključuje jednake socijalne i gospodarske mogućnosti. Korištenjem instrumenta NextGenerationEu uvećati će se tendencija zapošljavanja osoba sa invaliditetom te osoba koji žive na siromašnim, udaljenim ili ruralnim područjima, većem broju

ljudi osigurat će se pristojni i odgovarajući uvjeti stanovanja te će se ulagati u uključivo obrazovanje djece bez obzira na njihovo podrijetlo, situaciju ili posebne potrebe.

Uzročnici gubitka biološke raznolikosti i klimatskih promjena su globalni i nije moguće njihovo rješavanje unutar nacionalnih okvira. Samostalnim djelovanjem EU nije moguće ostvarivanje namjera Zelenog plana. Baudry (2021) pak tvrdi da COVID-19 vjerojatno neće ubrzati tranziciju ka niskougljičnom gospodarstvu. Egzogeni šok povezan s krizom koronavirusa samo kratkoročno povećava zalihe "zelenog" kapitala, ali taj utjecaj se smanjuje pa čak i poništava u srednjem i dugom roku. Prema Baudry (2021), dugoročno dominira usporavanje niskougljičnih ulaganja. Pandemija COVID-19 pogodila je proizvodne pogone obnovljive energije, lance opskrbe i tvrtke te usporila prijelaz prema tzv. održivoj energiji. Stoga bi energetske i klimatske politike mogle zahtijevati restrukturiranje na temelju (n) ovih okolnosti. U tom kontekstu, vlade bi trebale ponuditi nekoliko korisnih poticaja kako bi uvjerile privatni sektor (i društvo općenito) da ulažu u obnovljive izvore energije (Hosseini, 2020; Tian et al., 2022). Kako bi motivirala svoje partnere i susjede za održivi razvoj, EU može se poslužiti svojom kompetentnošću, utjecajem te financijskom potporom. Nastavit će sa ulaganjem dodatnih napora u izgrađivanja saveza sa istomišljenicima te osvješćivanju neupućenih i indiferentnih (Europska komisija 2019a).

Kada je pak riječ o perspektivi Hrvatske, prema Mačkić, Matutinović i Recher (2020), a u kontekstu ekonomske dimenzije održivosti, iskustvo sa virusnom pandemijom COVID-19 pokazalo je svu slabost deindustrijalizirane hrvatske ekonomije koja se od svoje samostalnosti oslanjala pretežno na turizam i druge uslužne djelatnosti. Zanemarivanje industrije ne predstavlja samo rizik gubitka tehničkih i tehnoloških kompetencija već i ovisnost o međunarodnoj trgovini u funkcioniranju svih ekonomskih sektora - sve do zadovoljavanja primarnih potreba stanovništva, što se u rizičnim situacijama, kao na primjer u slučaju dugotrajne pandemije ili međunarodnih trgovinskih ili vojnih sukoba, može pretvoriti u problem nacionalne sigurnosti. Vizija Republike Hrvatske prvenstveno treba odgovoriti na pitanje koji je njezin ekonomski identitet - agresivna ili atraktivna destinacija, odnosno destinacija u kojoj se kao cilj postavlja rast dohotka ili rast zaposlenosti? Socijaldemokratski odgovor na tu dilemu jest jasan i uvijek je isti - zaposlenost. Danas tome pridodajemo i kako izvor porasta zaposlenosti mora uzeti u obzir i okolišnu komponentu. Ovo je desetljeće u kojem ćemo (tj. trebali bi) osigurati bioraznolikost, zaustaviti trendove u klimatskim promjenama i postaviti temelje održivijim modelima proizvodnje, potrošnje, razmjene i raspodjele oskudnih dobara. Ako je vizija Hrvatske kao moderne, inovativne, otvorene, uključive, zdrave, zelene, sigurne i održive ekonomije, to onda podrazumijeva i određene korake u tom procesu. Prvi je navođenje ciljeva okolišne, društvene i ekonomske transformacije:

1. Prevencija i obrazovanje ekonomskih subjekata je prvi korak u uspješnoj regulatornoj funkciji države koja kao cilj postavlja stvaranje okvira u kojem će ishodi biti društveno poželjni.
2. Fiskalnom politikom odrediti optimalnu strukturu oporezivanja koja bi potaknula rast produktivnosti resursa i osigurala društvenu i okolišnu pravednost u transformacijskom procesu.
3. Pametnom državnom regulacijom osigurati: dekarbonizaciju i povećanje energetske efikasnosti u potrošnji, optimalnu energetsku tranziciju (decentralizaciju proiz-

vodnje energije na manje jedinice i državnu potporu u troškovima proizvodnje), financiranje istraživanja i razvoja tehnologija usmjerenih na skladištenje energije, institucionalne poticaje (subvencije i porezne olakšice) usmjerene na smanjenje otpada i implementaciju cirkularne ekonomije, sprječavanje energetskog siromaštva stanovništva.

4. Aktivnom industrijskom politikom poticati: domaće investicije u razvoj biotehnoloških znanja i proizvoda potrebnih za prilagođavanje poljoprivrednih kultura klimatskim promjenama, stvaranje klastera u proizvodnji hrane, funkcionalni razvoj prerađivačke industrije u domeni proizvodnje hrane.
5. „Više (EU) je bolje“: međusektorska i međunarodna suradnja unutar jedinstvenog europskog tržišta osigurava prelazak s linearne na cirkularnu ekonomiju.
6. Dekarbonizacija prijevoza (vlak i bicikl) kao budućnost te okolišno i društveno prihvatljiv oblik prijevoza.

Vijeće EU dalo je određene preporuke Hrvatskoj koje se odnose na jačanje kapaciteta za provedbu i pripremu propisa, sprečavanje korupcije te učinkovit, stabilan i predvidiv regulatorni i pravni sustav koji osigurava i omogućava mehanizme za rješavanje sporova. Preduvjet za provedbu Zelenog plana u Hrvatskoj, odnosno za tranziciju prema prosperitetnom i pravednom društvu s konkurentnim, resursno efikasnim i modernim gospodarstvom, jest provedba navedenih preporuka. Uključivanje metoda Europskog zelenog plana u Hrvatski program oporavka moglo bi u konačnici potaknuti gospodarski razvoj i inovacije (Europska komisija 2020g).

6. Zaključne napomene

Problem globalne ekonomije i ekoloških problema sežu daleko u povijest. Snažan tehnološki rast i razvoj znanosti ubrzavaju i povećavaju proizvodnju i produktivnost, što dovodi do sve većeg korištenja i iscrpljivanja prirodnih resursa. Globalni ekonomski rast zanemaruje okoliš i ljudsko zdravlje, te se temelji na iscrpljivanju prirodnih resursa što dovodi do ekološke neravnoteže. Makroekonomski značaj energije u ekonomskoj literaturi poprilično je zapostavljen. Važnost energije za ekonomski rast i gospodarsku aktivnost je neosporna.

Održiv razvoj u ekonomiji odnosi se na postizanje gospodarskog rasta i gospodarske učinkovitosti. Ekološka održivost uključuje razvoj koji uvažava sposobnost okoliša da prihvati iscrpljivanje prirodnih resursa i onečišćenje. Društvena održivost ostvaruje se postizanjem zadovoljavajuće razine životnog standarda. Što se tiče ciljeva održivog razvoja, isti trebaju počivati na odgovornosti prema okolišu, gospodarskoj učinkovitosti te socijalnom napretku. Kako bi EU realizirala svoj cilj postizanja klimatske neutralnosti, ponajprije je potrebno dekarbonizirati energetski sustav. Gotovo 75% emisija stakleničkih plinova u EU izvor su uporabe energije i proizvodnje u gospodarskim segmentima. Zato je nužno razviti energetski sektor koji se temelji na obnovljivim izvorima energije, uz postepeno ukidanje uporabe ugljena te dekarbonizaciju plina. U borbi protiv klimatskih promjena, upravo je

priroda najvažniji saveznik jer je izvor bioraznolikosti, regulira klimu te pohranjuje i apsorbira ugljik. Održivim i kružnim upravljanjem poboljšat će se životni uvjeti, održat će se zdrav okoliš te održiva proizvodnja hrane i energije. Upravo u najpogođenijim regijama, mehanizam za pravednu tranziciju biti će usredotočen na gospodarske i socijalne troškove tranzicije. U sklopu mehanizma financirat će se različiti projekti poput novih radnih mjesta, prekvalifikacije za nezaposlene koji su ostali bez posla uslijed tranzicije, potpore poduzećima, ulaganja u obnovljive izvore energije i održivi prijevoz, obnove zgrada. Uzročnici klimatskih promjena i gubitka biološke raznolikosti globalni su, i nije moguće njihovo rješavanje unutar nacionalnih okvira. Da bi motivirala svoje partnere i susjede za održivi razvoj, EU može se poslužiti svojom kompetentnošću, utjecajem te financijskom potporom.

Pandemija COVID-19 pokazala je povezanost između degradacije okoliša, zdravlja ljudi i utjecaja klimatskih promjena. Učinci klimatskih promjena već sada utječu na zdravlje, živote i egzistenciju svih, posebno najugroženijih slojeva stanovništva. Oporavak nakon pandemije trebao bi biti prilika za stvaranje zelenijih društava te gospodarstava. Na tom tragu, buduća istraživanja ove problematike mogla bi biti usmjerena u pravcu analiziranja uspješnosti energetske tranzicije prema niskougljničnom gospodarstvu ali na nacionalnoj razini za svaku zemlju članicu EU. Pri tome i samo orijentacijski može poslužiti rad od Tian et al. (2022) u kojem je dana sveobuhvatna (globalna) analiza tj. usporedba energetske tranzicije i COVID-19.

Literatura

1. Baudry, M. (2021). Low-Carbon Transition of EU-ETS Firms: Assessing the Long-Term Effects of Covid-19, in: Belaïd, F., Cretì, A. (Eds.) Energy Transition, Climate Change, and COVID-19: Economic Impacts of the Pandemic, str. 45-72, Springer International Publishing
2. Črnjar M, Črnjar K, (2009). Menadžment održivog razvoja (Ekonomija – ekologija - zaštita okoliša), Fakultet za menadžment u turizmu i ugostiteljstvu u Opatiji Sveučilišta u Rijeci Glosa, Rijeka
3. Europska komisija (2015). Okoliš – sprečavanje onečišćenja, https://ec.europa.eu/environment/basics/health-wellbeing/preventing-pollution/index_hr.htm (21.08.2021.)
4. Europska komisija (2019a). Komunikacija Komisije Europskom parlamentu, Europskom vijeću, Europskom gospodarskom i socijalnom odboru i Odboru regija - Europski zeleni plan, https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0019.02/DOC_1&format=PDF (06.07.2021.)
5. Europska komisija (2019b). Communication from the Commission – The European Green Deal, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX:52019DC0640 (06.06.2021.)
6. Europska komisija (2019c). Clean energy for all Europeans, https://data.europa.eu/doi/10.2833/21366 (05.09.2021.)
7. Europska komisija (2020a). Komunikacija Komisije Europskom parlamnetu, Vijeću, Europskom gospodarskom i socijalnom odboru i Odboru regija – Strategija „od polja do stola", https://eur-lex.europa.eu/legal-content/HR/TXT/HTML/?uri=CELEX:52020DC0381&from=EN (05.09.2021.)
8. Europska komisija (2020b). Communication from the Commission - EU Biodiversity Strategy for 2030, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX%3A52020DC0380 (10.09.2021.)
9. Europska komisija (2020c). Što su europski zeleni plan i mehanizam za pravednu tranziciju?, https://ec.europa.eu/commission/presscorner/detail/hr/qanda_20_24 (04.06.2021.)
10. Europska komisija (2020d). Komunikacija Komisije Europskom parlamentu, Europskom vijeću, Europskom gospodarskom i socijalnom odboru i Odboru regija – Plan ulaganja za održivu Europu, https://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:52020DC0021&from=EN (01.08.2021.)

11. Europska komisija (2020e). EU-ov proračun za oporavak: Pitanja i odgovori o mehanizmu za pravednu tranziciju, https://ec.europa.eu/commission/presscorner/detail/hr/qanda_20_931 (15.07.2021.)
12. Europska komisija (2020f). Mehanizam za pravednu tranziciju: nitko neće biti zapostavljen – Europski zeleni plan, https://ec.europa.eu/commission/presscorner/api/files/attachment/860447/just_transition_mechanism_hr.pdf.pdf (25.06.2021.)
13. Europska komisija (2020g). Projekti za zeleno gospodarstvo koje financira EU, https://data.europa.eu/doi/10.2775/363356 (14.08.2021.)
14. Europska komisija 2021, Održivo iskorištavanje naših prirodnih resursa, https://ec.europa.eu/commission/presscorner/api/files/attachment/869839/Nature_factsheet_HR.pdf. (29.08.2021.)
15. Europski parlament (2020). Impact of the coronavirus crisis on climate action and the European Green Deal, https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2020)649370 (10.09.2021.)
16. Europsko vijeće (2020a). Vijeće dalo prioritet mjerama za održive prehrambene sustave: zaključci o strategiji „od polja do stola", https://www.consilium.europa.eu/hr/press/press-releases/2020/10/19/council-prioritises-actions-for-sustainable-food-systems-conclusions-on-the-farm-to-fork-strategy/ (26.08.2021.)
17. Europsko vijeće (2020b). Pravedan prijelaz na klimatsku neutralnost – Vijeće usuglasilo stajalište o novom instrumentu za kreditiranje u javnom sektoru, https://www.consilium.europa.eu/hr/press/press-releases/2020/10/21/just-transition-towards-climate-neutrality-council-agrees-its-position-on-new-public-sector-loan-facility/ (15.07.2021.)
18. Europsko vijeće (2021). Europski propis o klimi: Vijeće i Parlament postigli privremeni dogovor, https://www.consilium.europa.eu/hr/press/press-releases/2021/05/05/european-climate-law-council-and-parliament-reach-provisional-agreement/ (12.07.2021.)
19. Hafner, M., Raimondi, P.P. (2020). Priorities and challenges of the EU energy transition: From the European Green Package to the new Green Deal, Russian Journal of Economics, Vol. 6, No. 4, pp. 374-389, doi: https://doi.org/10.32609/j.ruje.6.55375
20. Herceg N. (2013). Okoliš i održivi razvoj, Synopsis d.o.o, Zagreb
21. Hosseini, S.E. (2020). An outlook on the global development of renewable and sustainable energy at the time of COVID-19, Energy Research & Social Science, Vol. 68, No. 101633, doi: https://doi.org/10.1016/j.erss.2020.101633
22. Mačkić, V., Matutinović, I., Recher, V. (2020). Održivi razvoj u Hrvatskoj i Europski zeleni plan, http://library.fes.de/pdf-files/bueros/kroatien/17221.pdf (12.01.2022.)
23. Ministarstvo mora, prometa i infrastrukture RH (2020). Strategija održive i pametne mobilnosti, https://mmpi.gov.hr/vijesti-8/informacija-strategija-odrzive-i-pametne-mobilnosti/22500 (09.09.2021.)
24. Munta, M. (2020). The European Green Deal: A game changer or simply a buzzword,https://www.bib.irb.hr/1064244/download/1064244.Munta_GREEN_DEAL_analysis.pdf (30.08.2021.)
25. Obzor Europa 2020, Europski zeleni plan, https://www.obzoreuropa.hr/nadopunjavajuci-programi/europski-zeleni-plan (28.05.2021.)
26. Sundać D, Šundov M. (2018). Ekološko - socijalno – tržišna ekonomija, Ekonomski Fakultet Sveučilišta u Rijeci, Rijeka
27. Tian, J., Yu, L., Xue, R., Zhuang, S., Shan, Y. (2022). Global low-carbon energy transition in the post-COVID-19 era, Applied Energy, Vol. 307, No. 118205, doi: https://doi.org/10.1016/j.apenergy.2021.118205
28. Tišma S, Boromisa A-M, Funduk M, Čermak H. (2017). Okolišne politike i razvojne teme, Alinea, Zagreb
29. Udovičić B. (2004). Neodrživost održivog razvoja, Kigen d.o.o, Zagreb
30. Vlahinić Lenz, N., Fajdetić, B. (2021). Globalization and GHG Emissions in the EU: Do We Need a New Development Paradigm?, Sustainability, Vol. 13, No. 9936, doi: https://doi.org/10.3390/su13179936
31. Youssef, A.B. (2021). The Triple Climatic Dividend of COVID-19, in: Belaïd, F., Cretì, A. (Eds.) Energy Transition, Climate Change, and COVID-19: Economic Impacts of the Pandemic, str. 107-118, Springer International Publishing

