34 Prospects of Global Open Research

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Type few keywords (say "privacy research articles") in a search engine of your choice (e.g., Google or Bing), and you will be overwhelmed by the number of results returned (typically in the order of hundreds of thousands). You start to browse through them by clicking on the links you see, and move from page to page. One of the links takes you straight to a PDF file which opens itself automatically. A smile appears on your face: you can skim through that article, apply Keshav's first pass of paper reading [1], and decide whether it is relevant or not. It happens to be relevant, and you store it without delay on your tablet. Job done! Encouraged by this success (after all, it only took 30 s to download the article and decide on its pertinence), you carry on with the next link. Though the title of this new article looks really cool, accessing the PDF this time seems less straightforward. You need to sign in to another system and pay a fee to be able to decide whether the article would be relevant or not. "Hmm. This article looks so great. The authors might have left a copy somewhere on their website", you say. You visit the authors' websites—still nothing. Meanwhile, two minutes are gone, not to say wasted. Yes, wasted. Because despite all your efforts, you're still at square one: you still don't know if that very nice article contains ideas worth re-using. You might perhaps never know, because by now you've given up (frustrated) and moved to the next link.

If you've tried at least once to collect scientific articles to complete a student assignment, prepare a lecture, write your own article, or simply feed your personal curiosity, you're certainly familiar with the experience described above. But there is great news! Open access to scientific articles is a trend that is gaining momentum. And this trend will save time: yours and ours. There was at least seven million researchers worldwide in 2013 according to the Unesco [2]. If each saved one minute per year not wasting time clicking on non-accessible articles (and this is a very generous assumption), this is seven million minutes saved per year worldwide and a gain of about 14 years—14 valuable years of human effort to reinvest in innovation and invention.

Scientific articles are one important product of research, but scholarly communication is shaped through many other artefacts. Indeed, the process of producing a research article involves the choice of a research method, the collection and subsequent analysis of research datasets, the development (or use) of tools, and the evaluation of the work done by one or more colleagues (also known as

scholarly peer review). Open research intends to go beyond open access (i.e., PDF available for all) to make key artefacts used in scholarly communication—methods, datasets, tools, and peer-review discussions—openly accessible to everyone (Figure 1). I hope you begin to see what I see: if again each researcher saves one minute accessing any of these, this is a total of 70 years of human effort saved, a fantastic promise for open research!

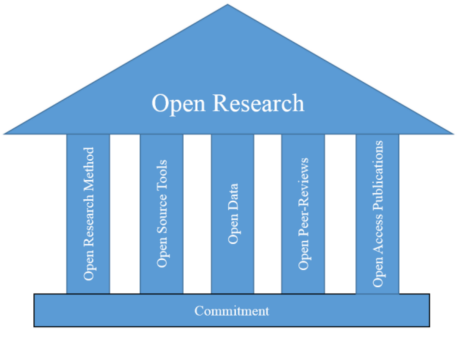

Figure 1. Open research rests on the commitment of people to make key artefacts of the research process freely accessible to everyone. It opens the door to substantial savings in human effort worldwide.

Knowledge accessible to all is a second key benefit of open research. For instance, buying one scientific article costs $15–30, and may be prohibitive to many. Figure 2 shows that there are at least two billion people worldwide living with less than $3.1 a day ($1132 annualized). These, clearly, may not afford using one percent of their annual income to access a single article. As said above, open research is more than open access to articles. It makes not only the final product of research (i.e., articles) free and available for anyone to re-use, but also the whole research factory (i.e., data, tools, methods, reviews) accessible to all. Open research thus lowers participation barriers to scientific discourse, enabling bright minds so far excluded to have their say and advance humanity's understanding of phenomena.

