

The Value of Open Source for Research, Education and Global Health – The Open Source Imaging Initiative

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MRI is an essential medical diagnostic tool that is beyond the reach of many patients throughout the world¹ (Fig. 1). This issue can be addressed collaboratively. Combining innovation and open source approaches will generate global value by reproducible science and development and will allow a major reduction of investments and operational costs. The Open Source Imaging Initiative (OSI²) is a not-for-profit movement with the goal to build an open source (software and hardware) MRI and to share, connect and inspire open source research and development.^{2,3} OSI² is open to all with our guiding principle "from the community, for the community". We offer a communication platform (www.opensourceimaging.org) and currently work on six goals⁵ (Fig. 2). Here we want to discuss the impact of open source on research, education and global health.

Figure 1: Medical MRI systems per million population¹.

Research and Development: Transparency and reproducibility are essential in science. Open source accelerates the scientific progress by fast and resource efficient reproducibility of scientific results, allowing to focus valuable resources on scientific progress rather than reproduction of the status quo. Open communication allows to minimise redundant developments and engage in demanding projects by sharing resources. Open source benefits the authors by disseminating their work and increasing its impact while maintaining their authorship through open source licenses. At the same time open source software and hardware benefits from good documentation by means of scientific publications that undergo a review process. Open source stimulates multidisciplinary collaborations, which is in particular important for the interdisciplinary MR community.

Figure 2: Illustration of the six goals of OSI^{2,3}.

Education: Education stands on transparency. Training of MR physicists and radiologists is crucial for the development of MRI as is the training of technicians, engineers and other hardware specialists. MR technology requires a large panel of skills that are simply unavailable in many regions of the globe. Providing open access to documentation, manuals, data, lectures, exercises, lab courses and source code facilitates the learning and training of users, developers, technicians, students and researchers, and stimulates creativity. An open source approach improves the quality of information gradually and constantly by the community and promotes discussion based learning.

Global Health: There is a high demand for affordable MR technology around the world to improve patient diagnosis and treatment. Open source research and development of MR software and hardware has the potential to significantly lower the total cost of ownership of an MR system^{4,5} (Fig. 3). Open access to know-how has the immense potential to unlock new business opportunities and local markets with stable low prices, encouraging product customizations and steadily increased product quality.^{6,7} The success of this strategy has already been observed in the open source software economy⁷ and for open source hardware such as the 3D printer, microcontroller or small-scale computer markets.⁸

Figure 3: Strategy to reduce the total cost of ownership.³

Open source encourages the participation of patients and practitioners in the development process. Their input can be used to improve the quality, ease of use, safety, function, patient comfort, costs and customization to local infrastructure of the devices. Lower total cost, new business opportunities and free access to knowledge without expiration date will improve the global distribution of medical devices, thereby improving diagnostics and care for millions of patients worldwide.

¹World Health Organization, Volume 2016; 2013. ²Winter L, et al., Proc. ISMRM, 2016, #3638. ³Arndt F, et al., ISMRM, 2017. ⁴Pipe J., Magnetic Resonance in Medicine Highlights, Aug 2015–Apr 2016. ⁵Sferrella S., Radiology Business, Dec 28 2012. ⁶Open-source medical devices, When code can kill or cure, Jun 2012, www.economist.com. ⁷Black Duck and North Bridge, Future of Open Source Survey Results, 2013. ⁸Pearce, J. M. "Emerging Business Models for Open Source Hardware." *Journal of Open Hardware* 1.1 (2017).