Web stranice.

1. https://europa.eu/next-generation-eu/index_hr (11.01.2022.)
2. https://ipbes.net/news/ipbes-global-assessment-preview (23.08.2021.)

HOW DID THE COVID-19 PANDEMIC CHANGE OUR ONLINE BEHAVIOR?

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Preliminary communication

Abstract

Around the globe, the COVID-19 pandemic and measures that were taken against the spread of the virus drastically changed the lives of billions of people. Work and education were forced into online space overnight, pushing people into learning new skills. COVID-19 changed the way we make and spend money, interact with others and spend our free time. But how? This paper aims to review relevant literature on this topic and give a holistic view of this phenomenon. Issues of interest that will be explored in this paper are teaching and learning, shopping, gambling, gaming, social interactions, and leisure activities. In the light of new social norms, internet addiction will be also discussed. An unparalleled event like this brings unparalleled opportunities. The world will never be the same again, but the changes brought by the deadly virus don't have to be negative. This pandemic gave us a glimpse of our digital future and lessons we learned from it should be used to improve it.

Keywords: COVID-19, online behavior, human behavior, internet addiction.

1. Introduction

The beginning of 2020 shook the world as we knew it to the core. Highly infectious SARS-CoV-2 virus with high fatality rates spread from Wuhan, China to the rest of the world (Xu et al., 2020). Data from the World Health Organization (WHO) Guidelines tell us that on January 13th the first case of COVID-19 was confirmed outside of China and that by January 14th, 2020, only 41 cases were confirmed (World Health Organization [WHO], 2020). An epidemic quickly turned into a pandemic. From the beginning of 2020 to mid-2021 almost 180 million cases of COVID-19 infections are confirmed worldwide, with

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almost 4 million fatalities (World Health Organization [WHO], 2021). Global response to the pandemic was partial or total lock-downs, practicing social distancing/isolation, and wearing protective gear. All of those preventive measures had a profound effect on every aspect of human life. Businesses shut down, economies weakened, families were torn apart, schools closed and traveling was banned. The existing theoretical basis for researching human response to mass-scale infections relies heavily on work done during the epidemics of Ebola (Gamma et al., 2019) and influenza A H1N1 (Rubin et al., 2009; Seale et al., 2009). However, this is the first pandemic to occur in the era where we are hyper-connected. With unprecedented disruptions in the daily activities of billions of people around the world, the pandemic has also strengthened the importance of communication to generate an adequate public response (Hanafiah and Wan, 2020).

2. Methods

Data were obtained by the author who carried out a comprehensive and non-systematic search in the PubMed, ResearchGate, Frontiers, and Google Scholar databases. Search strategies included terms as: "COVID-19," and "psychology," "pandemic," "habits,", "behavior changes", "consumer behavior", "social interactions", "online behavior", "social media", "internet addiction", "teaching", "learning", "gambling", "gaming". The search was conducted between June 22nd and July 15th. The author critically analyzed and chose recent publications, dissertations, thesis, published case series, consensus statements, guidelines, meta-analyses, systematic reviews, and prospective cohort studies. In addition, research was conducted in the public domains of informational official websites as well as the references contained in the previously acquired material.

3. Psychology of pandemics

Throughout history, human beings had to deal with a variety of infectious diseases. Infections on a mass scale are one of the most influential events in the making and shaping of human history, culture, and society. One of the earliest recorded pandemics happened during the Peloponnesian War around 430 B.C. Then came Justinian Plague, the Black Death, the Spanish Flu, HIV Pandemic (Huremović, 2019), and the currently present COVID-19 pandemic. There were other outbreaks in the different parts of the world, however, documents and research consider these to be the major ones. Since the sixteenth century, influenza (or flu) pandemics have occurred three times in a one-hundred-year period, or about every 10-50 years. There were three influenza pandemics in the twentieth century and each pandemic had a huge impact on human life and economic growth (WHO, 2011).

Previous research on large-scale disruptive events, such as various kinds of natural disasters (earthquakes, floods, etc.), shows that these types of tragic events are strongly linked to negative mental health outcomes, with posttraumatic stress disorder (PTSD) being the most common, followed by mood disorders (depression), anxiety, and other behavioral and psychological disorder (Makwana, 2019). Le and Nguyen (2020) researched

the psychological well-being of Americans during the COVID-19 pandemic and found that their results are comparable to Henriksen et al. (2010) who investigated the effects of terrorist attacks. According to Henriksen et al. (2010), those who were exposed to the 9/11 terrorist attacks are at least 42 % more likely to experience anxiety than those who were not. Similarly, Le and Nguyen (2020) found that individuals are 3.9, 4.4, 4.5, and 3.2 percent more likely to feel nervous, worried, unhappy, and depressed daily when the number of weekly COVID-19 death rate increases by 0.01 percent. The current pandemic poses a great risk of damaging one's mental health as various variables occurring in its duration are considered to have a negative impact on overall well-being.

Fear and uncertainty play a crucial role in human behavioral and emotional responses to the pandemic (Perdosa et al., 2020). Unlike the human immunodeficiency virus (HIV) which spreads through bodily fluids (sperm, blood, vaginal secretions, and breast milk) and is relatively difficult to get, the coronavirus spreads rapidly. One does not need to have risky sexual intercourse with an individual who carries the virus to get infected, all you need to do is be in the same room with them. At the same time, coronavirus is not very selective, as it does not occur more frequently in a particular age group, lifestyle choices, or any other category. Anyone can get it. Naturally, this produces the emotion of fear, which is a tool that helps human beings deal with threats coming from the environment. LaDoux (2014) explains how people respond to environmental threats. Defensive behaviors are instantaneous, driven by activity in survival circuits that identify dangers, and followed by the subjective experience of fear. Fear brought about by the COVID-19 pandemic is multifaceted and multilayered. People fear that they will get infected or that they will infect someone, that individual and community economic resources may become scarce or that they will not be able to recover shortly, they fear people coming from other countries (xenophobia) (Coelho et al., 2020). Fear could also have desirable consequences in the context of the COVID-19 pandemic because it pushes people toward preventive behaviors like hand-washing and social distancing/isolation (Harper et al., 2020). When fear becomes overwhelming, it has the potential to be dysfunctional, resulting in high amounts of distress and irrational behavior in both individuals and populations (Han, Mahendran & Yu, 2021).

Along with fear comes the inability to tolerate uncertainty. Uncertainty is characterized as the presence of ambiguous, complicated, or unpredictable stimuli or circumstances, as well as a lack of or inconsistent knowledge to deal with them (Toro, Avendao-Prieto, & Vargas 2019). The distress caused by the uncertainty is described as a subjective and personal unpleasant reaction to unknown aspects of the event (Freeston, Tiplady, Mawn, Bottesi, & Thwaites, 2020). In the light of the current pandemic, uncertainty can be seen as not having the ability to predict the course of disease-related events (Mishel, 1988; Kuang & Wilson, 2017). This includes doubts about whether we are already infected or not, will our loved ones become sick, whether there will be a shortage of supplies, whether the national economy will be impacted, whether our earnings will decrease, and so on.

4. Consumer behavior

As mentioned earlier the current research is based on investigations of people's reactions and changes in consumer behavior as a result of the Ebola (Gamma et al., 2019) and influenza A H1N1 epidemics (Rubin et al., 2009; Seale et al.,2009). Behavioral changes during epidemics and pandemics have previously been related to individual motives and government-enforced regulations (Wen et al., 2005). In new and confusing settings, individual and government decision-making is prone to mistakes and biases (Weinstein, 1988). The coronavirus prompted swift responses from governments, stock markets, and consumers. Almost every nation affected by the virus imposed travel restrictions, quarantined individuals, closed public places such as schools, and canceled or banned big public gatherings, among other things. (Anderson et al., 2020; Farooq et al., 2020). Researchers look at how ambiguity, product shortages, hoarding, manufactured obsolescence, isolation, increased use of internet channels, trust, and fear, and other variables affect how customers purchase and use products and services in the short and long term (Laato et al., 2020). While many of the unusual habits witnessed at the peak of the pandemic are expected to go away as the epidemiological situation improves (e.g., buying odd items and self-isolation), consumers' long-term behavior and tastes will be shaped by their experiences (Sheth, 2020). In the latest Euromonitor (2020, as cited in Berezka, Rebiazina, and Muravskaia, 2021) poll, nearly three-quarters of respondents think that the shift to e-commerce will be permanent, and 45 percent now anticipate the drop in in-store shopping to be permanent, up from 28 percent in April 2020. All of the restrictive measures taken by the governments forced businesses and consumers to go online. Despite having a favorable overall influence on the acceptance and development of disruptive technological prospects, researchers are becoming greatly worried about the regulatory aspect of the industry's expansion. Online entertainment and e-commerce can result in major setbacks when it comes to commitment, trust, and readiness to use technology after the pandemic threat has passed (Septianto & Chiew, 2021; Sheth, 2020).

Manss, Kurze & Bornschein (2020) define four types of consumers in the digital or omnichannel era:

1. Pure offline shoppers - They represent the population of people who carry out their shopping processes entirely through traditional media. They seek needed information in physical stores and also buy products at physical stores
2. Pure online shoppers - Much like pure offline shoppers they utilize only one type of media in their shopping process. Both information seeking and shopping happen in the digital space.
3. Webroomers - This subcategory of people who does research online before going into the store for a final evaluation and purchase.
4. Showroomers - These shoppers visit a store to seek information and examine the product and then purchase the product online.

Khan and Nedera (2021) from UNICEF bring a report from Bosnia and Herzegovina. Since the beginning of the pandemic, 13% of households have reported an increase in internet use and online transactions, such as online shopping, e-commerce, and e-banking. All this is especially prevalent among young people (aged 18 to 30) in urban areas and

households with a net income of 1,500 BAM and more. Toploko Herceg (2020) explored the impact of COVID-19 on online consumer behavior in Croatia. She found significant growth in online purchases of food and beverages as more consumers have resorted to online grocery shopping. Interestingly, a lot of them were forced to do it for the first time due to the circumstances. That shows that consumers' adaption to internet purchasing has been accelerated by the corona epidemic.

On the other hand, Sayyida et al. (2021) explored the impact of the COVID-19 pandemic on online retail sales and concluded that the effect is quite small. He reports that before the COVID-19 epidemic, the rise in worldwide online retail sales was less than 10% of overall retail sales or 10% to 15% of online retail sales. During the pandemic, the most significant surge in online retail sales happened in the second quarter of 2020, before declining in the third quarter. During the pandemic, internet retail sales accounted for no more than 35% of overall retail sales. He proposes that buyers sought information online before buying the actual product (webrooming) despite the social distancing rules. This could be explained by the consumer's need to feel the product before making the final purchase.

5. Teaching and learning

Much like any other public service, the government closed down schools and universities and imposed an online model of working. Closures influence approximately 90% of the world's students as of March 29, 2020 (UNESCO, 2020). Online education has its roots in nineteenth-century correspondence education. The way people learn has been changing since the turn of the century, thanks to advances in communication technology, and the Internet and open-source learning have created an atmosphere conducive to large-scale distance education (Volery, 2001).

Online learning can be divided into categories based on different parameters such as modality (totally online, blended, and web-enabled face-to-face), tempo (self-paced or class-paced), assumed student roles, and synchronicity (Means et al., 2014). Authors define two types of online teaching methods: synchronous and asynchronous. Synchronous refers to teachers and students meeting at a pre-determined time for interactive learning classes, whereas asynchronous refers to the teachers giving the course without interaction with the students. This proposes no interaction between the professors and the pupils. However, students can access online content anytime they choose with asynchronous types of online learning. During the pandemic majority of global teaching institutions chose to work with both methods (EasyLMS, 2021). According to Stec et al. (2020), there are three primary ways of online teaching: enhanced, blended learning, and online approach. To ensure creative and dynamic education, enhanced learning makes extensive use of technology. Blended learning combines classroom and online learning. The online method denotes that the course material is given over the internet. However, because students were exposed to a variety of e-learning schemes at the start of the COVID-19 pandemic, this type of online learning could not be categorized in any existing concepts (Naujoks et al.,2021). As a result, the events of the spring semester of 2020 can be classified as a new form of online learning called emergency remote teaching or emergency remote education (Bozkurt et al., 2020; Hodges et al., 2020).