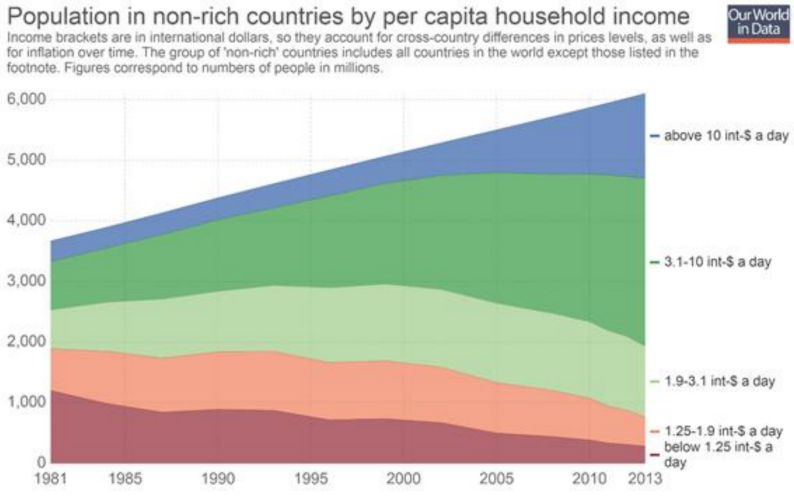

Figure 2. Population in non-rich countries by per capita household income [3]. Note: 'Non-rich' countries are all countries in the world except: Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom United States.

Besides substantial savings in time, and opening up new avenues for science through the inclusion of more people, open research holds the promise of enabling better research. First, the realization that the whole world can now see the inner workings of the research process is an incentive for researchers to engage in better documentation [4], and research methods. Next, making research artefacts open prevents reinventing the wheel, because it helps get a better impression of what has been achieved, and channel resources to truly unsolved problems. Last, open research paves the way for follow-up studies, which verify the conclusions of scientific analyses. Henderson [5] provided a compelling example of the pertinence of these follow-up studies in science. A picture of a piece of rock on Mars in 1976 created the illusion of a human face (see Figure 3), and opened the door to much speculation. The picture of the same piece of rock in 2001—from a different angle and at a better resolution—revealed that the "face" was not a face at all. So we need follow-up studies to confirm or infirm our conclusions in science. And being transparent about artefacts of the whole research process provides a baseline against which these follow-up studies can compare against.

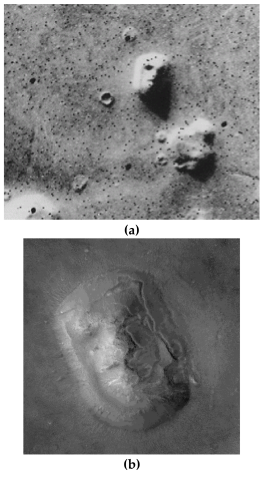

Figure 3. Pictures of a piece of rock on Mars in 1976 **(a)** and 2001 **(b)** [6].

References

1. Keshav, S. How to read a paper. *ACM SIGCOMM Comput. Commun. Rev.* **2007**, *37*, 83–84. [CrossRef]
2. UNESCO. Facts and Figures from the UNESCO Science Report. Available online: https://en.unesco.org/unesco_science_report/figures (accessed on 20 February 2018).
3. Roser, M.; Ortiz-Ospina, E. Global Extreme Poverty, 2018. Our World in Data. Available online: https://ourworldindata.org/extreme-poverty (accessed on 31 August 2018).
4. Tennant, J.P.; Waldner, F.; Jacques, D.C.; Masuzzo, P.; Collister, L.B.; Hartgerink, C.H.J. The academic, economic and societal impacts of Open Access: An evidence-based review. *F1000Research* **2016**, *5*, 632. [CrossRef] [PubMed]
5. Dakin Henderson. Why Should Scientific Results Be Reproducible? Available online: http://www.pbs.org/wgbh/nova/next/body/reproducibility-explainer/ (accessed on 27 February 2018).
6. NASA. Unmasking the Face on Mars, 2001. NASA Science. Available online: https://science.nasa.gov/science-news/science-at-nasa/2001/ast24may_1 (accessed on 31 August 2018).