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Research Information Management in Italy

The IRIS Platformised Infrastructure as a Sociotechnical Device

Leonardo Piromalli

ABSTRACT: *In an era of data deluge, the aggregation, curation, and utilisation of (meta) data about research is increasingly mediated by digital Research Information Management Systems (RIMSs). The aim of the contribution is to describe the effects of IRIS on the sphere of academia and explore the 'invisible work' it does through technical and social means on the fields of research and management. IRIS is examined as a platformised infrastructure and a sociotechnical device. On the one hand, IRIS exerts its technical agency by intra- and inter-connecting HE institutions, infrastructures and platforms through its internal and external interoperability capabilities. A digital ecological space of academia thus emerges – a space of standardisation which holds together the fields of research and its management. On the other, IRIS socially acts by conveying and naturalising ideas about what researchers and research should look like. Such ideas translate New Public Management logics of entrepreneurialisation and commensurative measurement. Thus, RIMSs cannot be considered as neutral and extra-social tools, as they orient practices and shape social arrangements. Methodologically, an 'infrastructure inversion' has been carried out through trace and digital ethnography, documentary analysis, interviews.*

KEYWORDS: *CRIS, Infrastructures, Platforms, Higher education, Italy*

1. The digitalisation of scientific research and the emergence of Resource Information Management

Digital technologies are increasingly relevant in scientific research. For several decades now, the internet has been mediating the work of scientists, often al-

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lowing it to overcome local boundaries. (Meta)data[1] are deluging and becoming crucial tokens, on the boundary between heterogeneous communities of practitioners and settings: they are a key resource for e-Sciences, i.e. computationally-intensive sciences that draw on big data, and for scholars using them to research; they are analysed and mashed-up by policy makers for evidence-based decision and forecasting (Kitchin, 2014); they are examined for assessing, evaluating and funding; they produce organisational rearrangements that are giving rise to new professional forms (e.g., data management, data governance, data stewardship). Data is thus gaining increasing political and economic relevance. As stated in 2011 by Neelie Kroes, former Vice-President of the European Commission for the Digital Agenda, «data is the new gold […] just as oil was likened to black gold, data takes on new importance and value in the digital age» (European Commission Press Corner, 2011).

Research Information Management has thus emerged as the aggregation, curation, and utilisation of metadata about research activities (Bryant *et al.*, 2017: 6). This practice is growingly mediated by Research Information Management Systems (RIMSs[2]), i.e. digital infrastructures/platforms to store, manage and disseminate metadata on research carried out at one or more institutions (Jörg, 2014; Leiva-Mederos, Senso, Hidalgo-Delgado and Hipola, 2017; STOA, 2014). On a technical level, RIMSs usually consist of a data model describing the field of Research & Development and a (ecosystem of) infrastructure (s)/platform (s) to manage the data.

The RIMS vision was already present in a 1971 UNESCO study. However, the first RIMSs were set up in the 1990s as administrative accountability tools for reporting research performances to governments. RIMSs are today widespread on a global scale as «multifunctional information systems of use also for research management as well as for the profiling or showcasing of research, both on an individual (researcher) and institutional level» (Clements, de Castro and Bryant, 2019: 11). RIMSs can contribute to the openness and FAIRness of research (Mornati, Bollini and Pascarelli, 2018), combine the local with the global (Bryant *et al.*, 2017), are inscribed with affordances for different types of users – policy makers, funders, entrepreneurs, researchers, media, citizens – and use

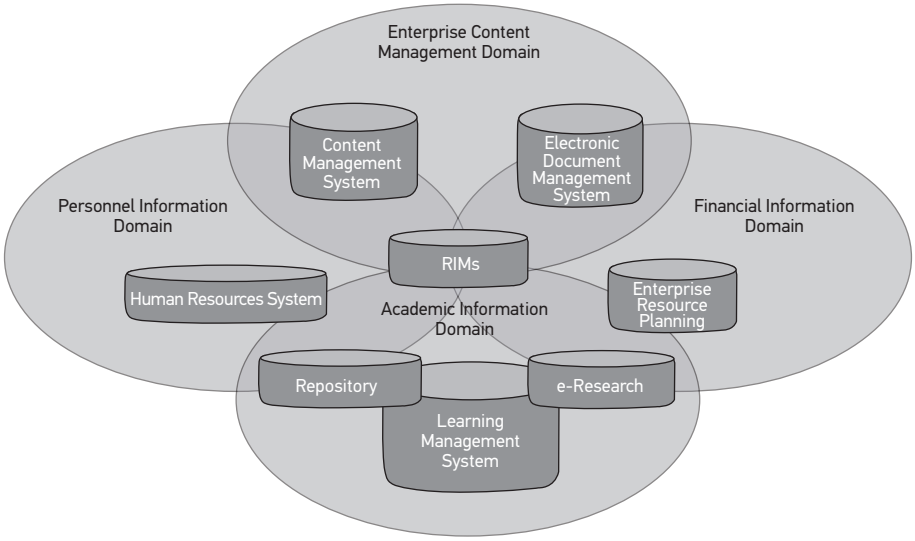
[1] Metadata can be broadly considered as data about data (Kitchin, 2014).

