Submitted on: 08.09.2019

IFLA CPDWL Satellite meeting:
Librarians and information professionals as (pro)motors of change:
immersing, including and initiating digital transformation for smart societies
Date: 20 – 21 August 2019
Location: National and University Library in Zagreb, Croatia

Islands and bridges: academic librarians towards Open Innovation and the Internet of Things

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Abstract:

"Innovation" is a universal human value. In this digital age, we can confuse it with the concept of "technology" and forget that real change is not the technological device, but the use we make of it. Libraries have always been places of innovation and education, and academic librarians made an enormous contribution to the development of electronic technology. Today, however, the border between innovation and human needs has become more fragile. In this context, academic librarians must adapt again to a generation of people accustomed to moving without filters. Moving in a smart environment means shifting attention from the object to the connection between objects. Therefore, we will think of the library as a set of relationships.
In this article, after a presentation of the University of Genoa (paragraph 1), we will talk about Open Innovation and IoT (paragraphs 2-3) and we will try to analyze the specific role of academic libraries in innovative processes, starting from the concept of "relationship" as an exchange prompter (paragraphs 4-5). Finally, we will draw two examples of relationship bridges built on Open Innovation topics at the libraries of the University of Genoa:
• Future library
• OpenScience@unige.it

Keywords: Open Innovation, Internet of Thing, Open Access, Open Science.

1. Unige at a glance: an archipelago of islands

The University of Genoa is the only public university in "Liguria", a small region in Italian north-western district of which Genoa (583.000 inhabitants) is the capital. Genoa is one of the most ancient cities in Italy, with a

medieval old town which is one of the largest in Europe; a beautiful city but also with urban difficulties about mobility and social disease.
The University of Genoa is usually classified as a medium-large university: more than 30,000 students, doctoral students and post-graduate students enrolled in degree programs in 6 cities; more than 1,200 professors work in 22 Departments; Unige researchers are active in almost all scientific areas, with active national and international research projects; over 1,200 staff carry out all administrative, linguistic, technical and logistical support activities. The University Library System is composed of 24 libraries and about 100 librarians.
Organisation and the various components of the University of Genoa are similar to those of all large universities; however, what makes Genoa an interesting case is *its relational complexity*.

To describe Unige at a glance, indeed, we can say that it is an **archipelago of islands**: islands-area, islands-people, islands-skill. We will analyze them briefly, seeing that islands of the Unige archipelago have difficulty getting in touch with each other; then we go on to clarify how librarians can act as a "bridge" between these different natures and how libraries are promoters of new relationships and educational growth in the themes of Open Innovation and IoT, Research 2.0 and Open Science.

Islands-area (the physical dislocation). Genoa University has got campuses in the four main Ligurian cities: Genoa, Imperia, Savona and La Spezia. Even if these cities are not far from each other, the chronic lack of rail, motorway connections and urban mobility make it difficult to move from one Ligurian Riviera to another and so the 4 academic campuses are like islands separated each other by a really big ocean.
Even in Genoa itself, the 5 Faculty and 22 Departments of the University, located in different areas of the city, are very different from each other and it is often not so easy to move from one to the other. In August 2018 there was a tragic event in Genoa, where 43 people lost their lives: the collapse of the Ponte Morandi, a motorway bridge (more than 1 km long and 90 m high), which connected east and west of the city and the region (The Guardian, 26 feb. 2019). The collapse of the bridge exacerbated this difficult reality.

Figure 1: islands-area

Islands-people (the diversity of aims**).** The University of Genoa tries to overcome the territorial difficulties to develop knowledge and social well-being. To do so, as all Italian Universities, its activity is divided into three macro-areas - learning, scientific research, the third mission (ANVUR, 2013 ; Cassella, 2017) – and for this reason the Unige community is made up by students, researchers, and staff.
The students and the scientific researchers have not always common goals (Figures 2, data 2018).
On the other hand, the Genoa University staff, that carry out all administrative, linguistic, technical, logistical and librarian support activities, has different workflows and languages.
These aspects can also be considered islands.