Different technologies are available and are being used on online platforms to assist in running online interactive lessons and reducing student loss. They are created to share knowledge and organize class activities (Martin-Blas & Serrano-Fernánde, 2009). According to UNESCO (2020b) report, the most used platforms to assist the online teaching are Hangouts Meet (video calls), Teams (chat, interactive meetings, video, and audio calls), Skype (video and audio calls), WhatsApp (video and audio calls, chat, and content share), and Zoom (video and audio calls, and collaboration features). In their meta-analysis, Camargo and her colleagues (2020) found that Zoom and Google platforms are the most popular online learning platforms.

There are some advantages to online learning. For example, Davletova et al. (2016) emphasized its flexibility and affordability. This proposes that students can choose the pace they want and need at that moment during the learning process. When students study at their own pace, learning becomes more flexible and convenient for them. It also decreases stress and increases pleasure and self-motivation, as opposed to the conventional classroom environment, when students have no choice but to learn at the pace of the teacher. The efficacy of online learning is dependent on adequate planning and instruction to increase learning quality and overall student outcomes. Both active and passive learners can benefit from online learning. Its goal is to give students comprehensive information that can be accessible at any time and from any location. This approach to learning and teaching extends beyond the classroom, allowing students to hone their critical thinking and research abilities while also acquiring new information that may be applied to new ideas (Songkram, 2012).

UNESCO (2020c) warns about a slew of difficulties brought on by closing schools down and restricting their work to the online domain. The consequent disruptions aggravate previously existing inequalities not just inside the educational system, but also in other aspects of student's life.

Some of them are:

- For some students schools are the only educational opportunity they have, so their learning became interrupted.
- Marginalized and underprivileged students relied on free or cheaper meals which school provided and the closure threatened their nutrition.
- Transition to online learning platforms proved to be stressful and confusing to both teachers and students
- Parents were unprepared for distance learning, especially those who have a restricted level of education and financial means.
- Without schools children become more vulnerable to violence and exploitation such as sexual and military exploitation. Similarly, peer pressure, substance abuse, and teenage pregnancies become more prevalent.
- Children's social skills were greatly affected by social isolation and the inability to interact with their peers.
- Teachers faced great challenges in measuring and validating learning

We are yet to see the real consequences of online education. The problem is that it is not only the educational process that affects learning. Ongoing stress due to fear of con-

tagion and illness, worry about the economy, social issues, and the future, and overall mental health conditions are all impacting both teaching and learning processes. Studies have shown that the transition between face-to-face and online teaching poses an unprecedented challenge even for teaching staff who are well-versed in using information and communication technology (ICT) in their classrooms. Teachers have had to adjust to this fast-changing new paradigm while juggling their difficulties, such as stress, loneliness, sickness, and family caregiving (Gorman, 2020). Whenever a human element is involved researchers have to keep in mind psychological processes that happen in the background when they evaluate the efficacy and efficiency. However, the COVID-19 pandemic served as a push towards the development of new teaching technologies and methods.

6. Addictions

According to Beard and Wolf (2001), Internet addiction (IA) is the misuse of the Internet that causes a person's psychological condition (both cognitive and emotional) to deteriorate, as well as their academic or work-related and social communications. Young et al. (1999) see IA as a hypernym encompassing a wide range of behaviors and difficulties related to impulse control that may be divided into five categories based on evidence from experimental research:

1. Cybersexual addiction
2. Cyber-relationship addiction
3. Net compulsions (gambling, shopping, and stock trading)
4. Information overload
5. Obsessive computer game playing

News reports (BBC, The Washington Post) tell us that in the first three months of 2020, BBC and Netflix acquired 16 million new members, about 100 percent more than in the last few months of 2019. Microsoft's game servers had ten million users in April, demonstrating how the internet gaming business has flourished despite the global epidemic.

Drug use and other potentially addictive behaviors such as gambling, gaming, watching TV shows and pornography, using social media, and surfing the Web have all been used to relieve stress and anxiety or lift a low mood, according to the existing body of literature (Király, Potenza and Stein, 2020). The problem with this behavior is that they can get out of hand quickly. Since COVID-19 is considered to be a highly stressful period for most people it is expected to see a rise in these unhealthy coping strategies which have a high potential of becoming extremely difficult to give up. This is all connected to the physical isolation caused by the lockdowns, resulting in people wasting time online for no apparent reason, spending longer, abnormally long periods online when bored (Koyuncu, Unsal, Arslantas, 2014). In summary, when individuals are feeling bad or bored, they frequently resort to unhealthy coping mechanisms for brief solace. King et al. report that Internet use has grown significantly during the lockdown, particularly in terms of access to websites related to pornography and video games. Internet addiction (particularly when it comes to social networking), online sex, and gaming addiction are among the most common behavioral addictions.

PornHub, one of the leading pornographic websites, published reports on traffic statistics during COVID-19 and they note that it became clear that as people spent more time at home, in self-isolation or distant working, PornHub traffic had increased. On March 17th, 2020, worldwide traffic to Pornhub increased by 11.6 percent. It is worth noting that Pornhub got 42 billion visitors in 2019 and the epidemic appears to have resulted in an even more dramatic and visible increase in visits to pornographic websites. One of the most interesting statistics is related to the search for coronavirus-themed pornography. The report states that the search for "coronavirus" and "coronavirus" began on January 25th and has since grown in popularity. The number of searches reached 1.5 million on March 5th. The problem with pornography is that it changes the brain structure (Kühn and Gallinat, 2014; Gola et al., 2017). Furthermore, due to an individual's desire for greater reward, newer, more extraordinary, and pathological content is sought (Love et al. 2015), which could explain the search for corona-related porn content.

Studies also focused on gaming, especially on its online form. Reports from Korea state that 24% of the participants spent more time online gaming after COVID-19 restrictive measures (Korean Addiction Forum, 2020). Another study from the same country says that 70.5% of the respondents reported an increase in time spent playing digital games, which is 4.8% more than in the year 2019 (Korea Creative Content Agency, 2020). In Iran, Fazeli et al. (2020), found that Internet gaming disorder, insomnia, and the life quality among adolescents during the COVID-19 pandemic are mediated by depression, anxiety, and stress.

Over the last decade, the use of social media has expanded astonishingly. People now use it for a wide variety of reasons from gathering information to entertainment. The top five platforms are Facebook (2.2 billion users), YouTube (1.9 billion), WeChat (around 1 billion), Instagram (1 billion), and TikTok (500 million) (Hauer & Sood, 2020). At the very beginning of the pandemic, strict preventive measures were taken by most governments, which left people heavily dependant on social media for contact and information update. Also, fear of the unknown prevented people from taking any risks and meeting with friends and family members. Zhao and Zhou (2020) point out that social media in the time of the COVID-19 pandemic played both positive and negative roles. Among the positive ones are the spread of information regarding the pandemics, promotion of preventive measures, and substitution of real-life social contact. Panic due to rumors and conspiracy theories which spread as fast as any other news is considered to be detrimental to one's mental health. Their study confirmed previous findings that heightened social media consumption is positively correlated with the high odds of anxiety and depression (Gao et al., 2020). Social media have a high potential to become addictive since they promote constant user engagement through endless scrolling, resulting in people spending hours and hours consuming their content. Prikhidko, Long & Wheaton (2020), report on a phenomenon called digital emotion contagion which can be defined as the transmission of emotional experience from one person to another in digital space. Given the fact that people spent a lot of time on social media either actively or passively communicating with others, it became easy to get 'infected' with other people's negative emotions. The level at which emotions of other people, even on social media platforms will affect, an individual depends on a personal susceptibility to emotion contagion (Wheaton, Prikhidko & Messner, 2021).

7. Conclusion

COVID-19 has given us a glimpse of our near future where most of the daily tasks can be digitized. Jobs, shopping, learning, and teaching as well as basic human communication are now transferred into an online realm. COVID-19 pandemic just sped up a train that carries us into the golden era of the digital world. We are still a long way from a complete digital transformation but this pandemic has forced people to be innovative in their use of technological advances. No one sane will deny that it has brought us many positive changes; it has revolutionized many aspects of our lives. However, the danger is always lurking beneath the shiny and attractive exterior. Many scientists are worried that our bodies and our brains are not designed to deal with such changes, meaning that the world is changing too fast, and our brains are lacking behind. Science fiction novels/TV shows/movies, as well as futurists, tend to somewhat forget how human psychology works. Many studies have shown that overuse of the internet in particular leads to significant mental impairment (mainly depression and anxiety). Studies have shown that it also disrupts our focus and concentration . This article would have been finished earlier if the author hasn't checked her social media accounts and messaged her friends. The Internet also offers us cheap and unhealthy stress coping mechanisms which have a huge potential to overpower us. It is interesting to look at the (over)use of the Internet in the days of the pandemic. Many people spent hours online chatting and playing games or just scrolling endlessly through their social media feeds. The time they spent engaged in those activities and negative consequences that it had on their minds or bodies could indicate the problem with overuse of the Internet. Can we categorize them as addicted to the Internet? For the majority, the answer is no. We could view it as a normal response to an abnormal situation. Although, scholars and medical professionals should keep track of this kind of behavior even after the pandemic to see how much COVID-19 has changed our online behavior and definitions of normality. To some extent, the digitization because of the COVID-19 pandemic has highlighted the stark differences between classes, where the poor have been prevented from getting the education and the rich got the best possible experience. This global calamity has thought us a valuable lesson; we still have a lot of work to do before we advance any further in technology. Growth is possible, as many individuals have shown us, but always with a healthy dose of caution.

References

1. Anderson, R. M., Heesterbeek, H., Klinkenberg, D., & Hollingsworth, T. D. (2020). How will country-based mitigation measures influence the course of the COVID-19 epidemic?. Lancet (London, England), 395(10228), 931–934.
2. Beard, K. W., & Wolf, E. M. (2001). Modification in the proposed diagnostic criteria for Internet addiction. Cyberpsychology & behavior, 4 (3), 377-383.
3. Berezka, S., Rebiazina, V., & Muravskaia, S. (2021). Changes in consumer behavior in the BRICS countries during the COVID-19 pandemic: The role of trust and anxiety. BRICS Journal of Economics, 2 (1), 53–73.
4. Bozkurt, A., Jung, I., Xiao, J., Vladimirschi, V., Schuwer, R., Egorov, G., ... & Paskevicius, M. (2020). A global outlook to the interruption of education due to COVID-19 pandemic: Navigating in a time of uncertainty and crisis. Asian Journal of Distance Education, 15 (1), 1-126.

5. Camargo, C.P., Tempski, P.Z., Busnardo, F.F., Martins, M.A., & Gemperli, R. (2020). Online learning and COVID-19: a meta-synthesis analysis. Clinics,75, e228
6. Coelho, C. M., Suttiwan, P., Arato, N., & Zsido, A. N. (2020). On the nature of fear and anxiety triggered by COVID-19. Frontiers in Psychology, 11, 3109.
7. Davletova, A. K., Maykibayeva, E. K., Rakhimzhanova, M. B., Kasymova, A. K., & Kusainov, A. A. (2016). Didactic Potential of Multimedia-Technology in the Development of Students 'Information Culture. Indian Journal of Science and Technology, 9 (12), 32-63.
8. EasyLMS (2021). Difference Synchronous vs Asynchronous Learning | Easy LMS. Available online at:https://www.easy-lms.com/knowledge-center/lms-knowledge-center/synchronous-vs-asynchronous-learning/item10387 Accessed : 09/07/2021
9. Farooq, A., Laato, S., & Islam, A. N. (2020). Impact of online information on self-isolation intention during the COVID-19 pandemic: cross-sectional study. Journal of Medical Internet research, 22 (5), e19128.
10. Fazeli, S., Zeidi, I. M., Lin, C. Y., Namdar, P., Griffiths, M. D., Ahorsu, D. K., & Pakpour, A. H. (2020). Depression, anxiety, and stress mediate the associations between internet gaming disorder, insomnia, and quality of life during the COVID-19 outbreak. Addictive Behaviors Reports, 12, 100307.
11. Freeston, M., Tiplady, A., Mawn, L., Bottesi, G., & Thwaites, S. (2020). Towards a model of uncertainty distress in the context of Coronavirus (COVID-19). The Cognitive Behavior Therapist, 13.
12. Gamma, A. E., Slekiene, J., & Mosler, H.-J. (2019). The impact of various promotional activities on Ebola prevention behaviors and psychosocial factors predicting Ebola prevention behaviors in the Gambia evaluation of Ebola prevention promotions. International Journal of Environmental,
13. Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., ... Dai, J. (2020). Mental health problems and social media exposure during COVID-19 outbreak. PLoS One, 15 (4), e0231924.
14. Gola, M., Wordecha, M., Sescousse, G., Lew-Starowicz, M., Kossowski, B., Wypych, M., et al. (2017). Can pornography be addictive? An fMRI study of men seeking treatment for problematic pornography use. Neuropsychopharmacology, 42, 2021–31.
15. Gorman, G. (2020). Teachers working through the coronavirus pandemic need our support more than ever. ABC Life. Available at: https://www.abc.net.au/life/teachers-working-through-coronaviruspandemic-need-kindness/12075544 Accessed: 09/07/2021
16. Han, M. F., Mahendran, R., & Yu, J. (2021). Associations between fear of COVID-19, affective symptoms and risk perception among community-dwelling older adults during a COVID-19 lockdown. Frontiers in Psychology, 12, 961.
17. Harper, C. A., Satchell, L. P., Fido, D., & Latzman, R. D. (2020). Functional fear predicts public health compliance in the COVID-19 pandemic. International journal of mental health and addiction, 1-14.
18. Hauer, M.K. & Sood, S. (2020). Using Social Media to Communicate Sustainable Preventive Measures and Curtail Misinformation. Frontiers in Psychology, 11, 568324
19. Henriksen, C. A., Bolton, J. M., & Sareen, J. (2010). The psychological impact of terrorist attacks: examining a dose-response relationship between exposure to 9/11 and Axis I mental disorders. Depression and Anxiety, 27 (11), 993-1000.
20. Hodges, C. B., Moore, S., Lockee, B. B., Trust, T., and Bond, A. (2020). The difference between emergency distance teaching and online learning. Educause Review. Available at: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning Visited: 09/07/2021
21. Huremović, D. (2019). Brief history of pandemics (pandemics throughout history). In Psychiatry of pandemics (pp. 7-35). Springer, Cham.
22. Khan, R. & Nedera, S. (2021). Procjena socijalnog utjecaja pandemije bolesti COVID-19 u Bosni i Hercegovini. Available at: https://www.unicef.org/bih/pri%C4%8De/procjena-socijalnog-utjecaja-pandemije-bolesti-covid-19-u-bosni-i-hercegovini Accessed: 05/07/2021
23. Király, O., Potenza, M. N., Stein, D. J., King, D. L., Hodgins, D. C., Saunders, J. B., ... & Demetrovics, Z. (2020). Preventing problematic internet use during the COVID-19 pandemic: Consensus guidance. Comprehensive psychiatry, 100, 152180.
24. Korea Creative Content Agency (KOCCA), (2020). The 7th survey report of the game users in Korea. Available at: https://www.kocca.kr/cop/bbs/view/B0000147/1842858.do?menuNo=201825 Accessed: 07/07/2021
25. Korean Addiction Forum (KAF), (2020). Republic of Korea: COVID-19 Pandemic & Change in Addictive Behaviors. Available at: http://www.addictionfr.org/2020/bbs/board.php?bo_table=sub06_1&wr_id=33&page=1 Accessed: 07/07/2021
26. Koyuncu, T., Unsal, A., & Arslantas, D. (2014). Assessment of internet addiction and loneliness in secondary and high school students. Journal of Pakistan Medical Association, 64 (9), 998-1002.
27. Kuang, K., & Wilson, S. R. (2017). A meta-analysis of uncertainty and information management in illness contexts. Journal of Communication, 67(3), 378-401.

