

The Italian academic research system through the lenses of ontology

Abstract

Keywords: Research evaluation, Ontology, Systematic Literature Network Analysis.

1 Introduction

The development of research evaluation within European countries has been often driven by reforms inspired by neo-liberal principles, aimed at simultaneously incrementing the steering capabilities of the policy-makers and the autonomous responsibilities of the universities, the redistribution of powers and the increasing capability of the organisations to plan, control and measure achievements [Whitley and Glaser, 2007; Neave, 1991]. Given this context, the implementation of an evaluation was mainly related to the level of autonomy granted to the institutions, and the type of competitive funding system in the different countries [Whitley and Glaser, 2007]. In Italy, weaknesses in the policy design and poor implementation led to unintended consequences of the reform process, and conflicts related to the introduction of research evaluation [Capano et al., 2016; Rebora and Turri, 2013; Reale and Seeber, 2013; Minelli et al., 2006]. A project of national interest [PRIN, 2017] has been dealing with the Italian academic research system with the aim of investigating the effects of research evaluation implemented by the government on the research work and the knowledge production performed in Italian universities. Moreover, the project aims at contributing to the design of a methodological approach for measuring the effects of evaluation at the individual level. Among the research questions addressed in the project are the epistemological and the methodological underpinnings of research evaluation and their implications for assessment at the individual level.

2 Context and purposes of the research

Since the 2000s the Italian government implemented two research assessment tools, which significantly impact on academics' role and work: VQR and ASN. Even though with some differences, both VQR and ASN assess the quality of research outputs produced by academics, using informed peer review and, extensively, either bibliometric indicators (IF and citations) or a rating of national and international journals based on quality (the so-called list of top 'A' journals). Thus, both instruments are intended to show academics what quality standards ought to be reached for excellent research in order to gain recognition at a national and institutional level, and how by formally adopting them grant access to professorship, pushing academics to comply with those rules and criteria. The PRIN project focuses on a set of possible effects on knowledge production already pointed out by the relevant literature. Research evaluation plausibly

produces different effects on academic research work and knowledge production, largely depending on the institutional and the geographical context where evaluation is applied, the field academics belong to, the stage of their research career (early researchers or seniors), and gender issues. Therefore, some open questions concern the conditions that allow research evaluation to guide research quality without creating distortions, and how measurable are both the quality of research and the effects of an external evaluation of research quality.

Moreover, the impacts of measurement at social and individual level depend on the reliability of its outcomes.

Therefore, given the complexity of the research process, the methodological aspects of its measurement and evaluation take on a particular importance, and highlight the need to build the core of an appropriate and relevant conceptual framework for this knowledge field, based on an explicit ontology.

Thus, the research questions this paper addresses are: what are the main elements of the Italian research system? How are they related to each other? How is it possible to structure this knowledge in order to share unambiguous information and support the identification of the impact that external research evaluation can produce on research practices?

3 Methodology

In the first phase, the research group aimed to explore the application of ontologies to the field of management and more specifically to research evaluation and to formally define the Italian research system.

Regarding the first purpose, a methodology called 'Systematic Literature Network Analysis (SLNA)' [Colicchia and Strozzi, 2012] was implemented, that "combines systematic literature review and bibliographic network analysis" [Strozzi et al., 2017].

In the preliminary analysis, methods related to the modelling of systems were taken into account [Forrester 1961]. A first attempt was to advance the hypothesis that the research system in Italy could be outlined in dynamic terms, in other words considering entities involved with their "causal dependency" relationships. Subsequently, it has been decided to develop a static model (ontology) of the entities present in the system and their possible relationships. On this basis, a model-based ontology has been developed. The most well-known definition of ontology – in the domain of intelligent systems concerning their interaction with experts given a specific context which can be modelled in ontological terms – is the following: "an explicit and formal specification of a shared conceptualization": formal, inasmuch ontology needs to be not ambiguous, well-defined, well-developed, meaning that it needs to be universally comprehensible and machine-compatible; shared, since it needs to be accepted not by the single, but by an entire group of domain experts that agree on the concepts, their definitions and possible properties and relationships among them [Gruber, 1993].

Initially the topic of the project – the research system in Italy – was described through a causal dependency graph – a traditional modelling technique for dynamic systems – by implementing a qualitative version of it. Given the modelling choice,

entities have been divided in "subjects" and "objects": the former – for example, researchers and editors – are to be intended as entities that can be the cause of observable effects; the latter – for example, manuscript and research guidelines – are to be intended as entities that can only be influenced by other causes. The result has taken the form of Figure 1, where the orange shapes are the subjects of the model and the grey ones are the objects, whereas the arrows describe the cause-effect relationship between entities.

