

Connecting science and industry with improved communication of research results

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EDITORIAL

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“Research for innovation” has been Serbian national scientific and technological development strategy for 2016 – 2020 period [1]. Similar strategies have been adopted elsewhere, including in the European Union. Horizon 2020, the EU Research and Innovation programme, implementing the Europe 2020 flagship initiative “Innovation Union”, which indicates that efficient research utilization and innovation are the means for smart, sustainable and inclusive growth of the society. ‘Innovation’ is defined as the actual implementation of new ideas, inventions or technologies to create a new value, not only for an individual or organization but also for the society as a whole, with ultimate aim of creating a smart future [2]. One of the goals in the Serbian national strategy is to assure relevance of the scientific research in Serbia for the industrial needs. Currently, the scientific research in Serbia, like in some other, especially developing countries [3], is majorly oriented towards production of scientific publications. Patent applications and novel technical solutions yielded only 3.3 % of the total scientific output in the preceding period 2011-2015 in Serbia [1]. However, the process of implementing the research findings into practice is burdened with substantial challenges, which include effective communication of the new knowledge to target stakeholders and actual implementation by the users [4]. Academic writing has often been regarded as being unnecessarily complex. And although practitioners in the field of technical and professional communication found that much of the published scientific research is indeed related to their practice, they found the research was not communicated in the way that could easily be adopted to their work [5]. This finding could probably be extended to other scientific fields as well.

Exacerbating problem is the so called “publish or perish” culture, still persisting in many academic environments. The number of scientific publications remains to be a measure for researchers’ performance and a requirement for career advancement. Such metric promotes literature quantity over research quality and sometimes leads to publication of low-quality research with incorrect conclusions [6]. It was reported that over 50 % of published results in preclinical life-sciences research cannot be reproduced independently under specified experimental conditions [7]. This is partially attributed to the desire of academic researchers to publish novel findings as quickly as possible without rigorous examination and replication and to show only positive results in order to reach high-impact factor journals [7,8]. The ‘publish or perish’ culture could also lead to increase in incidences of plagiarism and fabricated results [9]. Furthermore, the use of bibliometrics as a sole measure of scientific performance influences both scientists, especially early in academic careers, and main research trends. A study on doctoral students and postdoctoral scientists has shown that those pursuing academic career feel forced into a competition based on productivity terms expressed exclusively as the number of indexed publications, grants and recorded citations [10]. This in turn, may have much broader consequences since the postdocs are encouraged by the system to place their individual interests above those of the research group and may chose safe mainstream topics rather than pursue risky breakthrough ideas. In this context, finding solutions for practical and societal problems also loses importance [10].

This setting strongly affects scientific fields closely related to applications such as translational research in medical sciences as well as engineering disciplines. Translational research, “from bench-to-bedside”, requires a multidisciplinary approach with a team composed of basic scientists, medical doctors and engineers. The approach necessitates active engagement with industry, as primary customers, and with patients, as final users. The individualistic mentality and -

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competitiveness fostered by the current academic publishing culture fundamentally contradict this collaborative, cross-disciplinary teamwork required for successful development of novel pharmaceutical therapeutics [7] as well as medical therapies and devices, in general. Translational research projects require longer times and substantial resources, while the results may not provide desired bibliometrics due to the need for intellectual property protection. Thus, in order to secure funding and career advancements, researchers are forced to focus on publication-generating work and to abandon time- and resource-consuming translational research [11].

In engineering disciplines, maintaining functional relations with the local industry is mandatory while, traditionally, publishing has not been particularly important consideration [12]. Engineers primarily focus on practical advancements, development of novel technical solutions, prototypes and technologies. Although this work is based on innovative research, it also encompasses technical tasks in designing, assembling and testing new, or existing, components that do not lead to publications [12]. Thus, the use of bibliometric performance indicators may motivate engineers to abandon practically oriented research in favor of topics promoted in international peer reviewed journals. That leads to question if engineers should focus on more provocative topics, unlikely to be adopted in practice but more likely to be published, over searching for critical solutions required in established production processes [12].

Overall, the unanimous conclusion is that the current trend in the (mis)use of research metrics may have broad and multifaceted unintended consequences and should be accompanied with qualitative assessments of the scientific results. Relevance of the research in a wider socio-economic and cultural context should be considered, and research aiming to deliver solutions to societal problems should be rewarded [11,13].