28. Kühn, S. & Gallinat, J. (2014). Brain structure and functional connectivity associated with pornography consumption: the brain on porn. JAMA Psychiatry, 71, 827–34.
29. Laato, S., Islam, A. N., Farooq, A., & Dhir, A. (2020). Unusual purchasing behavior during the early stages of the COVID-19 pandemic: The stimulus-organism-response approach. Journal of Retailing and Consumer Services, 57, 102224.
30. LeDoux, J. E. (2014). Coming to terms with fear. Proceedings of the National Academy of Sciences, 111 (8), 2871-2878.
31. Love, T., Laier, C., Brand, M., Hatch, L. & Hajela, R. (2015). Neuroscience of internet pornography addiction: a review and update. Behavioral Sciences (5), 388–433.
32. MacIntyre, C. R. (2009). The community's attitude towards swine flu and pandemic influenza.
33. Makwana, N (2019). Disaster and its impact on mental health:A narrative review. Journal of family medicine and primary care, 8(10), 3090.
34. Manss, R., Kurze, K., & Bornschein, R. (2020). What drives competitive webrooming? The roles of channel and retailer aspects. The International Review of Retail, Distribution and Consumer Research, 30 (3), 233-265.
35. Martín-Blas, T., & Serrano-Fernández, A. (2009). The role of new technologies in the learning process: Moodle as a teaching tool in Physics. Computers & Education, 52, 35-44.
36. Means, B., Bakia, M. and Murphy, R. (2014). Learning Online: What Research Tells Us about Whether, When and How. Routledge Taylor & Frances, New York.
37. Mishel, M. H. (1988). Uncertainty in illness. Image: The Journal of Nursing Scholarship, 20(4), 225-232.
38. Mohd Hanafiah, K., & Wan, C. D. (2020). Public knowledge, perception and communication behavior surrounding COVID-19 in Malaysia.
39. Naujoks, N., Bedenlier, S., Gläser-Zikuda, M., Kammerl, R., Kopp, B., Ziegler, A., & Händel, M. (2021). Self-Regulated Resource Management in Emergency Remote Higher Education: Status Quo and Predictors. Frontiers in Psychology, 12.
40. Pedrosa, A. L., Bitencourt, L., Fróes, A. C. F., Cazumbá, M. L. B., Campos, R. G. B., de Brito, S. B. C. S., & e Silva, A. C. S. (2020). Emotional, behavioral, and psychological impact of the COVID-19 pandemic. Frontiers in Psychology, 11.
41. Pornhub (2020). Coronavirus Insights. Available at: https://www.pornhub.com/insights/coronavirus Accessed: 07/07/2021
42. Prikhidko, A., Long, H. & Wheaton, M.G. (2020). The Effect of Concerns About COVID-19 on Anxiety, Stress, Parental Burnout, and Emotion Regulation: The Role of Susceptibility to Digital Emotion Contagion. Frontiers in Public Health, 8, 567250.
43. Rubin, G. J., Amlot, R., Page, L., & Wessely, S. (2009). Public perceptions, anxiety, and behavior change in relation to the swine flu outbreak: Cross sectional telephone survey. BMJ, 339, b2651–b2651.
44. Sayyida, S., Hartini, S., Gunawan, S., & Husin, S. (2021). The Impact of the Covid-19 Pandemic on Retail Consumer Behavior. Aptisi Transactions on Management (ATM), 5 (1), 79-88.
45. Seale, H., McLaws, M. L., Heywood, A. E., Ward, K. F., Lowbridge, C. P., Van, D., ... & MacIntyre, C. R. (2009). The community's attitude towards swine flu and pandemic influenza. Medical Journal of Australia, 191(5), 267-269.
46. Septianto, F., & Chiew, T. M. (2021). Perceived Threat of COVID-19 Influences Product Preferences: The Moderating Role of Consumers 'Mindset. Australasian Marketing Journal, 29 (1), 78-86.
47. Sheth, J. (2020). Impact of Covid-19 on consumer behavior: Will the old habits return or die?. Journal of Business Research, 117, 280-283.
48. Smith, N. (2020). The Giants of the Video Game Industry Have Thrived in the Pandemic. Can the Success Continue? Available online at: https://www.washingtonpost.com/video-games/2020/05/12/video-game-industry-coronavirus/ Accessed: 19/07/2021
49. Songkram, N. (2017). Online course design for creativity and innovative skills in virtual cultural ASEAN community: from research to empirical practice. International Journal of Emerging Technologies in Learning, 12 (1), 4-20.
50. Stec, M., Smith, C., and Jacox, E. (2020). Technology enhanced teaching and learning: exploration of faculty adaptation to iPad delivered curriculum. Technology, Knowledge and Learning, 25 (3), 651-665
51. Thomas, Z (2020). Netflix Gets 16 Million New Sign-Ups Thanks to Lockdown. Available online at: https://www.bbc.com/news/business-52376022 Accessed: 19/07/2021
52. Topolko Herceg, K. (2021). IMPACT OF COVID-19 PANDEMIC ON ONLINE CONSUMER BEHAVIOR IN CROATIA. CroDiM, 4 (1), 131-140.
53. Toro, R. A., Avendaño-Prieto, B. L., & Vargas, N. (2020). Transdiagnostic model of anxiety and depression according to the relationship with affect, uncertainly intolerance, and anxiety sensitivity. Rev. CES psicologia, 13 (1), 140-152.

54. UNESCO (2020). Education: From disruption to recovery. Available at: https://en.unesco.org/covid19/educationresponse Accessed: 19/07/2021
55. UNESCO (2020b). Distance Learning Tools. Available at: https://en.unesco.org/covid19/educationresponse/support Accessed: 09/07/2021
56. UNESCO (2020c). Adverse consequences of school closures. Available at: https://en.unesco.org/covid19/educationresponse/consequences Accessed: 05/07/2021
57. Volery, T. (2001). Online education: An exploratory study into success factors. Journal of educational computing research, 24 (1), 77-92.
58. Weinstein, N. D. (1988). The precaution adoption process. Health psychology, 7 (4), 355.
59. Wen, Z., Huimin, G., Kavanaugh, R.R. (2005). The impacts of SARS on the consumer behavior of Chinese domestic tourists. Current Issues in Tourism, 8 (1), 22–38.
60. Wheaton, M.G., Prikhidko, A. & Messner, G.R. (2021). Is Fear of COVID-19 Contagious? The Effects of Emotion Contagion and Social Media Use on Anxiety in Response to the Coronavirus Pandemic. Frontiers in Psychology 11, 567379.
61. World Health Organization (2020). Timeline: WHO's COVID-19 response. Avaliable at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#! Visited: 09/07/2021
62. World Health Organization (2011b). Comparative Analysis of National Pandemic Influenza Preparedness Plan. Geneva-Switzerland: WHO.
63. Xu, Z., Shi, L., Wang, Y., Zhang, J., Huang, L., Zhang, C., ... & Wang, F. S. (2020). Pathological findings of COVID-19 associated with acute respiratory distress syndrome. The Lancet respiratory medicine, 8 (4), 420-422.
64. Young, K.S., Pistner, M., O'Mara, J., & Buchanan. J. (1999). Cyberdisorders: The mental health concern for the new millennium. CyberPsychology & Behavior, 2, 475-479.
65. Zhao, N. & Zhou, G. (2020). Social Media Use and Mental Health during the COVID-19 Pandemic: Moderator Role of Disaster Stressor and Mediator Role of Negative Affect. Applied Psychology: Health and Well-being, 12(4), 1019-1038

CROWDSENSING SYSTEM FOR SMART CITIES

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Abstract

This paper investigates the opportunities that crowdsensing, Internet of things and mobile technologies and services bring to improving life quality and healthcare ecosystem in smart cities. The main goal is to develop a crowdsensing system for smart cities that will encourage citizens to participate in collecting environmental data and solving problems related to ecology and healthcare. The proposed system will enable monitoring of air quality, allergens, level of noise and vibration caused by traffics. Intelligent devices such as mobile phones with embedded sensors, microcomputers, microcontrollers, and different sensors will be used for the monitoring. All the crowdsensing data collected from the smart city will be stored in the cloud, and used by different stakeholders via developed web and mobile applications. The crowdsensing data will be gathered in the city of Belgrade, Republic of Serbia. The proposed crowdsensing system and obtained results could serve as a good basis for adoption and implementation of crowdsensing smart city services in Serbia and other cities and governments. Furthermore, the proposed system can enhance citizens' e-participation and initiative to contribute to the detection of problems related to environmental pollution.

Keywords: crowdsensing, mobile crowdsensing, smart cities, IoT.

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1. Introduction

The migrations of population from rural to urban areas have been an ongoing process for many years (Heaton and Parlikad, 2019). According to UN, it is expected that by the year 2030, 70% of population will live in urban communities (United Nations Development Programme, 2016). The raising increase of population creates problems in the city's infrastructure, services and management, and requires new approaches regarding the healthcare, traffic environmental protection, and the quality of life in general (Alvear et al., 2018). These problems can be solved by applying modern information technologies such as Internet of Things, web and mobile technologies, cloud computing and big data. Implementation of these technologies in urban environments can improve the quality of citizens' life and enable the easier and more effective realization of everyday life activities.

For the development of the smart city, it is necessary to build adequate infrastructure based on the mentioned information technologies. This implies implementation of different kind of intelligent devices in the smart city application domains such as: smart houses and buildings, smart offices, smart classrooms, smart transportation, smart healthcare, etc. All intelligent devices, such as microcomputers, microcontrollers, modules, sensors, actuators, and mobile devices, should monitor environments where they are placed, and enable delivery of information and smart city services in real time. These data are important for different kind of smart city users such as: government, citizens, business users, providers of services. Besides the implementation of intelligent devices in the smart city infrastructure, important contribution can be given by citizens who participate in crowdsensing and collect data from the smart city. This usually means that citizen use their smart devices to measure parameters from the environment and to share data with aim to contribute to resolving problems in the city such as: air pollution, noise pollution, waste removal, traffic jams, monitoring patients with chronic diseases, etc.

This paper presents a crowdsensing system for smart cities that enables citizens to participate in collecting environmental data related to noise pollution, vibrations, air pollution, detection of allergens, and microclimate conditions. The proposed system could serve as a good basis for adoption and implementation of crowdsensing smart city services in Serbia and other cities.

The rest of the paper is organized as follows: section 2 gives the theoretical background on the smart city concepts, technologies and applications; section 3 considers the issues of crowdsourcing in smart cities; section 4 presents the developed crowdsensing system. Finally, we give conclusions and implications.

2. Smart cities

The concept of smart city relies on integration of human and social capital with modern information technologies, with the goal of solving the problems of urban infrastructures and achieving a higher quality of life (Manville et al., 2014). The specter of definitions of smart city is wide, some researcher are focusing on the application of information technology (Camero and Alba, 2019; Staletić, et al., 2020; Jezdović et al., 2021), while oth-

ers keep focus on social and human capital. According to (Schaffers et al., 2011), "a city can be called smart when there are planned investments of human and social capital and where modern communication infrastructure comes to the fore, resulting in sustainable economic growth and high quality of life, with smart management of natural resources, based on management by citizens through e-participation". In addition, some authors use the terms such as intelligent city, future city, sustainable city, digital city, etc. (Ahvenniemi et al., 2017).

2.1 Smart city: application domains

A smart city is a geographical entity where digital services are applied in domains of everyday life, business, health, education, public utilities, transportation and public safety services to improve life quality and environmental protection (Sánchez et al., 2014; Kummitha and Crutzen, 2017; Staletić, et al., 2020). In the smart city, the intelligent devices are implemented in any environment, in order to collect data and automate the processes in real time (Jin et al., 2014; Jezdovic et al., 2017). Intelligent devices can collect data about humidity, temperature, emissions of the harmful gases, air and noise pollution, parameters relevant for fire detection, public safety (Li et al., 2016). These data are used for detection, analysis and decisions about the different issues in the city.

Smart city application domains include (Radenković et al., 2017; Jezdovic et al., 2017):

1. Administration, participation programs and public safety. For improving quality of life in a smart city it is important to enable citizens' e-participation in problem detecting and solving, and decision-making (Estrada, Soto and D'Arminio, 2013).
2. Smart home and business environments. This domain refers to the automation systems within houses, buildings and offices (heating, water, electricity, waste, etc.) to achieve energy savings and reduced maintenance (Davidović and Labus, 2016), to built adequate conditions for life and make it safe and effective (Kim and Lavrova, 2013).
3. Smart healthcare. The primary is to improve the efficiency, quality of health services and treatment methods (Solanas, 2014), as well as to contribute to prevention and well-being in general (Rodić-Trmčić et al., 2017; Rodić-Trmčić et al., 2018).
4. Smart learning environments. These environments should improve realization of learning process, using advanced multimedia technologies that increase efficiency of the process of knowledge transfer (Simić et al., 2016).
5. Smart traffic. Using information and communication technologies and intelligent transport systems (ITS) for monitoring the traffic in the city, can increase safety, make traffic more effective, reduce delay and long period of travelling and reduce environmental pollution.
6. Smart grid. Smart grid is related to efficient and reliable delivery of electricity in smart environments, greater control over power consumption, increasing the number of electric vehicles, reduction of global emissions of carbon dioxide (Lukic et al., 2016)(Radenković et al., 2020).