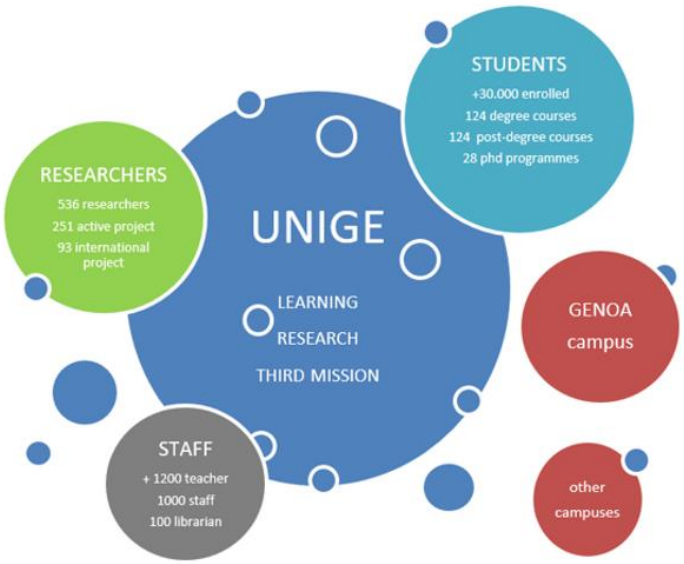

Figure 2: islands-people

Islands-skill (the different abilities). What is important, for the purposes of this paper, is that in Unige there are also many islands-skill: individual or team expertises, which need to be connected to improve results and benefits. A staff that follows the entire lifecycle of research projects supports the scholars'activity: planning, auditing, evaluation. The E-learning Department that manages the Aulaweb platform, based on Moodle, supports the teaching activities. Since 2015, the University is part of EduOpen, an Italian online platform hosting free university courses (MOOCs, Massive Online Open Courses). Research groups of STM (Science, Technology, Medicine) departments deal with study topics on open data and big data by means of degree courses and research projects. The University Library System is engaged in the advocacy of Open Access, in the management of the IRIS-Unige institutional archive, in the filing of doctoral theses and in the control of the intellectual property to encourage Green open access.
(Figure 3, islands-skill)

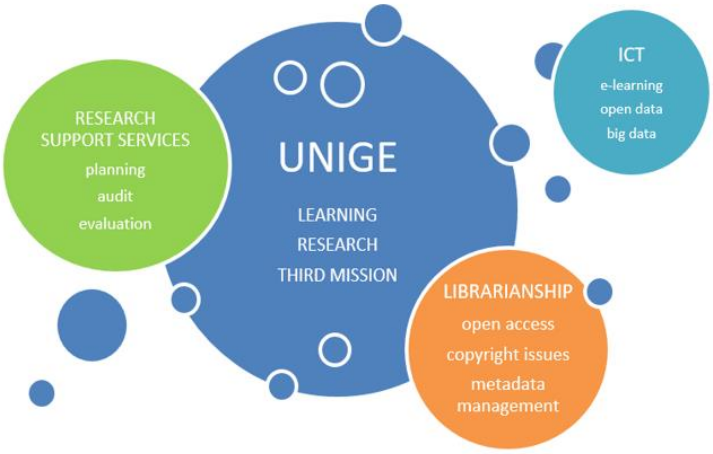

Figure 3: islands-skill

Languages, behaviours, skills and goals of all these islands are often very different and prevent the creation of constructive relationships.
Implementing three-year planning, Genoa University has reflected on the need to bridge these gaps. In particular, by 2021 it wants to achieve the goal of devising a new form of coordination between research, teaching and the

third mission that goes beyond the current disciplinary approach (Università di Genova 2019, p. 39 for example, with the establishment of the Center on the Sea).
In this context, the libraries of the University of Genoa have begun a process of transformation starting from a reflection on the themes of Open Innovation, IoT and Open Science.

2. Open Innovation and the IoT

When we think about innovation, we often think about technology. However, very often we forget that change is not in the device we have in hand, but the idea that determines its evolution, the use that we are doing of this device. Innovation is a human value, strictly connected with creativity and imagination.

Investigating on innovation and open science means that we did not limit our sources to classic scientific literature, but enlarged the focus to a significant number and various types of business documents, corporate and public observer reports, portals and websites, project-related web materials, companies' documentation; Open Innovation and IoT are topics of numerous TED talks, starting from the Global TED 2005, to date (Leadbeter, 2005; Hougland, 2014).