[2] RIMs are also known as CRIS (Current Research Information Systems) and RIS (Research Information Systems).

cases: «developing programs, allocating funding, assessing projects, executing projects, generating results, assessing results or transferring technology» (STOA, 2014: 31). On an institutional level, RIMSs are used as tools for decision-making and output-based evaluation, as well as logs for research in progress and instruments to assist project planning (STOA, 2014); at the individual level, they are employed for identifying opportunities for research funding, avoiding duplication of research, finding references to full-text publication, identifying new networks and markets, exhibiting one's own research (*ibidem*). RIMs can also «tell a story about major research issues […], and also support reputation management for institutions and its researchers» (Bryant *et al.*, 2017: 6). The importance attributed to such functions is heterogeneous among locales (Clements *et al.*, 2019).

Some contributions put RIMs in the middle of knowledge management and production practices within a model that proposes «a simplification of the overall setting of information supply and management of academic institutions» (Razum, Simons and Horstmann, 2007: 3; Baars, Dijk, Hogenaar and Meel, 2008; Vernooy-Gerritsen, 2009). Such model allows to distinguish between the

FIG. 1. *The information supply and management of academic institutions*



Source: Vernooy-Gerritsen (2009).

information elements that are mostly related to the academic information processes, and those more related to administration. In the version proposed by Vernooy-Gerritsten (2009), it consists of four 'domains' (Fig. 1): Personnel Information Domain, with Human Research System/LDAP directory service for managing employees; Financial Information Domain, with Enterprise Resource Planning systems; Academic Information Domain, with Current Research Information Systems, Open Access Repositories, Learning Management Systems, e-Research resources (i.e., datasets, etc.); Enterprise Content Management Domain, with Content Management Systems and Electronic Document Management System.

In this paper, RIMSs will be addressed as heterogeneous sociotechnical assemblages. In particular, the most widespread RIMS in Italy will be observed in order to explore its effects on the Italian higher education (HE) arena. In the second paragraph, literature on standards, infrastructures and platforms will be introduced. The objectives and methods of the work will be presented thereafter. In the fourth paragraph, the IRIS RIMS will be explored, while in the fifth some final conclusions will be drawn.

2. Standards, infrastructures, platforms

Standards, infrastructures and platforms are investigated by scholars as crucial social and material components of all aspects of everyday life. Such notions have been tackled through different theoretical sensitivities, such as information studies (Carter, 2016), computer-supported cooperative work (Monteiro, Pollock, Hanseth and Williams, 2013), media studies (Plantin, Lagoze, Edwards and Sandvig, 2018; van Dijck, Poell and De Waal, 2018), geography (Graham and Marvin, 2001; Graham, 2014), education (Jones, 2015; Lawn, 2011), Science and Technology Studies (Star, 1999; Mongili and Pellegrino, 2014; Landri, 2018).

In a Science and Technology Studies (STS) perspective, *standards* can be broadly considered as agreed-upon rules «to establish uniformities across time and space, achieving coordination and control of activities at a distance […] by which to order and perform realities» (Landri, 2018: 8; see also Busch, 2011). Standards are entwined as barely tangible threads in the fabric of everyday lives.

Susan Leigh Star and Martha Lampard depicted standards as «forms of compression and representations of actions» (Star and Lampland, 2009: 4) and described some of their dimensions: *i*) they are nested inside one another; *ii*) they are distributed unevenly across the sociocultural landscape; *iii*) they are relative to communities of practice; *iv*) they are increasingly linked to and integrated with one another across many organisations, nations and technical systems; *v*) they codify, embody or prescribe ethics and values (*ibidem*: 5). Moral choices are embedded and concealed in the production of standards and classifications which can cause social and cultural effects (Bowker and Star, 1999) and exercise political power (Lawn and Grek, 2012).

Also, standards are embedded in *infrastructures*. In an ecological perspective, an infrastructure is a «pervasive enabling resources in network form […] that allow knotted work to be executed» (Bowker, Baker, Millerand and Ribes, 2010: 98) – a «thoroughly heterogeneous and interpenetrating 'assemblage' of technological objects, standards, values, administrative procedures, and organizational work» (Williamson, 2018: 5). STS scholars identified some dimensions that can be found in (information) infrastructures. First, they emerge in relation to situated practices – «analytically, infrastructure appears only as a relational property, not as a thing stripped of use» (Star and Ruhleder, 1996: 113). They are thus embedded in other sociotechnical arrangements, imbricated in the conventions of communities of practice and built on installed bases. Infrastructures are taught on situated learning paths, and invisibly support tasks at hand. Another dimension of infrastructures is that of connectedness or scaling. Finally, and most importantly, infrastructures are invisible: they are a hidden middle-layer that enables the movement of other things (Star and Ruhleder, 1996; Karasti and Blomberg, 2018).