2.2 Technologies for smart city development

Enabling technologies for smart city development are Internet of things (hereinafter: IoT), web and mobile technologies, cloud computing, and big data (Jezdović et al., 2017).

Internet of things is a global network infrastructure that enables the connection of physical and virtual objects on the Internet, where communication between objects is enabled using different protocols and intelligent interfaces (Ashton, 2009; Gubbi et al., 2013). Furthermore, IoT enables connecting a large numbers of various intelligent devices, such as microcomputers, microcontrollers, mobile devices, sensors, actuators, tags and readers, with services and applications on the Internet (Gubbi et al., 2013) with the aim to build the IoT infrastructure for smart city. Smart city IoT infrastructure enables the implementation of intelligent devices in homes, offices, classrooms, hospitals, in traffic, parking and roads, parks, and other public places in the city in aim to improve citizens' quality of life, business, education, delivering healthcare services, etc. (Gubbi et al., 2013; Jezdović et al., 2017).

Intelligent devices are placed in the lowest IoT infrastructure layer and have the role to collect data from smart environments such as fire detection, temperature, humidity, radiation, air and noise pollution, electricity and water consumption, traffic intensity, parking management, etc. The next IoT infrastructure layer is the network-centric layer, which provides a communication channel for intelligent devices. Smart city services are usually based on web and mobile technologies. These technologies enable receiving data from the smart environments in the city via wireless networks. Cloud-Centric IoT layer is responsible for storing, processing and distribution of the collected data. Finally, the application layer consists of applications that enable controlling and management of smart city services in real time.

With the increase in the number of intelligent devices connected to the Internet, the amount of collected data grows exponentially, which enables more detailed analyses for decision making in the smart city. Large amounts of data can be collected from intelligent devices placed in the smart environment and collected from mobile devices. In order to provide processing and analysis of collected data, big data technologies have to be used (Radenković et al., 2017).

3. Crowdsourcing in smart cities

Crowdsourcing represents the act of a company or an institution which outsources a function of the employees to an undefined (big in generally) network of people, connected via the Internet, in the form of a public call (Howe, 2006) (Staletić et al., 2020). It also represents a business model based on e-participation of individuals of various professional profiles to create, start and manage projects on interactive Internet platforms (Bogdanović et al., 2015; Staletić and Petrović, 2016). Participants in crowdsourcing projects usually do not know each other, so there may be different rules for participating.

The goal of applying crowdsourcing in smart cities is to encourage citizens to participate in resolving problems detected in a city and to propose innovative smart city services

by applying their collective intelligence (Liao et al., 2019). In smart cities, crowdsourcing can be applied through the following models (Staletić et al., 2020):

- crowd wisdom or collective intelligence is a crowdsourcing model in which a "crowd" gathers and shares their knowledge via Internet (Surowiecki, 2005). Crowd wisdom in a smart city can be defined through the active participation of citizens in sharing knowledge, ideas, information and attitudes through various crowdsourcing platforms to improve the quality of life in a smart city (Prelec et al., 2017).
- crowd creation is an open call made through a crowdsourcing platform to gather new knowledge. The call contains a description of the project, the purpose, the qualifications to be possessed by the participants, the duration of the project and the compensation for the participation. The application of crowd creation in a smart city is reflected in the provision of creative solutions by citizens who are experts in a particular field (Radenković et al., 2017; Kittur et al., 2013, Liu et al., 2019).
- crowdvoting is based on voting by project participants. It is applied when it is necessary to gather the opinion of the audience ("crowds") through a crowdvoting platform on a particular issue. The application of crowdvoting in a smart city is most often reflected in the involvement of the public, through voting, in decision-making processes and creating priorities in the implementation of the smart city services (Maletić et al., 2019).
- crowdfunding is a special model of crowdsourcing that refers exclusively to financial contribution (Belleflamme et al., 2014). From the aspect of a smart city, crowdfunding is most often used to financially support projects that are important for a better life of citizens in the city.
- crowdsensing enables collecting data generated by sensors (Lau et al., 2017). Mobile crowdsensing enables ordinary citizens to provide data generated from their mobile devices, which are consolidated and used in the cloud to provide people-centric services (Staletić et al., 2020).

Crowdsourcing in a smart city is most often implemented through IoT crowdsourcing platforms (Mueller et al., 2018; Staletić et al., 2020). Citizens, legal entities and local governments can create or participate in projects on these platforms with aim to improve quality of life in the smart city (Mueller et al., 2018). Using applications and services citizens can participate in decision-making processes related to introducing new crowdsourcing services in the smart city, collect data from the environments and share information valuable for the solving problem in the smart city (Staletić et al., 2020).

4. Crowdsensing system for smart cities

In this article, we propose a comprehensive crowdsensing system for smart cities that integrates various services, including:

- A mobile crowdsensing system for measuring noise pollution and vibrations in traffic.

- An IoT crowdsensing system for monitoring air quality and allergens.
- An IoT crowdsensing system for monitoring microclimate conditions.

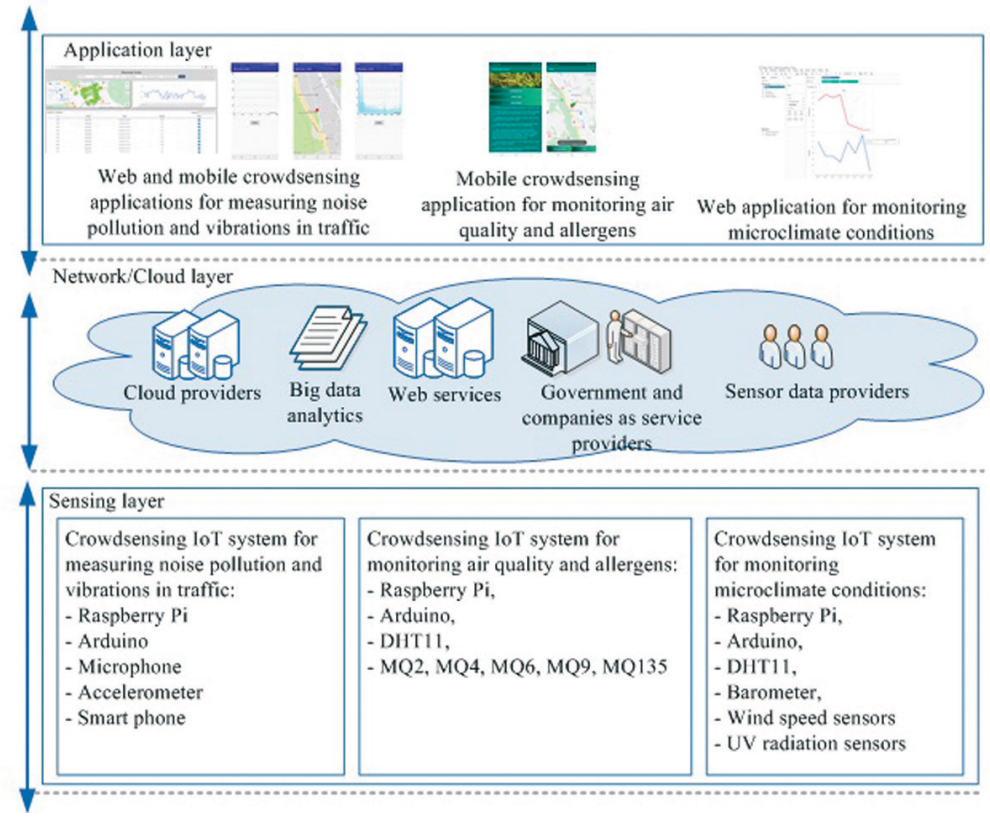

Figure 1. Crowdsensing system for smart cities
Source: Authors

The system is developed as an internal project of E-business Department, Faculty of Organizational Sciences, University of Belgrade. Although the system is developed in the academic environment, it allows ordinary citizens to participate in crowdsensing projects and become part of the crowdsensing network.

The architecture of the proposed system is shown in Figure 1. The cloud infrastructure of the system is developed within the private cloud of the E-business Department. In further text, we give more details about the three developed crowdsensing subsystems.

4.1. Mobile crowdsensing system for measuring noise pollution and vibrations in traffic

The mobile crowdsensing system for measuring noise pollution and vibrations in traffic is based on mainly on mobile technologies, but it includes IoT components as well. The developed system enables measuring noise and vibration using the smart phone, or an IoT system consisting of Raspberry Pi microcomputer, Arduino microcontroller, microphone

and accelerometer. Intelligent devices can be placed in specific micro locations where the traffic intensity is high, or and in public transportation vehicles. The main scenario of usage is based on citizens' participation in the measuring of noise and vibrations in the city's micro locations using their mobile devices and during their rides in public transportation (bus, tram, train, etc.) (Baljak et al., 2019a; Baljak et al., 2019b; Jezdović et al., 2021). Citizen can measure noise and vibration using the developed mobile application that enables recording short audio recordings, and mapping the micro location using a GPS device. FFT (Fast Fourier Transform) data analysis is performed on recording devices immediately after measurement. All collected data are stored in the cloud infrastructure, then analyzed and finally compared with the prescribed norms. Due to the large amount of data, all data is stored in a MongoDB non-relational database: locations where audio recordings are made, location data, maximum and average volume in dB (A), as well as the complete result of FFT (Jezdović et al., 2021).

All measurements, in the form of a chart on an interactive map, are displayed on developed web application (Figure 2). Using web application citizen can further search and sort data, launch initiatives for solving problems related to noise pollution. Google maps were used to visualize geolocation data, and Google charts were used to display sound analysis. The main component of the system is the server, which hosts the API that communicates with all elements of the system: stations, mobile and web applications. The RESTful API was created using the Flight framework.

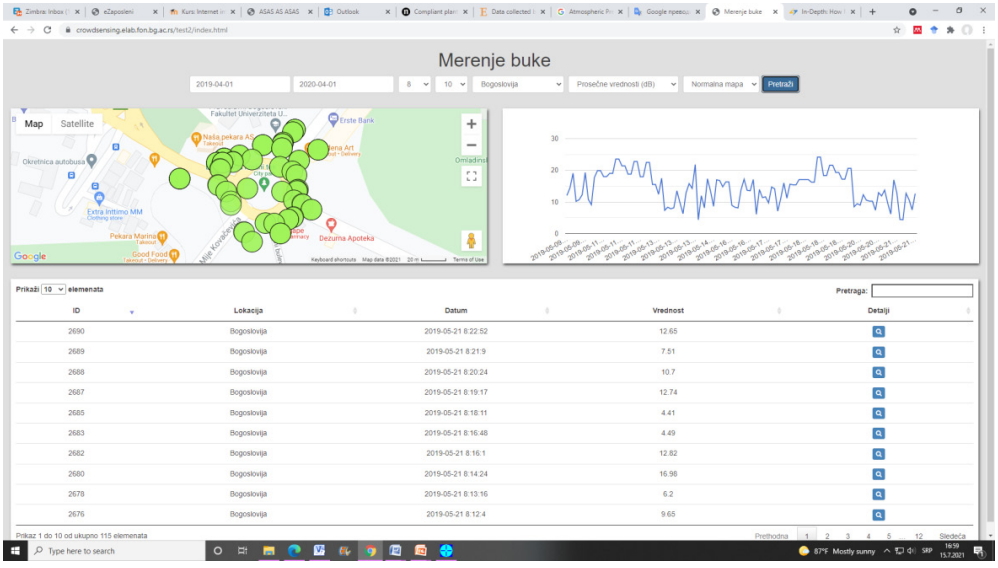

Figure 2. Web application for tracking noise pollution in the smart city
Source: Jezdović et al., 2021

The mobile application is made for the Android operating system. The application has the ability to measure noise levels, store noise and location data on the server application, as well as display a noise level map based on the collected data. The mobile application is shown in Figure 3.

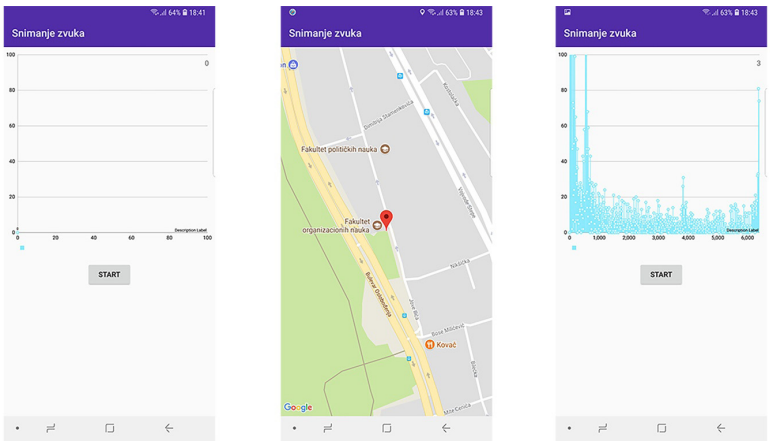

Figure 3. Crowdsensing mobile application for measuring noise pollution
Source: Jezdović et al., 2021

The same Android application enables measuring vibration manually or automatically (Figure 4). Users can manually measure vibrations in four type locations: at home, at work, on the bus, and in the car. After selecting location, the application enables recording vibrations and storing the location through the Google Location API. Measured vibration in real-time are displayed via GraphView. Users can record vibration automatically by selecting the time interval between the two measurements and the duration of the measurement. In both cases all recorded data are sent to the database by the web service.