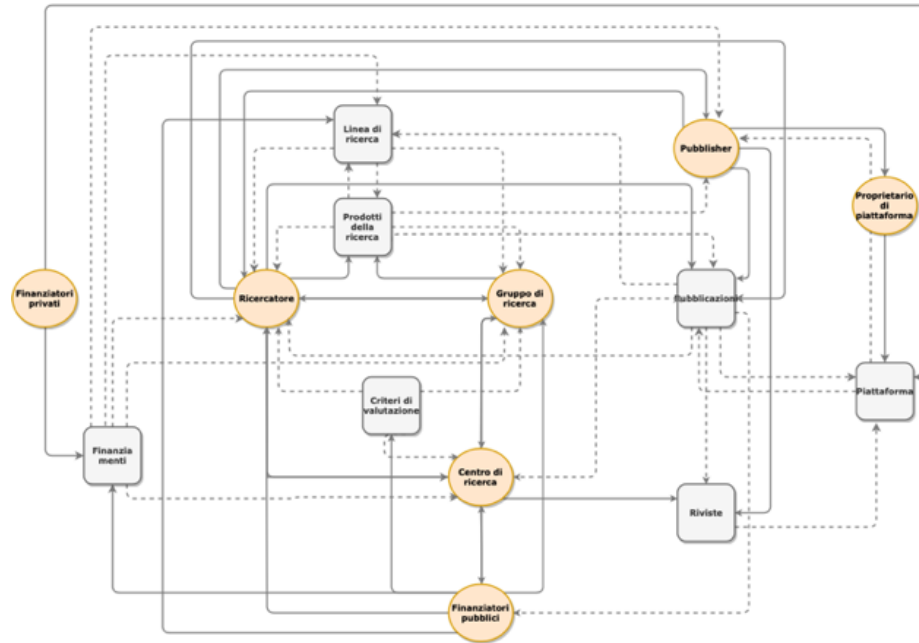


Fig. 1. Preliminary graph of causal dependencies of a research system.

This description has highlighted what is already well-known, meaning that the object is sufficiently complex, even when observed in a general manner, due to the multiple feedback phenomena involving the relevant entities.

Because of this, it has been considered appropriate to develop a static description of the object, through the identification of entities and their relations.

The identified tool to describe statically the object of study is the ontology, a formal representation of the domain of interest obtained through the fulfilment of a taxonomy of the entities at different aggregation levels. This formal description can be realised by dividing all domain entities into different classes, and each one of these into subclasses. At a formal level, an ontology can be built by writing a series of elements – called “triple” – which connect two entities, classes or subclasses through specific connections.

There are four main reasons to use this instrument. First, an ontology is a structured way to connect words and meanings, enabling domain experts to use the same

terminology to refer to the same entities [Guarino, 1995]. In this sense, we are dealing with a well-founded tool for elicitation of knowledge and communication, which would help identify biases and increase the probability of comprehension [O’Leary 1998]. Secondly, identifying the system’s entities, with their classes and relationships subsisting among them, is a method to define the study perimeter by declaring explicitly which ones are relevant for the project’s purpose. Thirdly, one can use an ontology to overcome the traditional representation of VQR thanks to a less conditioned one than the common practice of evaluation. Fourth, an ontology can be used as a foundation to develop a dynamic model, which could manipulate the entities and their properties that are part of the studied phenomenon given a temporal evolution [Mendonça et al. 2020].

4 Preliminary results

An ontology is, thus, an instrument that delivers a shared representation of the Italian research system [Sure et al., 2005], on which basis a model can be built enabling the comprehension of the possible critical areas in the procedure of assessing the scientific output of Italian academics, and the identification of possible development areas [Bai et al., 2014]. The literature analysis offers various examples of ontology-based applications that deal with research system [Aminah et al., 2017; Lezcano et al., 2012; Grace & Gartner 2010].

Since 2003, the Cornell University Library has developed an ontology called VIVO¹ that describes entities and relations among these entities within the American research system [Börner et al., 2012]. Currently, this tool is very broad and rich in information, including also elements that are not of interest for the specific objective of our research (such as the emeritus system, which in Italy has only an honorary scope). The process focused, thus, on reducing the dimensions taken into account by VIVO, in such way to obtain a more suitable result, without any unessential elements and tailored for the domain of interest of our project, the Italian research system (see Fig.2).

¹ See: <https://duraspace.org/vivo/> for the official documentation of the project and the latest version of the ontology.

See the official page of VIVO as a project complying with the W3C standard project: <https://www.w3.org/community/vivo/>

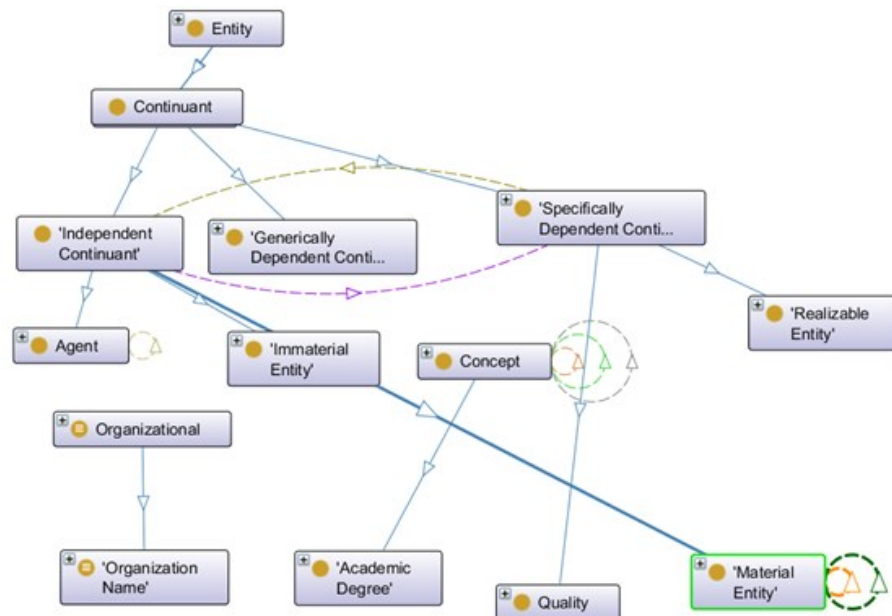


Fig. 2. Excerpt of the VIVO ontology, with a hierarchical view of some classes and subclasses.

All classes shown in VIVO ontology were reviewed and compared with the essential elements of the Italian system, extending the ontology when elements were missing and connecting them to already existing classes where possible, defining translation labels in Italian for all entities leading to the project, and so on.

The review process of the ontology was conducted following the already validated methods in the literature, for example, OntoClean [Guarino and Welty, 2004].

The ontology was subsequently applied to the framework of interviews with academics in order to point out the effects of research evaluation both at the individual and the organisational level.

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