The notion of *platform* is in some respects close to that of infrastructure. Scholars introduced the concept of 'platform society' to stress the inextricable relationship between online platforms and social processes (van Dijck *et al.*, 2018). In such framework (*ibidem*; van Dijck, 2013), platforms are conceived as programmable digital architectures designed to order interaction among users and aimed at the systematic collection, algorithmic processing, circulation, and monetisation of user data. Platforms – which rely on powerful mechanisms as datafication, commodification and selection – now operate in disparate fields, such as tourism, news, health, mobility, administration, and education. How-

TAB. 1. *Summary of infrastructure and platform properties*

	INFRASTRUCTURE	PLATFORM
Architecture	Heterogeneous systems and networks connected via sociotechnical gateways	Programmable, stable core system: modular, variable complementary components
Relation between components	Interoperability through standards	Programmability within affordances, APIs
Market structure	Administratively regulated in public interest: sometimes private or public monopoly	Private, competitive, sometimes regulated via antitrust and intellectual property
Focal interest	Public value; essential services	Private profit, user benefits
Standardization	Negotiated or *de facto*	Unilaterally imposed by platforms
Temporality	Long-term sustainability, reliability	Frequent updating for competitive environment
Scale	Large to very large; ubiquitous, widely accessible	Small to very large: may grow to become ubiquitous
Funding	Government, subscription. lifeline services for indigent customers, pay-per-use (e.g. tickets)	Platform purchase (device), subscription (online), pay-per-use (e.g. TV shows), advertising
Agency of users	'Opt out', for example, going off the grid	'Opt in', for example, choosing one platform instead of another: creating mashups

Source: Plantin et al., 2018: 299. API: application programming interface.

ever, they cannot be considered as mere technical or economic phenomena, as they are inscribed with hidden cultures and normative values (Gillespie, Boczkowski and Foot, 2014), and they do work on the social world. Digital platforms thus emerge as both technical architectures, political stages and arrays of relationships that constantly need to be performed (van Dijck, 2013). They are sociotechnical devices possessing agency and shaping everyday life (Williamson, 2017; Decuypere, 2018).

In media studies, an attempt was made by Jean-Christophe Plantin and colleagues to cross-articulate the infrastructure and platform perspectives (Plantin *et al.*, 2018). Some common properties were thus identified (Tab. 1): they are behind-the-scenes structures that support more visible entities; they are extensible; they can reach a large scale; they are embedded in the social world. According to the authors, the different theoretical origins of infrastructure and platform perspectives – respectively, STS and media studies – partially concealed the relationships between them.

The authors thus discuss a double movement of '*infrastructuralization of platforms*' and '*platformization of infrastructures*' (*ibidem*; see also Plantin and

Punathambekar, 2019). Infrastructures become digital platforms when they move away from the «modern infrastructural ideal» (Graham and Marvin, 2001) of universal service towards competitive and profit-motivated logics. At the same time, platforms become infrastructural as they grow in scale and become crucial in the everyday life of their users.

3. Purposes and methods: Observing the IRIS RIMS as a sociotechnical device

IRIS by CINECA[3] is today the most widespread Resource Information Management System in Italy. The aim of the contribution is to describe its effects on the sphere of Italian academia and explore the 'invisible work' that it does through technical and social means on the fields of research and management[4]. Different operations have thus been accomplished. First, an attempt has been made to trail its policy and practice traces back in the Italian arena (par. 4.1). As a second step, an effort has been carried out to 'materialise' IRIS by outlining its sociomaterial components and describing their work (par. 4.2). Lastly, the technical and social agencies of IRIS have been explored through digital ethnographic observation on two empirical fields: the interoperabilities capabilities of IRIS/CERIF, and the 'public' as well as 'private' spaces of IRIS (par. 4.3).

A *sociomaterial approach* has been adopted in order to examine IRIS as a sociotechnical device, i.e. as an active device exerting agency by performing operations and enacting ideas (Decuypere, 2018). Using such an approach means recognising that the artefacts that populate the world are not mere extra-social supports for human action. Rather, they are non-neutral and restless 'assemblages' of heterogeneous entities that carry discourses and do work on the world (Muniesa, Millo and Callon, 2007; Ferrante, 2017). A double focus of observation has thus been adopted for investigating the IRIS assemblage: on *technicality*, for exploring how IRIS exerts agency by regulating – delineating or limiting

[3] Webpage on CINECA website: https://www.cineca.it/en/content/iris-institutional-research-information-system (last access: December 2019).

[4] The field of investigation has thus been limited to the social construction of the IRIS infrastructure; its use by its users has not been analysed. It has been in fact considered that the infrastructure's agency and the users' agency are deeply intertwined, and the former should be examined before observing the latter.