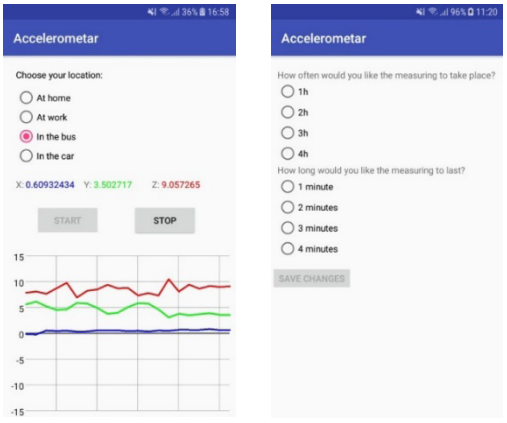

Figure 4. Mobile application for crowdsensing vibration
Source: Baljak et al., 2019a; Baljak et al., 2019b

Each smartphone has a set of sensors and services that can be used for gathering data from its surroundings such as:

- the accelerometer which can be used to determine direction of movement.
- the magnetometer which is used as a compass for detecting the position of the device in accordance to the 4 cardinal directions of the world.

GPS service that determines locations of the vibration measurements.

All data are stored in the cloud, and the format of data storing can be relational or non-relational, depending on the observed problem. For data visualization, a way of communicating with the cloud database is required. It can be done through direct requests from the database or through a previously developed API. Figure 5 shows the web application that enables preview of vibrations measured by locations and grouped into clusters.

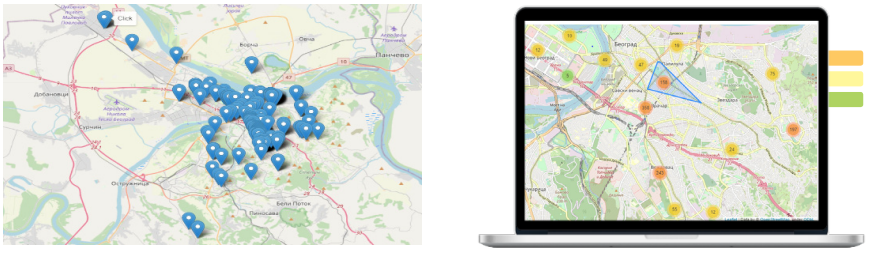

Figure 5. Web application: preview of the vibrations measured by locations
Source: Baljak et al., 2019a; Baljak et al., 2019b

Average values of intensity by frequencies and by type of vehicle are shown in Figure 6.

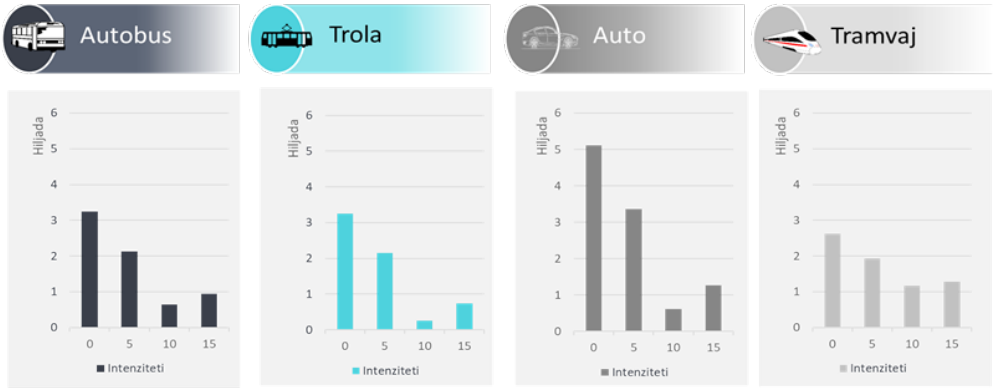

Figure 6. Average values of intensity by frequencies and by type of vehicle
Source: Baljak et al., 2019a; Baljak et al., 2019b

4.2. IoT crowdsensing system for monitoring air quality and allergens

The developed IoT crowdsensing system for monitoring air quality and allergens consists of (Figure 7)(Stefanović et al., 2021): Raspberry Pi, Arduino and sensors for monitoring air quality parameters MQ2, MQ4, MQ6, MQ9, MQ135, and DHT11. Sensors monitor various parameters in the air, such as: LPG (liquefied petroleum gas), temperature, humidity, flammable gases, carbon monoxide, harmful gases, and allergens particles etc.

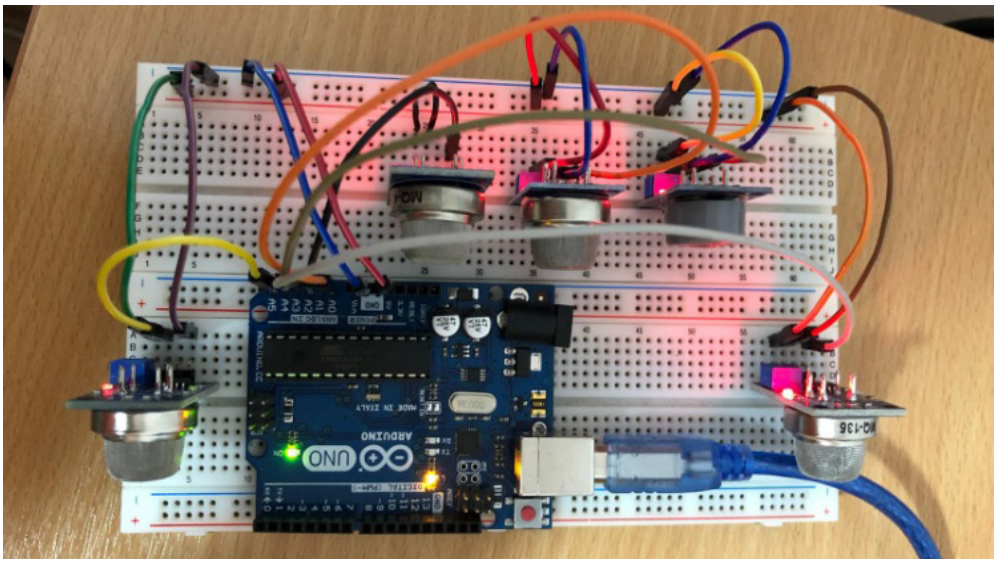

Figure 7. IoT crowdsensing system for monitoring air quality and allergens
Source:Stefanović at al., 2021

Sensors are connected to the Arduino and the measured values are processed using appropriate scripts, and then forwarded to the Raspberry Pi. Values from Raspberry Pi are forwarded to the mobile healthcare application via REST web service in JSON format. Measured values of the air quality parameters are displayed in real-time in the mobile healthcare application (Figure 8).

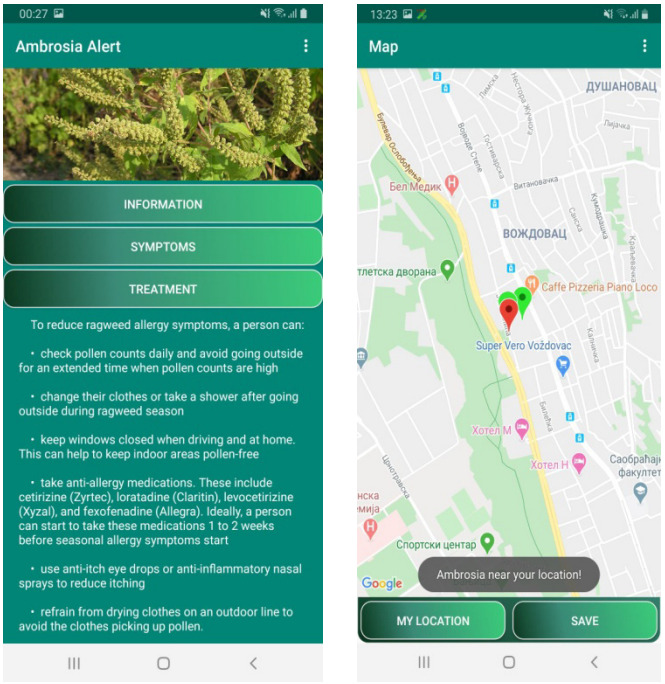

Figure 8. Crowdsensing mobile healthcare application
Source: Stefanović et al., 2020

Mobile application enables users to mark location where they detect allergens like ambrosia. Collected data are stored in the cloud hosted database and mobile application displays locations in a custom Google Map embedded in the application. If users are located near one of the locations where allergens are detected, they will be notified accordingly and presented with useful information about the symptoms caused by the specific allergen and suggestions for appropriate treatment.

4.3. IoT crowdsensing system for monitoring microclimate conditions

Crowdsensing IoT system for monitoring microclimate conditions consists of (Jezdović et al., 2017): Raspberry Pi, Arduino, DHT11 sensor that measures the temperature and humidity, and barometer that measures the air pressure. Raspberry Pi via web service sends the measured weather data to the cloud in database for further analysis and storage. Developed system is adaptable so other sensor can be added for measuring wind speed and UV radiation, etc. System can be implemented in any micro location in the smart city and to provide citizens with real time information about the microclimate conditions with specific recommendation related to their health care. The system is shown in Figure 9.

Users can access weather data through web application (Figure 10). Analysis of the data is processed by using Hadoop (Figure 11) and the visualization of the data is enabled using Tableau Desktop tool.

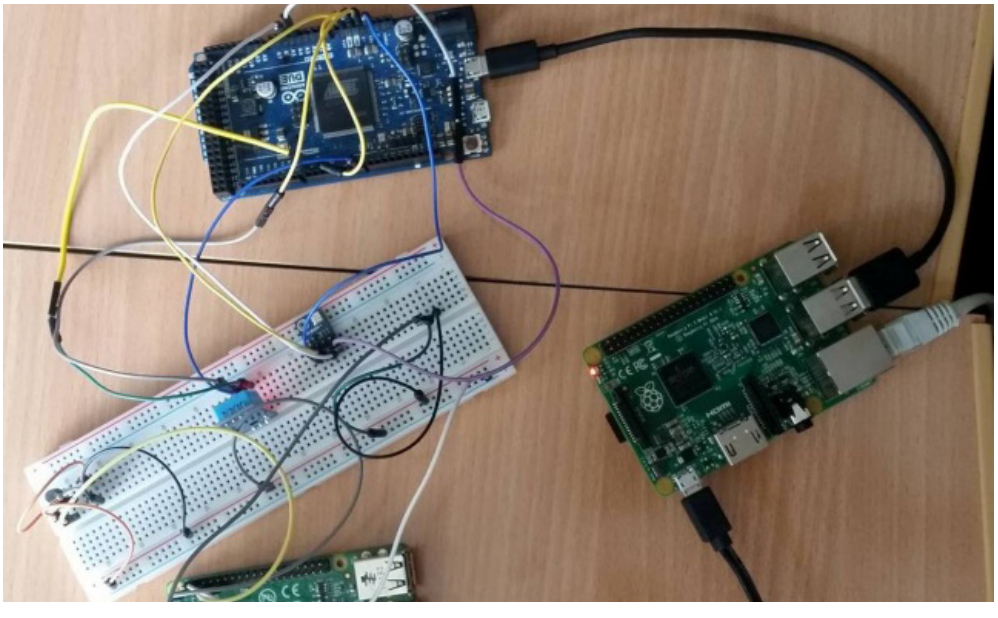

Figure 9. Crowdsensing IoT system for monitoring microclimate conditions
Source: Jezdović et al., 2017

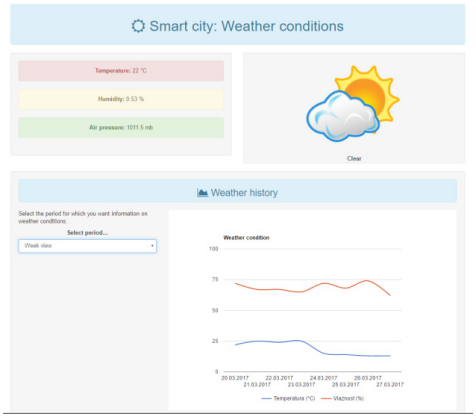

Figure 10. Web application
Source: Jezdović et al., 2017

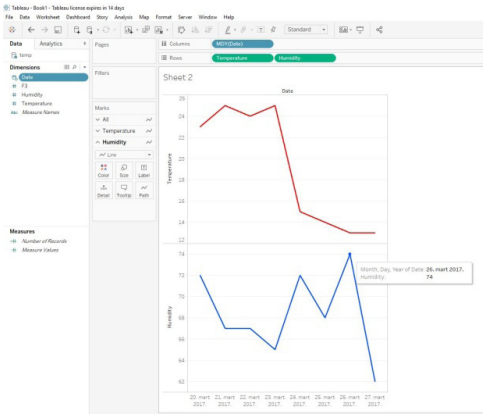

Figure 11. Data visualization in Tableau
Source: Jezdović et al., 2017

5. Conclusion

This paper presents a comprehensive crowdsensing system developed at the Faculty of Organizational Sciences, University of Belgrade, with three implemented subsystems: for crowdsensing noise and vibration in traffic, for crowdsensing the air quality, and for crowdsensing the microclimate conditions. The proposed approach enables citizens to connect their devices (IoT stations of mobile phones) and submit the measured data to the system, as well as to use the available data. Unlike the systems for official measurements, this system enables collecting data from various micro locations in a smart city, thus providing information from micro locations not covered by official measurements.

The web and mobile applications have been developed to provide users with various reports and analyses. The evaluation of each developed subsystems has been conducted, and the results point out to the usability of the developed services.

The proposed approach has some limitations that will be addressed in the future work. First of all, all crowdsensing systems face the problem of forged data and possible manipulation of the data. A possible solution can be realized by developing a blockchain based loyalty program of the smart city, where citizens who participate in the crowdsensing will be awarded with incentives, and will be trusted regarding the quality of the collected data. This will also contribute to solving the general problem of motivation of citizens to participate in crowdsensing projects. In addition, future work will be directed to further development of new business models that will provide sustainable and high-quality crowdsensing services to all the smart city stakeholders, including citizens, companies, local government, and others.