The journal *Hemijska industrija* strives to strengthen the communication between the scientific and professional communities by supporting both original scientific manuscripts and technical contributions. We address the reproducibility issue in publications by stressing the importance of detailed descriptions of experimental procedures. We carefully inspect the Materials and Methods section where the authors are required to state the producers and grades of all materials as well as equipment used, number of replicates, statistical analysis of the results and detailed experimental protocols so that they could be replicated by an independent expert in the field. We also encourage authors to submit technical contributions describing their experimental protocols and technical solutions such as excellent manuscripts Pantelić et al. [14]., A stepwise protocol for drug permeation assessment that combines heat-separated porcine ear epidermis and vertical diffusion cells, Hem. Ind. 72(1) 47–53 (2018) and Re'em [15]., Preparation of TGF-beta1/affinity-bound alginate macroporous scaffolds, Hem. Ind. 72(2) 81–90 (2018). The journal *Hemijska industrija* also invites practitioners to submit technical contributions regarding industrial processes such as the manuscript Korčok et al. [16]., Low moisture starch for improved viability and stability of new probiotic *L. plantarum* 299v preparation, Hem. Ind. 72(2) 107–113 (2018). Finally, we believe that technical contributions describing inventions and innovations could directly foster knowledge implementation and better presentation of the scientific discoveries to variety of relevant stakeholders such as industry, policy-makers and final users.

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Povezivanje nauke i industrije boljim predstavljanjem naučnih rezultata

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REČ UREDNIKA

“Istraživanja za inovacije” je nacionalna strategija naučnog i tehnološkog razvoja Republike Srbije za period od 2016 – 2020 godine [1]. Slične strategije su usvojene u velikom broju zemalja uključujući i Evropsku Uniju u okviru programa “Horizont 2020” (Okvirni program EU za istraživanje i inovacije). U ovom programu se primenjuje jedna od vodećih inicijativa strategije “Evropa 2020” pod nazivom “Unija inovacija” u kojoj se navodi da su efikasna primena naučnih istraživanja i inovacije sredstvo za razvoj pametnog, održivog i inkluzivnog društva. Pojam inovacije je definisan kao praktična primena novih ideja, invencija ili tehnologija radi stvaranja nove vrednosti, ne samo za pojedinca ili organizaciju, već takođe i za društvo kao celinu sa krajnjim ciljem kreiranja pametne budućnosti [2]. Jedan od ciljeva u Nacionalnoj strategiji Republike Srbije je obezbeđivanje relevantnosti naučnih istraživanja za potrebe industrije. Trenutno su istraživanja u Srbiji, kao i u nekim drugim i, posebno, zemljama u razvoju [3], najvećim delom okrenuta ka produkciji naučnih publikacija. Patentne prijave i nova tehnička rešenja su činila svega 3,3 % od ukupnih naučnih rezultata u Srbiji u prethodnom periodu od 2011-2015 godine [1]. Međutim, proces do primene naučnih otkrića u praksi nosi značajne izazove koji uključuju i efikasno predstavljanje novih saznanja ciljnim interesnim stranama, kao i usvajanje i korišćenje naučnih rezultata od strane korisnika [4]. Jezik naučnih i akademskih radova se često ocenjuje kao nepotrebno komplikovan. Na primer, u jednom istraživanju se navodi da su praktičari u oblasti tehničke i profesionalne komunikacije ocenili da je veći deo publikovanih naučnih rezultata relevantan za njihovu praksu, ali nije predstavljen na način na koji bi oni mogli da ih iskoriste u svojoj praksi [5]. Ovaj zaključak bi verovatno mogao da se proširi i na druge naučne oblasti.

Dodatni problem predstavlja i takozvana kultura “publikuj ili nestani” (engl. “publish or perish”) koja postoji u mnogim akademskim sredinama. Broj naučnih radova ostaje mera učinka istraživača i zahtev za napredovanje u karijeri. Ovakva metrika promoviše kvantitet publikovanih radova u odnosu na kvalitet istraživanja i ponekad dovodi do publikovanja nekvalitetnih istraživanja sa netačnim zaključcima [6]. Studija u oblasti prekliničkih istraživanja je pokazala da nezavisni eksperti nisu mogli da ponove preko 50 % publikovanih rezultata u navedenim eksperimentalnim uslovima [7]. Ovaj nalaz se delimično pripisuje želji istraživača da što pre objave nove rezultate ne podvrgavajući ih rigoroznim analizama i ponavljanju, kao i da prikažu samo pozitivne rezultate koji bi bili pogodni za objavljivanje u časopisima sa velikim faktorom uticajnosti (impakt faktor) [7,8]. Kultura ‘publikuj ili nestani’ takođe može da dovede i do povećanja plagijarizma i fabrikovanja i falsifikovanja rezultata [9]. Isto tako, primena bibliometrijskog vrednovanja kao jedine mere naučnog uspeha utiče kako na naučnike, i to pogotovo mlade istraživače, tako i na glavne pravce istraživanja. Istraživanje sprovedeno na studentima doktorskih studija i istraživačima na postdoktorskom usavršavanju je pokazalo da se pojedinci koji žele akademsku karijeru osećaju primorani da uđu u takmičenje zasnovano na merenju produktivnosti isključivo kroz brojeve publikacija u indeksiranim časopisima, projekata i citata [10]. Ovo, sa druge strane, može imati mnogo šire posledice, pošto su istraživači na postdoktorskom usavršavanju sistemski podstaknuti da stave svoje lične interese iznad interesa istraživačke grupe kojoj pripadaju, pri čemu će radije izabrati sigurne teme u trendu nego rizične, napredne i nekonvencionalne ideje koje mogu da dovedu do prodora u nauci. U ovom kontekstu i rešavanje praktičnih i društvenih problema gubi značaj [10].