– through technical means the affordances of users, and on *sociality*, for unravelling the social effects enacted in and through IRIS (Decuypere, 2016; 2018; Williamson, 2016). Technicalities and socialities will be distinguished here for analytical purposes only, as they are deeply entangled in real-world practices and continuously co-constitute each other within and throughout sociomaterial assemblages (Orlikowski and Scott, 2008).

Methodologically, an «infrastructure inversion» has been carried out to make visible and dis/entangle the standards, platforms and infrastructures in the background of the IRIS device (Bowker and Star, 1999). Different techniques have been used to trace down the practices, relationships, choices and agendas inscribed in such technology: trace ethnography (Geiger and Ribes, 2011) of the CERIF data model code, digital ethnography (Pink, Horst, Postill, Hjorth and Lewis, 2015), documentary analysis on grey literature and offline webpages, semi-structured interviews with three IRIS/CERIF developers.

4. The in/visible work of the IRIS Resource Information Management System

An exploration of the technical and social aspects of the IRIS RIMS has been thus carried out in order to describe its effects on the arena of Italian higher education. A brief history of RIMSs policy and practice in Italy will be traced. IRIS will be then 'materialised'. An observation of its technicality and sociality will follow.

4.1. *Resource Information Management Systems in Italy: The role of CINECA*

The first policy traces related to RIMSs in Italy date back to 2009. In such year, the Conference of Rectors of Italian Universities (CRUI), which acts as an advisory body for the Italian Minister of Education, University and Research (MIUR), published its recommendation about open access and the evaluation of scientific research products (CRUI, 2009; see also Galimberti, 2010). Three years later, the CRUI addressed again the RIMSs issue with its guidelines about the creation and management of metadata in institutional repositories (CRUI,

2012). However, RIMSs as a practice had already reached the Italian HE since some years. In 2004 the CILEA inter-university consortium had started the planning and implementation of the SURplus RIMS, and CINECA had begun the development of the U-GOV Research RIMS in 2005.

CINECA (Consorzio Interuniversitario per il Calcolo Automatico dell'Italia Nord Orientale[5]) has probably been the main developer of RIMSs in Italian HE, and one of the main actors in its overall informatisation. It was founded in 1967 by the Rectors of the Universities of Bologna, Padua, Florence and Venice. In 1969, CINECA hosted the first supercomputer available in Italy. In the 1980s it became an important node for national and international academic networks – such as the GARR, the data transmission network for Italian scientific research, and the EARN-BITNET, which connects more than 500 sites in 15 European and North American countries. The MIUR became part of the CINECA consortium in 2007. In 2012, the inter-university consortiums CASPUR, CILEA and CINECA were merged into a single entity called CINECA. In 2013, CINECA could count on 72 members – 69 universities and 3 research institutions.

CINECA has been developing software for the MIUR since the late nineties: an e-voting system for university staff recruitment (1999), a Student Management System (ESSE3, 2001), the U-GOV RIMS (U-GOV, 2004), a digital Student Registry Office (Anagrafe degli Studenti, 2004), a personal website for Italian researchers for managing their careers (LoginMIUR/Sito Docente, 2007). Around 2007, some universities asked CINECA to start organising the scientific production in a catalogue connected to the university management environment. This product was developed within U-GOV. In 2013 CINECA decided to split the functionalities of the RIMS from U-GOV, which was thus assigned to the management domains. All the universities using U-GOV thus had to migrate their data to the new IRIS infrastructure, sometimes with major issues in cleaning input data and controlling outputs. IRIS was therefore released as an Institutional Research Information System (Colarusso, 2017). As of 18/04/2018, IRIS was used by 70 Italian HEIs (Higher University Institutions), including 62 of the 91 Italian universities.

[5] Interuniversity Consortium for the Automatic Calculation of North-Eastern Italy.

4.2. *IRIS, materially speaking*

IRIS acts through diverse material components. Among them, three are crucial: *i*) a data model (IRIS/CERIF[6]), *ii*) a set of tools to manage the data, *iii*) a user interface. The IRIS/CERIF data model is at least three different things: *i*) an abstract conceptualisation that describes/prescribes which entities exist in the domain of research and how they relate; *ii*) a concrete formalisation of such conceptualisation through database 'layouts' containing instruction on how data should be structured and interrelated in databases; *iii*) a translation device allowing interchange among inhomogeneous data formats. Also, IRIS' functions are distributed across various modules: Institutional Repository/Open Archive, Evaluation & Review, Resource Management, Expertise & Skills, Activities & Projects, etc. (Fig. 2).

The IRIS data model can be considered as an enactment of the CERIF data model, which is a European recommendation (European Commission, 1991). The original CERIF data model was developed as a standard format with the purpose of helping sociotechnical arrangements (software, organisations, practices, etc.) to achieve better interoperability, i.e. to 'work together' better on syntactical and semantical levels to achieve a common goal (Ide and Pustejovsky, 2010). While external interoperability refers in this case to interoperation between an HEi and other external infrastructures, internal interoperability concerns interoperation across an HEIs infrastructural domains.