References:

1. Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities?. Cities, 60, 234–245.
2. Alvear, O., Calafate, C. T., Cano, J. C., & Manzoni, P. (2018). Crowdsensing in smart cities: Overview, platforms, and environment sensing issues. Sensors, 18(2), 460.
3. Ashton, K. (2009). That 'internet of things' thing. RFID journal, 22(7), 97-114.
4. Baljak, L., Bojkovic, N., Labus, A., Naumovic, T., & Maksimovic, A. (2019b). A system for crowdsensing vibration in public transportation. In 2019 International Conference on Artificial Intelligence: Applications and Innovations (IC-AIAI) (pp. 30-304). IEEE.
5. Baljak, L., Filipović, F., Jezdović, I., & Labus, A. (2019a). A system for Crowdsensing Vibration Comfort in Smart Traffic. IPSI Transactions on Advanced Research, Volume 15, Number 1, pp 16-23, ISSN 1820 – 4511
6. Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. Journal of business venturing, 29(5), 585–609.
7. Bogdanović, Z., Labus, A., Radenković, M., Popović, S., Mitorvić, S., Despotović-Zrakić, M. (2021). A Blockchain-based Loyalty Program for a Smart City, 9th World Conference on Information Systems and TechnologiesWorldCIST 2021, 30 March - 02 April 2021, Terceira, Portugal
8. Bogdanović, Z., Labus, A., Simić, K., Ratković-Živanović, V., & Milinović, S. (2015). Harnessing Crowdvoting to Support Students› Creativity. In EDULEARN15 Proceedings (pp. 4318-4326). IATED.
9. Camero, A., & Alba, E. (2019). Smart City and information technology: A review. Cities, 93, 84–94.
10. Davidovic, B. and Labus, A. (2015). A smart home system based on sensor technology. Facta Universitatis, Series: Electronics and Energetics, 29(3), pp.451-460.
11. Estrada, J.E.P., Soto, A.R.P. and D›Arminio, P. (2013). The new era of the smart cities Open Innovation based on human-centered computing methodologies applied in the PEOPLE project. In Information Systems and Technologies (CISTI), 2013 8th Iberian Conference on (pp. 1-6). IEEE.
12. Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. Future generation computer systems, 29(7), 1645-1660.
13. Heaton, J., & Parlikad, A. K. (2019). A conceptual framework for the alignment of infrastructure assets to citizen requirements within a Smart Cities framework. Cities, 90, 32–41.
14. Howe, J. (2006). The rise of crowdsourcing. Wired magazine, 14(6), 1–4.
15. Jezdovic, I., Nedeljkovic, N., Bogdanovic, Z., Labus, A., & Radenkovic, B. (2017). Smart Cities-System for Monitoring Microclimate Conditions based on Crowdsensing. In ICE-B (pp. 108-115).
16. Jezdović, I., Popović, S., Radenković, M., Labus, A., & Bogdanović, Z. (2021). A crowdsensing platform for real-time monitoring and analysis of noise pollution in smart cities. Sustainable Computing: Informatics and Systems, 100588.
17. Jin, J., Gubbi, J., Marusic, S. and Palaniswami, M. (2014). An information framework for creating a smart city through internet of things. IEEE Internet of Things Journal, 1(2), pp.112-121.
18. Kim, B. and Lavrova, O. (2013). Optimal power flow and energy-sharing among multi-agent smart buildings in the smart grid. In Energytech, 2013 IEEE (pp. 1-5). IEEE.
19. Kittur, A., Nickerson, J. V., Bernstein, M., Gerber, E., Shaw, A., Zimmerman, J., ... & Horton, J. (2013). The future of crowd work. In Proceedings of the 2013 conference on Computer supported cooperative work (pp. 1301-1318).
20. Kummitha, R. K. R., & Crutzen, N. (2017). How do we understand smart cities? An evolutionary perspective. Cities, 67, 43–52.
21. Li, C.M., Liu, B., Qin, R.F. and Yang, N. (2016). An urban mobile monitoring system integrating remote sensing and environmental sensors. In Design, Manufacturing and Mechatronics: Proceedings of the 2015 International Conference on Design, Manufacturing and Mechatronics (ICDMM2015) (pp. 510-519).
22. Liao, P., Wan, Y., Tang, P., Wu, C., Hu, Y., & Zhang, S. (2019). Applying crowdsourcing techniques in urban planning: A bibliometric analysis of research and practice prospects. Cities, 94, 33-43.
23. Liu, W., Moultrie, J., & Ye, S. (2019). The Customer-Dominated Innovation Process: Involving Customers as Designers and Decision-Makers in Developing New Product. The Design Journal, 22(3), 299–324.
24. Lukić, J., Radenković, M., Despotović-Zrakić, M., Labus, A. and Bogdanović, Z. (2016.) A hybrid approach to building a multi-dimensional business intelligence system for electricity grid operators. Utilities Policy, 41, pp.95-106.
25. Maletić, M., Barać, D., Naumović, T., Bogdanović, Z., & Radenković, B. (2019). Blending crowdvoting in modern e-learning environments. International Review of Research in Open and Distributed Learning, 20(2).

26. Manville, C., Cochrane, G., Cave, J., Millard, J., Pederson, J. K., Thaarup, R. K., ... & Kotterink, B. (2014). Mapping smart cities in the EU. Available via: https://www.rand.org/pubs/external_publications/EP50486.html (last access: 8. 4. 2018)
27. Mueller, J., Lu, H., Chirkin, A., Klein, B., & Schmitt, G. (2018). Citizen Design Science: A strategy for crowd-creative urban design. Cities, 72, 181–188.
28. Prelec, D., Seung, H. S., & McCoy, J. (2017). A solution to the single-question crowd wisdom problem. Nature, 541(7638), 532–535.
29. Radenković, B., Despotović-Zrakić, M., Bogdanović, Z., Barać, D., Labus, A. & Bojović Ž., (2017). Internet Inteligentnih uređaja. Fakultet organizacionih nauka. ISBN:978-86-7680-304-0.
30. Radenković, M., Bogdanović, Z., Despotović-Zrakić, M., Labus, A., & Lazarević, S. (2020). Assessing consumer readiness for participation in IoT-based demand response business models. Technological Forecasting and Social Change, 150, 119715.
31. Rodić-Trmčić, B., Labus, A., Bogdanović, Z., Babić, D. D., & Dacić-Pilčević, A. (2017). Usability of m-Health services: a health professional's perspective. Management: Journal of Sustainable Business and Management Solutions in Emerging Economies, 21(80), 45-54.
32. Sánchez, L., Elicegui, I., Cuesta, J. and Muñoz, L., (2014). On the energy savings achieved through an internet of things enabled smart city trial. In Communications (ICC), 2014 IEEE International Conference on (pp. 3836-3841). IEEE.
33. Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M., & Oliveira, A. (2011). Smart cities and the future internet: Towards cooperation frameworks for open innovation. The future internet, 431–446.
34. Simić, K., Despotović-Zrakić, M., Bojović, Ž., Jovanić, B. and Knežević, Đ. (2016). A platform for a smart learning environment. Facta universitatis-series: Electronics and Energetics, 29(3), pp.407-417.
35. Solanas, A., Patsakis, C., Conti, M., Vlachos, I.S., Ramos, V., Falcone, F., Postolache, O., Pérez-Martínez, P.A., Di Pietro, R., Perrea, D.N. and Martinez-Balleste, A. (2014). Smart health: a context-aware health paradigm within smart cities. IEEE Communications Magazine, 52(8), pp.74-81.
36. Staletić, N., & Petrović, V. (2016) Implementation of the crowdfunding concept in higher education, in University of Belgrade, Faculty of Organizational Sciences proceeding XV International symposium Symorg 2016 in Zlatibor, Serbia, June 2016, 304–311.
37. Staletić, N., Labus, A., Bogdanović, Z., Despotović-Zrakić, M., & Radenković, B. (2020). Citizens' readiness to crowdsource smart city services: A developing country perspective. Cities, 107, 102883.
38. Stefanović, S., Milanović, S., Despotović-Zrakić, M. (2020). Crowdsensing mobile healthcare application for detection of ambrosia. XVII International Symposium Business and Artificial Intelligence, SYMORG Belgrade, September 7-9, pp. 513-519. ISBN 978-86-7680-385-9
39. Stefanović, S., Nešković, S., Rodić, B., Bjelica, A., Jovanić, B., Labus, A. (2021). Development of a crowdsensing IoT system for tracking air quality. E-business technologies conference, Faculty of Organizational Sciences, Belgrade, (pp. 117-119), ISBN 978-86-7680-390-3
40. Surowiecki, J. (2005). The wisdom of crowds. Anchor Books.
41. Trmčić, B. R., Labus, A., Mitrović, S., Buha, V., & Stanojević, G. (2018). Internet of things in E-health: an application of wearables in prevention and well-being. In Wearable Technologies: Concepts, Methodologies, Tools, and Applications (pp. 880-885). IGI global.
42. United Nations Development Programme (UNDP). (2016). Human Development Report 2016, Human Development for Everyone. Published for the United Nations Development Programme (UNDP). eISBN: 978-92-1-060036-1.
43. Wu, M., Lu, T. J., Ling, F. Y., Sun, J., & Du, H. Y. (2010). Research on the architecture of Internet of Things. In 2010 3rd international conference on advanced computer theory and engineering (ICACTE) (Vol. 5, pp. V5-484). IEEE.

CROWDSOURCING MODELS IN HIGHER EDUCATION

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Original scientific paper
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Abstract

Crowdsourcing refers to the distribution of tasks between a group of people with the aim of solving a problem or completing a task. It is a collaborative model that uses different technologies to connect the "crowd" involved in the problem solving. This model was originally developed as an innovative business model, however, it later found its use in various fields including education. The aim of this paper is to determine which models of crowdsourcing can be used in education and which models are suitable for higher education. In addition, the aim is to determine the benefits of applying the crowdsourcing models in higher education for all participants in this process. Some of the models are crowdteaching, crowdlearning, crowdsensing, etc. Some of these models are intended for students, some are for teaching staff. There are also models that seek to use the crowd to raise funds to support a particular educational goal. Innovative approach to applying crowdsourcing in education include smart technologies.

Key words: crowdsourcing, higher education, crowdteaching, crowdlearning, crowdfunding, crowdsensing.

1. Introduction

The impact of globalization and the development of the information society has set new demands in all aspects of social life, including higher education, so that e-learning has become a significant instrument in the new digital environment of higher education that encourages centered learning for students and new educational practices resulting in more flexible learning methods (Shopova, 2012).

E-education of new generation is aimed at students exchanging their experiences through interaction, and creating new knowledge (Orehovački, Konecki & Radošević, 2007).

In this new learning environment, students are no longer just consumers of static content created by professionals, but they themselves are involved in the processes of designing and creating content (Tabot, Oyibo & Hamada, 2013). This way of education puts students in an active role and emphasizes their individual development, and all learning activities are organized with the aim of improving students' knowledge, skills and competencies (Palacious & Evans, 2013).

The aim of this paper is to determine which models of crowdsourcing can be used in education and which models are suitable for higher education. In addition, the aim is to determine the benefits of applying the crowdsourcing models in higher education for all participants in this process. The following models are presented: crowdteaching, crowdlearning, crowdfunding, crowdtuitition, crowdwoting and crowdsensing.

2. Crowdsourcing

Crowdsourcing is a collaborative model that is enabled through people-centered web technologies to solve individual, organizational and social problems using a dynamically formed group of people who respond to the invitation to participate (Pedersen, Kocsis, Tripathi, Tarrell, Weerakoon, Tahmasbi, Xiong, Deng, Oh & deVreede, 2013). Crowdsourcing "is a combination of the efforts of a group of people, usually volunteers, in a job in which each individual makes a small contribution in order to achieve a greater result and group goal" (Injac-Malbaša, 2013). Community-based crowdsourcing takes place in an environment that connects different individuals based on common interest, social group, nationality (Puah, Bakar & Ching, 2011).

The key elements of a crowdsourcing process are (Niu, Qin, Vines, Wong & Lu, 2018):

- the crowdsourcer (requester) – institution or an individual seeking help from the crowd
- the crowd – group of people working on crowdsourcing task
- the task – needs to be well defined
- the platform – web platform that allowes the crowdsourcer to access the crowd.

A simplified crowdsourcing process is presented in Figure 1.

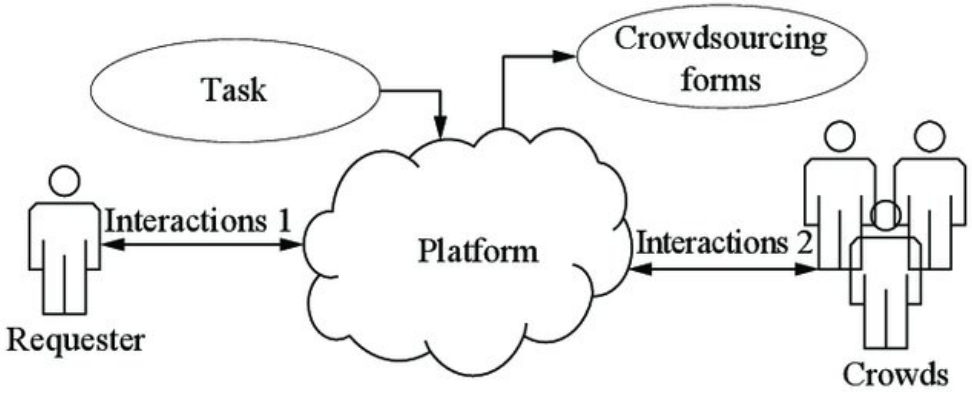

Figure 1. Crowdsourcing process
Source: (Niu et al.,, 2018)

Authors (Pan & Blevis, 2011) singles out the application of crowdsourcing in three basic forms. These three forms are crowdsourcing in an academic, business, and social environment. When it comes to the academic environment, the following values of crwd-sourcing stand out:

- The number of contributing individuals is increasing;
- Leads to innovation and discovery;
- Maintaining diversity and supporting fundamental research.

3. Crowdsourcing models in higher education

Crowdsourcing can be used in several different domains to take advantage of wisdom of the crowdsuch as business and marketing, medicine, education, sociology, ect (Hosseini et al., 2014). Collective intelligence and crowdsourcing are also used in education to use knowledge and ideas, as well as solutions to problems from different users connected ICT (Heusler & Spann, 2014). Numerous applications take advantage of these approaches, some examples are: forecasting the future (eg predictive markets), design of new products (npr. Jovoto), funding initiatives (eg Kickstarter), solving crowdsourcing tasks (eg Amazon Mechanical Turk) (Heusler & Spann, 2014).

The paper (Llorente & Morant, 2015) lists four key models of crowdsourcing in higher education: crowdteaching, crowdlearning, crowdfunding and crowdtuition. This can be extended to the increasingly prevalent crowdvoting, as well as crowdsensing which is especially important for smart educational environments.

The most important models of crowdsourcing in higher education are presented in Figure 2.

