Chapter 28
Balancing Formalization and Representation in Cross-Domain Data Management for Sustainable Development

Paolo Diviacco
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS, Italy

Adam Leadbetter
Marine Institute, Ireland

ABSTRACT

Sustainable development is grounded in complex systems where phenomena and processes are so interrelated and intermingled that they can only be studied in a multiple disciplinary manner. Limitations in understanding such systems can be identified that are either epistemic and cognitive or socio-economic. Both cases are problematic for collaborative and multidisciplinary studies in sustainable development. This chapter explores these difficulties with a particular focus on data management, an activity that is at the same time very important and very sensitive to such problems. To allow users to find their way through data and information spaces, solutions are proposed that take advantage of either the formalization of knowledge; or of representations, such as schemas, mind maps or graphs. Through a careful balance of these two pathways this chapter demonstrates that it is possible to mitigate the difficulties mentioned above and allow a community to work together at profit.

INTRODUCTION

Sustainable development is the possibility to benefit from natural resources without incurring in their depletion or triggering negative side-effects in other domains. This dualism is also reflected in the United Nation's (UN) Sustainable Development Goals (UN resolution A/RES/70/1, 2015), where on one hand the UN lists goals such as end poverty and hunger or ensure healthy lives, while, at the same

DOI: 10.4018/978-1-5225-3817-2.ch028

time, claiming that these have to be achieved ensuring conservation of the environment, ecosystems and combatting climate change and its impacts.

This balance is very hard to obtain because it is very difficult to understand all the aspects of the related processes and phenomena and it is very complicated to try to control them. Indeed in sustainable development, understanding is problematic because:

- The necessary skills and competences come from multiple disciplines such as biology, geology, sociology or economics
- Since multiple fields are involved, research projects in this area are very likely to be collaborative and cross-disciplinary
- Approaches and methods needed for sustainable development related to scientific fields are often not as rigorous as those needed in other domains such as for example computer science or engineering
- The need to collaborate with other people can introduce issues that range from simple misunderstanding, to lack of awareness, tacit knowledge, up to politics or rhetoric

It is important to understand that these effects are not due to insufficient efforts spent during coordination or managing of projects but to the intrinsic nature of knowledge, and its usage, in the domain of sustainable development. It is a cultural problem. To address such issues, therefore, instead of organizing the work within a "one-size-fits-all" manner that has been devised for other sectors, we need to develop strategies and perspectives focused on the specific case of sustainable development. In this chapter we will consider the case of data management, an activity where all the above mentioned issues very clearly emerge since data, and the information built on top of those data, are at the base of all sustainable development activity. In this sense it is possible to highlight the existence of a gap between what is required by stakeholders and what can be offered by experts. This is not only a gap but a structural difference. The main focus of stakeholders is on norms, decisions and protocols, while scientists offer observations and hypotheses.

The availability of data is therefore overwhelmingly important. It is necessary to enable information to be built from different perspectives and ways of thinking by actors with different point of views, approaches and aims. To facilitate this, data should be understandable by all the designated community.

To address all this we will, in this chapter:

- Describe the mechanisms that are at the base of the issues that limit and obstruct handling of such topics
- Introduce the concept of representation and its implication in data management and in particular in the case where contrasting cognitive models access the same representation
- Introduce the problem of formalization of knowledge that can be applied to assist data access and to frame collaborative research activities
- Discuss the advantages and disadvantages of formalization and how this can be put in practice and the tools needed
- Discuss whether knowledge can be exploited even without the need to formalize it; how this can be put in practice and the tools needed