IRIS thus emerges as neither a pure infrastructure nor a platform (Plantin *et al.*, 2018) (Tab. 1). Some of its properties are typically infrastructural: the interoperability it provides through the CERIF standard, for instance, as well as the kind of agency that users can exert – as will be shown shortly, they can only 'opt out' from IRIS, since no alternative exists. Some features are characteristic of platforms, e.g. the modular architecture and the extensible scale. Other properties place IRIS on the boundary between infrastructure and platform. This is the case, for example, of the market structure of CINECA, as well as its focal interest: on the one hand, it is formally regulated in the public interest as a sort of private monopoly; on the other, it had legal issues for having sold for-profit services to private individuals external to the consortium[7]. For such reasons, IRIS might be understood as a plat-

[6] The designation 'IRIS/CERIF' will be used in the paper for more clearly distinguishing the IRIS data model from the broader IRIS assemblage.

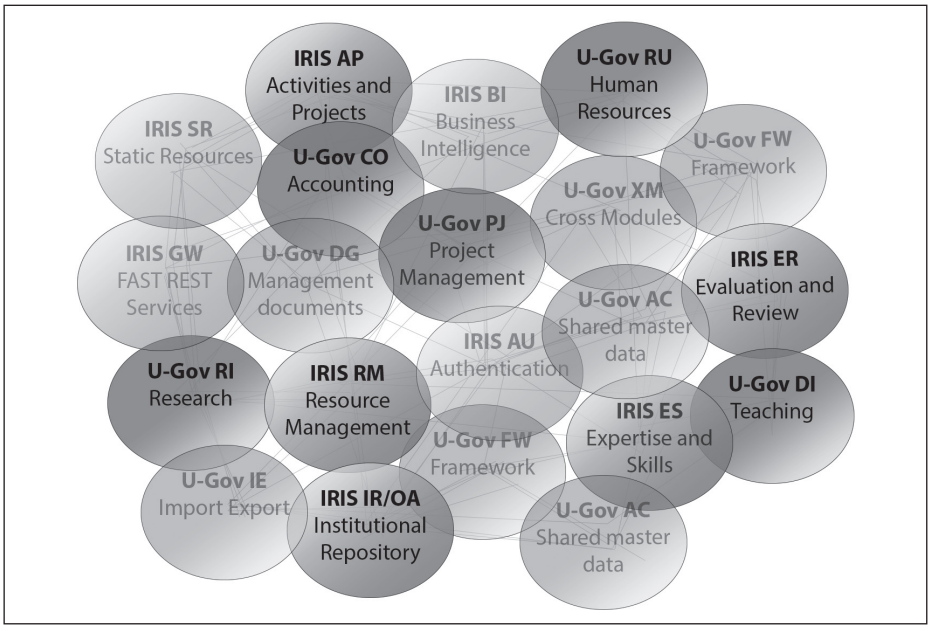
[7] See https://www.agcm.it/dotcmsDOC/bollettini/23-17.pdf (last access: December 2019).

formised infrastructure (*ibidem*): although it retains many infrastructural features, it is nevertheless arguably heading towards an entrepreneurial path.

4.3. *IRIS and its technicality: IRIS/CERIF and the interoperabilities*

As mentioned, the IRIS/CERIF data model affords external and internal interoperability capacities. With respect to *external interoperability*, the IRIS/CERIF translation layer enables IRIS to both send and accept data. On the one hand, IRIS can deliver data to external CERIF-compatible infrastructures/platforms, such as the MIUR (to whose database the research products uploaded on IRIS are sent), metadata harvesting systems (e.g., DART Europe for PhD theses) and repositories (e.g., OpenAIRE for open access European papers). On the other, as we will see shortly, IRIS/CERIF can receive data on publications from bibliometrics databases.

FIG. 2. *A loose representation of the IRIS/U-GOV ecology*



Source: Elaboration by the author.

Also, IRIS/CERIF is endowed with *internal interoperability* capabilities. The IRIS modules, which deal with research entities and their relationships, can thereby interoperate and intertwine with the U-GOV ones, which handle managerial aspects: Human Resources, Document Management, Planning and Control, etc. (Fig. 2). These infrastructures are deeply enmeshed.

Internal interoperability happens when data is seamlessly interchanged among infrastructures – i.e., from an ecological perspective, practices, organisations, people, technologies, etc. – within the same HEi. A fluid ecology is thereby set in motion and kept alive:

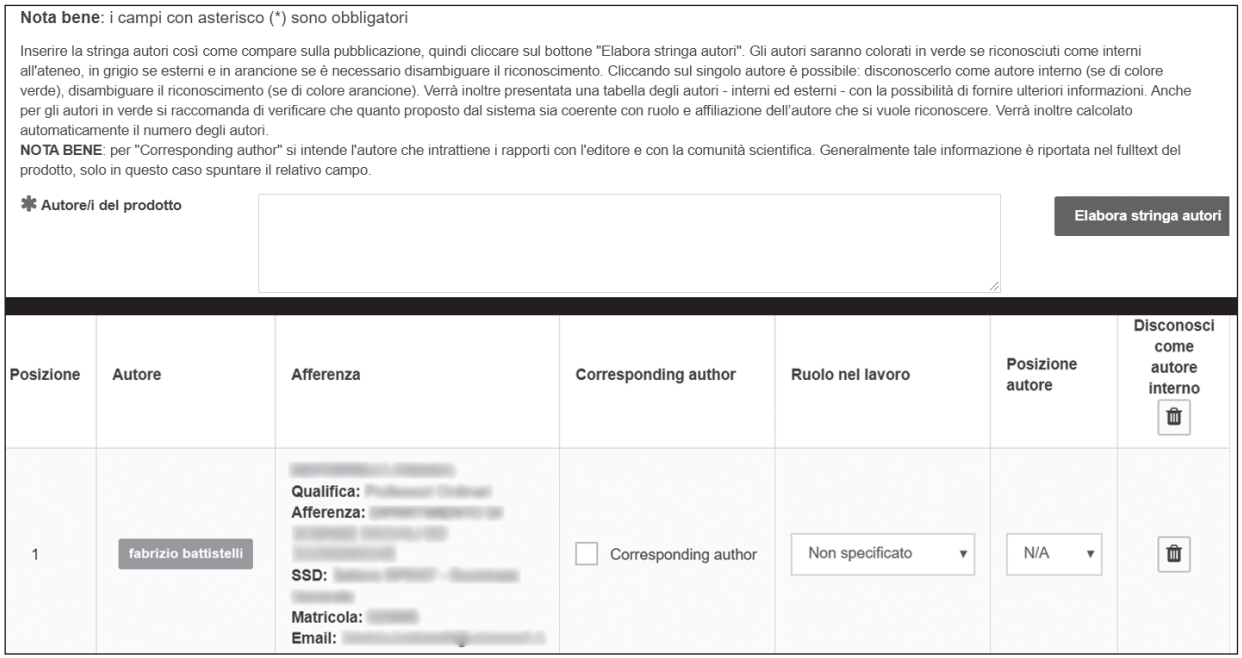
> It is a reticular model. Theoretically, I could enter from 'Project activities' and end up looking at the scientific profiles of the researchers participating in these activities. Or I could start from the publications, and find out who the connected researchers are, and in which departments they work. (IRIS Developer)

This is the case, for example, of the upload procedure for new research products on the IRIS Institutional Repository catalogue. The upload procedure unfolds through various steps. In the first three steps, users have to 'describe' their research product. Then, they have to 'upload' it, 'check' it, 'license' it and, lastly, 'finalise' the procedure. The author/s of the research product have to be specified during the third step. To do so, users have to input an 'authors string' as it appears on the research product (e.g., with APA or MLA citational style) and click 'Elabora stringa autori [Process authors string]' (Fig. 3). A box with the career of the authors corresponding to this string is then returned as output by IRIS. If duplicates are found, users will have to disambiguate them by selecting the correct authors.

This blackboxed processing activity results from the intertwining of at least two infrastructures: the IRIS infrastructure, where the user-driven research products upload procedure takes place, and the U-GOV infrastructure, where data on the careers of the personnel is stored. When users click the 'Elabora stringa autori [Process authors string]' button, such entangled infrastructures interact through the internal interoperability that the IRIS/CERIF data model affords.

Hence, complex effects are produced when IRIS/CERIF enacts its interoperabilities thus exerting its technical agency. External interoperability, on the one hand, allows the local sphere of CERIF-compatible HEis to connect with

FIG. 3. *The research product upload procedure in IRIS: the 'authors string', before (upper figure) and after (lower figure) its processing*



Source: Screenshot by the author on http://iris.uniroma1.it (last access to the webpage: November 2019).

global scales of research practice and management; such interlockings enables the ongoing fabrication of a transnational digital ecological space of academic research and management. Internal interoperability, on the other, maps out a web of viable roads among the different spheres, domains, practices, infrastructures, platforms that were previously loosely coupled within the HEi – it holds them together and stabilizes them in a unified texture.