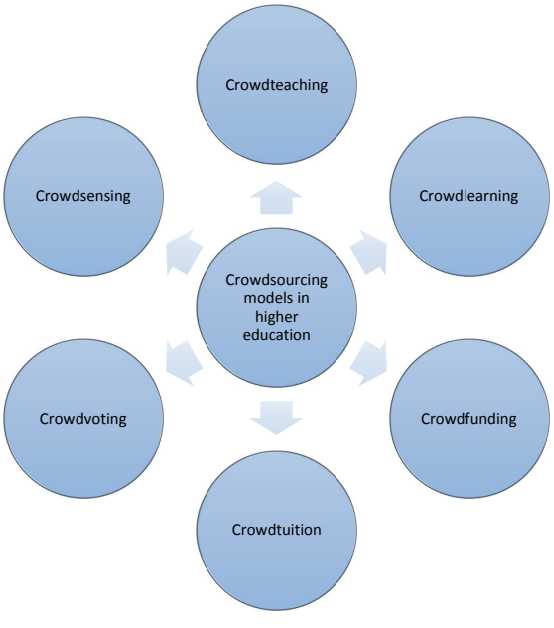

Figure 2. Crowdsourcing models in higher education
Source: Llorente & Morant, 2015

3.1. Crowdteaching

Crowdteaching serves to optimize lectures and exercises through the sharing and exchange of educational materials. Through crowdteaching, teachers share and compose teaching materials together, following the university curriculum (Llorente & Morant, 2015). Crowdteaching provides new potential to teachers as designers of curricula and teaching activities. When the possibilities of today's participatory web culture and infrastructure are added to the concept of crowdteaching, then teachers can take full advantage of the collective intelligence or crowdsourcing community (Recker, Yuan & Ye, 2014). Crowdteaching can take place through an ad hoc platform that will allow the exchange of content (Llorente & Morant, 2015) or existing web tools for crowdteaching, such as Instructional Architect. This tool allows teachers to create projects, and to find, create and share educational materials (Recker, Yuan & Ye, 2014).

Crowdsourcing is often used in universities through the sharing of educational materials, because professors look for materials that are of good quality and that correspond to the field they teach (Llorente & Morant, 2015). Professors use crowdteaching to communicate formally and informally, with the goal of gathering, developing, and sharing information and resources (Kramer, Ocenar & Yamasaki, 2016). However, special attention must be paid to the source of these materials, and this is a problem that students often face. Eg. The Uclass application allows professors to access the best lecture materials through crowdsourcing, which also saves them the time needed to prepare lectures. Also, Uclass allows students to work together on collaborative projects (Llorente & Morant, 2015).

3.2. Crowdlearning

The concept of crowdsourcing can be applied in learning (Dontcheva, Morris, Brandt & Gerber, 2014) and in that case it is about crowdlearning. Crowdlearning is the learning of a group of students through work on real projects (Llorente, Morant & Garrigos-Simon, 2015). This type of learning mostly refers to collaborative projects in which students have certain skills, and share information and learn from each other, which is a good preparation for their career (Llorente & Morant, 2015). Through crowdlearning, groups of students from the same or different educational institutions can work together on collaborative projects, which are coordinated by teachers (Llorente, Morant & Garrigos-Simon, 2015). In order for the project to be successfully realized, each student contributes his / her own skills. The results of the paper (Dontcheva et al., 2014) showed that crowdsourcing can be combined with learning with the aim of improving the learning and performance of individuals. Also, it has been shown that users are more motivated when a real problem that needs to be solved is added to the process itself.

Crowdlearning is based on project-based learning and has been successfully implemented in universities around the world. In this approach, the knowledge building process is based on collaborative projects where different students share knowledge, teach each other and learn together to successfully solve the project. An example of crowdlearning is the Skillshare educational platform, which brings together the online learning community to acquire real skills through project-based classes. The advantage of this technique is that

each student can use the skill they already have, which is needed to successfully complete the project (Llorente & Morant, 2015). Various crowdlearning tools, especially the use of massive open online courses - MOOC, can reduce the pressure on teachers, and at the same time create a global learning audience (Llorente, Morant & Garrigos-Simon, 2015).

3.3. Crowdfunding

Crowdsourcing can be used to raise funds for a specific purpose (Llorente & Morant, 2015). It is mainly implemented online to support various educational projects (Solemon, Ariffin, Din & Anwar, 2013). The subject of crowdfunding can be anything that will support education, and most often it is laboratories and the necessary technical equipment. Laboratory equipment at higher education institutions can be particularly expensive, especially in the case of engineering studies, where in addition to the necessary equipment, appropriate materials are often required. Thus crowdfunding can be used to form laboratories for exercises and lectures that will be socially useful, e.g. for research on certain diseases (Llorente & Morant, 2015). The paper (Llorente, Morant & Garrigos-Simon, 2015) identified four types of crowdfunding: donations, rewards, equality and credit.

As education has become more expensive around the world in the last ten years, crowdfunding has emerged as an interesting option that can help students raise money for tuition. Some examples of crowdfunding sites for students are Upstart or Scolaris, which allow students and donors to connect. Although a large number of students still rely on other sources in such cases (eg government, companies, families, etc.), crowdfunding platforms have proven to be effective in connecting those in need of funds with those willing to give (Dron & Anderson, 2014). Also, one of the trends in crowdfunding is raising funds for the implementation of scientific research projects (Solemon et al., 2013).

3.4. Crowdtuition

Since crowdsourcing has a significant impact on social benefits, the crowdtuition technique can be used to enable the best students to have their tuition paid through crowdsourcing methods (Llorente & Morant, 2015).

Crowdtuition as a model of crowdsourcing in educational environments, belongs to the broader concept of crowdfunding, and is a type of crowdfunding. The difference is that crowdtuition refers exclusively to student tuition, while in crowdfunding funds can be raised for various purposes.

There are numerous websites dedicated to crowdtuition, e.g. ScholarMatch. Crowdtuition can be conducted as a fundraising campaign through crowdfunding platforms (Llorente, Morant & Garrigos-Simon, 2015).

3.5. Crowdvoting

Crowdvoting refers to a situation where the crowd is asked to vote on certain points of interest (Araman & Caldentey, 2016). Subjective responses of the crowd are collected in order to make a specific decision (Prpić, Shukla, Keitzmann & McCarthy, 2015). These subjective responses may relate to opinions, ideas, and decisions by the public (Solemon et al., 2013). When conducting crowdvoting, the duration of voting is mostly predetermined (Araman & Caldentey, 2016).

This concept is increasingly becoming a practice of a different companies when they are in the phase of designing or placing new products on the market (Araman & Caldentey, 2016). Crowdvoting is applied in higher education mainly within the framework of competition-based initiatives, most often in order to enable students to make decisions (Solemon et al., 2013).

In higher education, crowdvoting can be conducted in different ways, e.g. through social networks in order to support student creative projects (Bogdanović, Labus, Simić, Ratković-Živanović & Milinović, 2015). Within education, the crowdvoting strategy can also be used for innovation, since through such initiatives large groups of participants can be engaged for various competitions or problem solving (Solemon et al., 2013).

3.6. Crowdsensing

When it comes to crowdsensing, it mostly refers to mobile crowdsensing. It is a new paradigm that takes advantage of mobile devices that have the role of efficiently collecting data and enabling the use of numerous applications (Ma, Zhao & Yuan, 2014). Viewed in the context of education, mobile devices are effective tools that allow students to actively participate and collaborate on large-scale applications because they are equipped with a large number of different sensors (Longo, Zappatore & Bochicchio, 2015).

Unlike typical IoT objects, which often lack computing capabilities, mobile devices have many sensors, as well as computing and communication capabilities, and as such can serve as a link to everyday objects or as a means of generating environmental information (Ganti, Ye & Lei , 2011).

Mobile crowdsensing provides ways for continious learning of students through the experience of participating in practical activities, which also results in the development of skills for students (Longo, Zappatore & Bochicchio, 2015). In addition, mobile crowdsensing in education enables the implementation of various applications and devices of a smart educational environment, because it enables the collection of sensory data that can relate to information about the institutions' environment, students' location, attendance control, classroom occupancy, noise detection, temperature , pressure, etc.

4. Conclusion

Crowdsourcing as a collaborative and business model provides the possibility of implementation within higher education to harness the power of a networked group (the crowd). This can be reflected in the creation and sharing of educational content between teaching staff or students, problem solving, fundraising etc.

In relation to the goal of the crowdsourcing process, various models of crowdsourcing have been developed that can be applied within education. The paper presents the most important models of crowdsourcing that can be applied in higher education. Those models are crowdteaching, crowdlearning, crowdfunding, crowdtuitition, crowdvoting and crowdsensing. This provides opportunities for further research in the context of combining crowdsourcing and higher education environment.

References

1. Araman, V. & Caldentey, R. (2016). Crowdvoting the Timing of New Product Introduction. Retrieved from: https://ssrn.com/abstract=2723515 (last visited: 09.11.2017.)
2. Bogdanović, Z., Labus, A., Simić, K., Ratković-Živanović, V. & Milinović, S. (2015). Harnessing crowdvoting to support students' creativity. In Proceedings of the 7th International Conference on Education and New Learning Technologies, (pp. 4318-4326), Barcelona, Spain.
3. Dontcheva, M., Morris, R., Brandt, J. & Gerber, E. M. (2014). Combining Crowdsourcing and Learning to Improve Engagement and Performance. In Proceedings of the Computer Supported Cooperative Work Conference (CSCW '14) (pp.3379-3388), Toronto, Canada. DOI: http://dx.doi.org/10.1145/2556288.2557217
4. Dron, J. & Anderson, T. (2014). Teaching Crowds – learning and social media. AU Press: Athabasca University.
5. Ganti, R. K., Fan, Y. & Hui, L. (2011). Mobile Crowdsensing: Current State and Future Challenges. IEEE Communications Magazine, 49, 11, 32–39.
6. Heusler, A. & Spann, M. (2014). Knowledge Stock Exchanges: A Coopetitive Crowdsourcing Mechanism For E-Learning. In Proceedings of the European Conference on Information Systems (ECIS) 2014, Tel Aviv, Israel.
7. Hosseini, M., Phalp, K., Taylor, J. & Ali, R. (2014). The four pillars of crowdsourcing: A reference model. The IEEE Eight International Conference on Research Challenges in Information Sciences (pp. 1-12), Marrakesh, Marocco. DOI: 10.1109/RCIS.2014.6861072
8. Injac-Malbaša, V. (2013). Crowdsourcing – određenje pojma, tipologija i srodni termini. Glasnik Narodne biblioteke Srbije, 2012/2013, 239-255.
9. Kramer, J., Ocenar, J. & Yamasaki, J. (2016). Crowdteaching: Online Crowdsourcing in Education. Retrieved from: https://tccpapers.coe.hawaii.edu/index.php/tcc/article/view/8 (last visited: 20.10.2017.)
10. Llorente, R., Morant, M. & Garrigos-Simon, F. J. (2015). Crowdlearning, Applying Social Collaboration in Higher Education. International Conference – New perspectives in science education. Retrieved from website: http://conference.pixel-online.net/NPSE/files/npse/ed0004/FP/1550-SERA935- FP-NPSE4.pdf (last visited: 08.08.2017.).
11. Longo, A., Zappatore, M. & Bochicchio, M. A. (2015). Collaborative learning from Mobile Crowd Sensing: A case study in electromagnetic monitoring. In Proceedings of the IEEE Global Engineering Education Conference (EDUCON). Tallinn, Estonia.
12. Ma, H., Zhao, D. & Yuan, P. (2014). Opportunities in mobile crowd sensing. IEEE Communications Magazine, 52, 8, 29–35.
13. Niu, X. J., Qin, S. F.,Vines, J., Wong, R. & Lu, H. (2018). Key Crowdsourcing Technologies for Product Design and Development. International Journal of Automation and Computing. DOI: 10.1007/s11633-018-1138-7
14. Orehovački, T., Bubas, G. & Kermek, D. (2007). Razvoj kvalitete u eobrazovanju. 9. CARNetova korisnička konferencija: Korisnik u fokusu. Retrieved from website: https://cuc.carnet.hr/cuc2007/

program/radovi/pdf/g2- 1-rad.pdf (last visited: 28.11.2017.)
15. Palacious, L. & Evans, C. (2013). The Effect of Interactivity in E-learning Systems. Newcastle upon Tyne: Cambridge Scholars
16. Pan, Y. & Blevis, E. (2011). A Survey of Crowdsourcing as a means of Collaboration and the Implications of Crowdsourcing for Interaction Design. In Proceedings of the 2011 International Conference on Collaboration Technologies and Systems (CTS), (pp. 397-403). Philadelphia, PA, USA. DOI:10.1109/CTS.2011.5928716
17. Pedersen, J., Kocsis, D., Tripathi, A., Tarrell, A., Weerakoon, A., Tahmasbi, N., Xiong, J., Deng, W., Oh, O. & deVreede, G. J. (2013). Conceptual Foundations of Crowdsourcing: A Review of IS Research. In Proceedings of the 46th Hawaii International Conference on System Sciences (pp. 579-588). Wailea, Maui, HI USA. DOI: 10.1109/HICSS.2013.143
18. Prpić, J., Melton, J., Taeihagh, A. & Anderson, T. (2015). MOOCs and crowdsourcing: Massive courses and massive resourcer. First Monday, 20, 12. doi:http://dx.doi.org/10.5210/fm.v20i12.6143
19. Puah, C., Bakar, A., Zaki, A., Ching, C.W. (2011). Strategies for community based crowdsourcing. In Proceedings of the International Conference On Research and Innovation in Information Systems (ICRIIS), (pp. 1–4), Kuala Lumpur, Malaysia
20. Recker, M., Yuan, M. & Ye, L. (2014). Crowdteaching: Supporting Teaching as Designing in Collective Intelligence Communities. International Review of Research in Open and Distributed Learning, 15, 4, 138-159.
21. Shopova, T. (2012). E-learning in higher education environment. In Proceedings of International Conference the Future of Education, Florence, Italy.
22. Solemon, B., Ariffin, I., Din, M. M. & Anwar, R. M. (2013). A review of the uses of crowdsourcing in higher education. International Journal of Asian Social Science, 3, 9, 2066-2073.
23. Tabot, A., Oyibo, K. & Hamada, M. (2013). Chapter I: E-Learning Evolution: Past, Present and Future. In: E-Learning: New technology, applications and future trends. Editor: Homada, M. Nova Science Publishers: New York.