Opisana situacija veoma utiče na naučne oblasti koje su usko vezane za praktičnu primenu kao što su translaciona istraživanja u medicinskim naukama ili inženjerske discipline. Translaciona istraživanja “od laboratorijskog stola do bolničkog kreveta” (engl. “from bench-to bedside”) zahtevaju multidisciplinarni pristup sa istraživačkim timovima sastavljenim od naučnika, lekara i inženjera. Ovaj pristup takođe zahteva aktivno uključivanje industrije, kao primarnih kupaca rezultata istraživanja, i pacijenata kao krajnjih korisnika. Individualistički i hiper-takmičarski mentalitet forsiran



trenutnom kulturom publikovanja i metrike u akademskoj sredini je u fundamentalnoj suprotnosti sa multidisciplinarnim timskim radom neophodnim za uspešan razvoj novih farmaceutskih preparata [7], kao i novih medicinskih terapija i uređaja, uopšte. Projekti translacionih istraživanja zahtevaju duže vreme i znatne resurse, dok iz rezultata ne moraju da proizađu željeni bibliometrijski indikatori usled potrebe za zaštitom intelektualne svojine. Prema tome, da bi osigurali finansiranje za dalja istraživanja i napredovanje u karijeri, istraživači su primorani da se fokusiraju na rad koji dovodi do publikacija i da odbace vremenski i finansijski zahtevna translaciona istraživanja [11].

U inženjerskim disciplinama je odražavanje funkcionalnih veza sa lokalnom privredom od najveće važnosti dok publikovanju tradicionalno nije pridavana velika važnost [12]. Inženjeri se primarno fokusiraju na praktični napredak i razvoj novih tehničkih rešenja, prototipova i tehnologija. Iako je ovaj rad zasnovan na inovativnim istraživanjima, on takođe uključuje tehničke faze u projektovanju, konstruisanju i testiranju novih ili postojećih komponenata, što ne dovodi do publikacija [12]. Stoga, primena bibliometrijskog vredovanja može da motiviše inženjere da odbace praktično orijentisana istraživanja u korist tema koje se promovisu u međunarodnim naučnim časopisima. Time se postavlja pitanje da li inženjeri treba da se pre fokusiraju na provokativnije teme koje će verovatno biti neprimenljive u praksi, ali lakše za objavljivanje, nego na iznalaženje ključnih rešenja potrebnih u postojećim proizvodnim procesima [12].

Generalno, jedinstven zaključak je da trenutni trend u (pogrešnoj) primeni metrike u vredovanju istraživanja može da dovede do širokih i višestrukih neželjenih efekata tako da treba da bude dopunjen kvalitativnom ocenom naučnih rezultata. Pri tome je potrebno razmotriti relevantnost naučnih istraživanja u širem socio-ekonomskom i kulturološkom kontekstu, a istraživanja koja imaju za cilj da daju rešenja za društvene i praktične probleme treba da budu nagrađena [11,13].

Časopis *Hemijska industrija* nastoji da pojača komunikaciju između naučne i stručne zajednice objavljivanjem kako originalnih naučnih radova, tako i stručnih radova. Posebnu pažnju obraćamo na problem reproduktivnosti objavljenih rezultata ističući značaj detaljnog opisa eksperimentalnih procedura. Odeljak "Materijali i metode" se pažljivo pregleda gde se traži od autora da navedu proizvođače i oznake svih korišćenih materijala i uređaja, broj ponovljenih eksperimenata, metode statističke analize rezultata i detaljne eksperimentalne procedure tako da mogu da budu ponovljene od strane nezavisnog eksperta u oblasti. Takođe, pozivamo autore i da podnesu stručne radove koji će opisati njihove originalne eksperimentalne procedure kao što je to u dva odlična rada: Pantelić i sar. [14], A stepwise protocol for drug permeation assessment that combines heat-separated porcine ear epidermis and vertical diffusion cells, *Hem. Ind.* 72(1) 47–53 (2018) i Re'em [15], Preparation of TGF-beta1/affinity-bound alginate macroporous scaffolds, *Hem. Ind.* 72(2) 81–90 (2018). Časopis *Hemijska industrija* takođe poziva eksperte iz prakse da podnesu stručne radove koji se odnose na industrijske procese, kao što je to rad Korčok i sar. [16], Low moisture starch for improved viability and stability of new probiotic *L. plantarum* 299v preparation, *Hem. Ind.* 72(2) 107–113 (2018). Najzad, verujemo da stručni radovi koji opisuju invencije i inovacije mogu direktno da doprinesu bržoj implementaciji znanja i boljem predstavljanju naučnih otkrića različitim interesnim grupama kao što su industrija, krajnji korisnici i institucije i organizacije koje donose strategije i odluke.

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