4.4. *IRIS and its sociality: Public spaces, private spaces and evaluation*

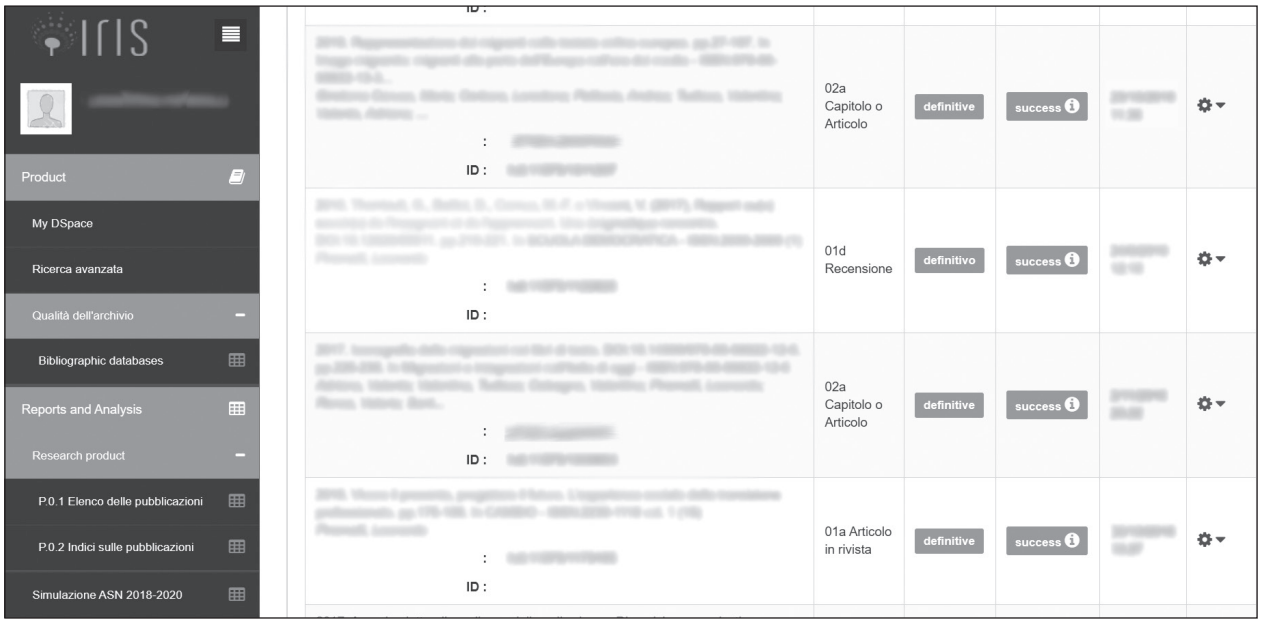
At least two forms can be distinguished in the digital spaces that IRIS enact for its users. Each of these spaces has affordances, constraints, atmospheres, and each of them performs particular visions of what and how research should be done and managed.

Users provided with an account (e.g. researchers, managers, operators, etc.) can log in a *'private' space* – a sort of backstage (Fig. 4). This arena is dominated by inscriptions related to the sphere of research evaluation. Once logged in, researchers access to a sort of management panel for their research output. They can manage their products, create links among products they uploaded on the institutional catalogue of IRIS and global bibliometric databases, access to analytics and search functions.

This is also where users can launch the procedure for uploading research products. This procedure is often strongly endorsed for accountability purposes. It is also necessary for receiving formal validation[8] of one own's scientific production from ANVUR (the Italian National Agency for the Evaluation of the University and Research Systems) and thus participating in calls issued by the MIUR. Academics employed in HEis which use IRIS as RIMS have no way to carry out this procedure outside of IRIS. Thus, IRIS has become an obligatory passage point for working as an academic in the vast majority of Italian higher education institutions – be they promoted by state or non-state, public or private. The evaluation issue, which is a state competence, is thereby delegated to IRIS, through which it is a performed as an everyday academic practice.

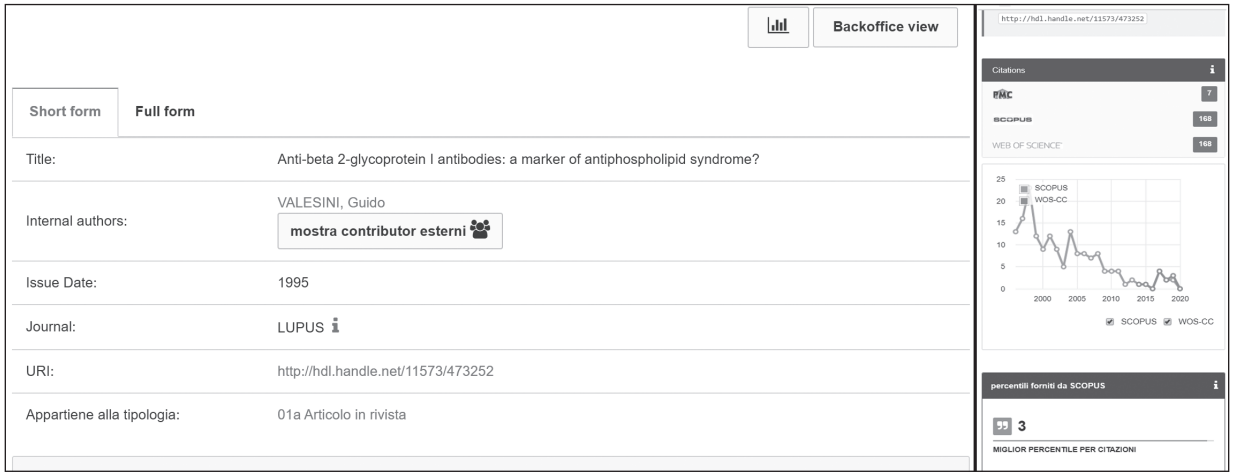
[8] Once uploaded, research products are sent to MIUR's LoginMIUR infrastructure through IRIS/CERIF external interoperability for validation.

