# Five key elements to enable open science for society

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This paper discusses how open science can serve for addressing social issues, particularly for those caused by environmental deterioration. To address wicked social-ecological problems, solution-oriented research has involved research experts from different domains (interdisciplinarity) and also practitioners such as governments, funders, industries, non-profit organizations, and civil members (transdisciplinarity). However, such team science is often disrupted by asymmetric information, knowledge, wisdom, value, socio-economic status, and power among above-mentioned actors. Such socio-psychological asymmetry is possibly reduced by boundary spanning with special attention to the following five key elements: (1) considering ethical equity with special attention to empowering marginalized (or "small voice") actors; (2) developing visualization of data based on the FAIR (findable, accessible, interoperable, and reusable) Principles as well as information; (3) building trust by securing transparency in the research process; (4) facilitating dialogue; and (5) discovering and sharing the goals that actors with different interests can tackle together (transcend) where necessary. Civic Tech can be applied as a holistic approach, in which civic engineers develop a solution to local issues by using disclosed data and information and communication technologies. This proposed methodology is cyclically assessed and improved through practical case studies, with special interest in developing a method to measure participants' perceptual transformation through interventions.

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