FIG. 4. *The IRIS (platformised) infrastructure: the private space*



Source: Screenshot by the author on http://iris.uniroma1.it (last access to the webpage: November 2019).

FIG. 5. *The IRIS (platformised) infrastructure: a random example of public space*



Source: Screenshot by the author on https://iris.uniroma1.it/handle/11573/473252#.XePY_uhKiUl (last access to the webpage: November 2019).

IRIS also enacts a *public space* that every user can access, whether logged or not. In such space, research work is staged as an output (Fig. 5). On the left side of the screen, the metadata of the research is described. On the right side, its performance is measured on global bibliometric databases such as PubMed Central, Scopus, Web of Science. A snapshot of the citation count for that product is followed by a visualization of its performance over time through line charts. This bibliometrics is meant to support human resources and overall IRIS governance in decision-making (Bollini, Mennielli, Mornati and Palmer, 2016: 740).

A discursive and visual nexus is thus constructed which ties the research products of Italian universities with transnational infrastructures fabricating bibliometrics standards and rankings. This is not a neutral operation, as is conveys and naturalise ideas about what scientific research should be and do: research should be available on these infrastructures – hence, on transnational scales of visibility; and 'research impact' measurement operations are a proper register of value for the evaluation of quality in scientific research, on a synchronic and diachronic level, fitting all sizes (Espeland and Sauder, 2016).

5. Final remarks

The purpose of this work was to explore the effects of IRIS, the most widespread Resource Information Management System in Italian universities, on the Italian higher education arena. Drawing on STS literature, IRIS was framed as a sociotechnical device (Decuypere, 2018) and a (platformised) infrastructure (Plantin *et al.*, 2018). First, its history and its main sociomaterial components were traced, i.e. its data model, which is an enactment of the CERIF standard, and its modular arrangement. Then, its sociotechnical effects were explored focusing on two empirical fields: the interoperabilities afforded by IRIS/CERIF, and the 'public' and 'private' spaces enacted by IRIS.

The attempt to follow the IRIS sociotechnical object allowed three actors to emerge on the scene: IRIS itself, as a RIMS and a complex digital assemblage; IRIS/CERIF, i.e. the data model embedded in IRIS; and a digital space of research and management, continuously fabricated as an effect of the CERIF interoperability. Their stories are enmeshed. IRIS, when observed through a

sociotechnical approach, appears as an intricate artefact that exerts effects on two different yet intertwined levels: on the technical level, it 'acts' by outlining courses of action for its users; on the social level, it 'makes its users act' by conveying ideas and performing realities (Decuypere, 2018: 3).

In particular, on the one hand, IRIS/CERIF *technically acts* through its interoperability capabilities by building bridges and junctions among heterogeneous spaces, practices and organisational textures: internal interoperability allows HEis to 'hold together' their domains, while external interoperability let them communicate with nodes in global HE spaces using the same language. IRIS/CERIF takes thereby part in the fabrication of a digital ecological space of academia: a space of infrastructures, platforms and standards that are nested together, entangled with each other, more or less visible. This is a space of standardisation that holds together the fields of research and its management.

On the other hand, this space is not neutral and extra-social. In its situated enactments – the diverse infrastructures and platforms that implement (i.e., translate) CERIF – normative visions on research and management are made operative. The IRIS RIMS, in particular, *socially acts* by performing ideas about what researchers and research should look like. It appears as a private (platformised) infrastructure acting as a mediator for the (public) evaluation processes and an obligatory passage point for working as an academic in most HEis in Italy. In accomplishing that, IRIS translates New Public Management logics (Ball and Youdell, 2007; Gunter, Grimaldi, Hall and Serpieri, 2016; Normand and Villani, 2019) – entrepreneurialisation, transnationalisation, accountability and commensurative measurement (Espeland and Stevens, 2008) of research output.

Thus, RIMSs cannot be understood as passive tools that merely complement or augment practices. As shown in the case of IRIS, they do invisible work on the world. They are inscribed with values and endowed with normative powers: they can promote ideas, orient practices and shape social arrangements in diverse fields.

Further research could provide additional qualitative as well as quantitative data, and fill the limitations of this study. It is the case, for instance, of the subjective experience of RIMSs users, who may comply with such technology as well as resist and subvert, through passive and/or creative practices (Souto-Otero and Beneito-Montagut, 2016). Also, research could be set on the vulnera-

bilities and injustices that could be concealed on the IRIS/CERIF data model and in the translation processes – its classifications and categories may exclude knowledges and social actors (Bowker and Star, 1999; Espeland and Sauder, 2016). Lastly, the theme of resource information management may be connected to wider topics related to data in contemporary societies: its use by the local and global institutions involved, the datification of their users' daily life, the issue of open access and democratic access to academic knowledge.

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