The international business horizon has been discussing about Open Innovation (OI) and Internet of Things (IoT) for at least 15 years; in 2003 Henry William Chesbrough wrote: "*Open Innovation: The new imperative for creating and profiting from technology"* (Chesbrough, 2003). Chesbrough gave a precise definition of Open innovation as "*a paradigm that assumes that firms can and should* ***use external ideas as well as internal ideas****, and internal and external paths to* market, as the firms look to advance their technology". (Chesbrough, 2006).
The idea and the term IoT was coined in 1999 by Kevin Ashton, executive director of the Auto-ID Center, in his "That 'Internet of Things' Thing" – a report on RFID applications in Procter & Gambles (Ashton, 1999). In 2005 the Internet report of ITU (International Telecommunication Union) was titled: "Internet of Things"; in 2008, the EU organized the First European IOT conference.

In recent years (2015-2019) we have become familiar with the concept of Open Innovation and IoT related to cultural heritage; H. Patricia McKenna was the first to talk of Internet of Cultural Things (IoCT), exploring the possibilities of applying IoT to the cultural heritage, relating with urban environment and smart cities (McKenna, 2016)

The European Union, since the "Dublin Innovation Declaration" (2013), promoted the "Open Innovation 2.0" program, emphasizing what is called "Quadruple helix model". EU also founded The Open Innovation Strategy and Policy Group (OISPG) that organises events to implement and enhance the idea of Open Innovation 2.0

In Italy, there are realities studying and promoting OI and IoT, aimed at companies but also at public services and the management of cultural heritage: for example the Milan Polytechnic Observatory on the Internet of Things, the "School of Innovation" and the "Contamination lab" of the University of Trento, the "Digital 360 Group", and others.

Regarding the application in libraries, Jennifer Rowley wrote in 2011 one of the first contributions about open innovation in libraries (Rowley, 2011) ; in 2016 Magdalena Wójcik produced "Internet of Things – potential for libraries" (Wojcik, 2016); some fundamental contributions emerged recently in German: editor De Gruyter dedicated an entire book to "Innovationsmanagement in Bibliotheken" (Fingerle & Mumenthaler, 2016). The University of Düsseldorf presented to the 2018 Hawaii International Conference on System Sciences, Waikoloa, the paper "Open Innovation in Libraries". The Leibniz-Informationszentrum Wirtschaft produced ZBW Mediatalk, a specialized blog about Open Science, Science Policy and Innovations: the report "How the library will become a hub for open innovation and science" puts the accent on the relationship, the connection, the sharing of technology and knowledge, and contains a chapter named "Libraries as bridge-builders". A debate

on Open Innovation and IoT in libraries took place at the 2018 Inconecss (International Conference on Economics and Business Information) promoted by Leibniz-Informationszentrum Wirtschaft ZBW.

3. IoT and OI in US University Libraries

It is a consolidated trend of the US Universities to include advanced innovation centres inside academic libraries, making available free tools in open spaces such as 3D printers, 3D scanners, software, and stimulating active learning of advanced 3D technologies. It is the case of the cutting-edge makerspace lab put inside the William Robertson **Coe Library**, in Wyoming; and
for example, the **CoLab of the University of Ohio**, a space designed as a physical centre for student innovation and entrepreneurial activities across the campus, opened on the third floor of **the Library of Alden**.
According to the official website of the Library, the centre represents itself as **a new model of library services based on deep and meaningful collaboration with the campus partners**, moving towards implementation of the university strategic plan. The director, Tyler Kerr, said that the Coe Library innovation centre is "*open to all members of the university community, faculty and staff, to local kindergarten through grade 12 educators and students*" and supports the use of 3D technology as a way to promote library and museum collections (Kerr, 2019)

In US cases, we can note that what transforms libraries in open innovation centres is not having 3D tools, but it is **sharing these tools inside and outside the academic boundaries**, with the clear objective to foster critical thinking.

4. The power of relationship: Academic libraries in a smart environment

Libraries have always been not only places for the preservation of knowledge but also the ground for the propulsion of expertise, areas for innovation and education. In a traditional view, academic libraries organize their services to satisfy the needs of students, professors, researchers; for many years the development of academic libraries has been devoted to increasing, managing, providing and teaching how to use electronic resources: in this way, academic librarians gave a massive contribution, and the role of academic librarians as promoters of education was active and precise.

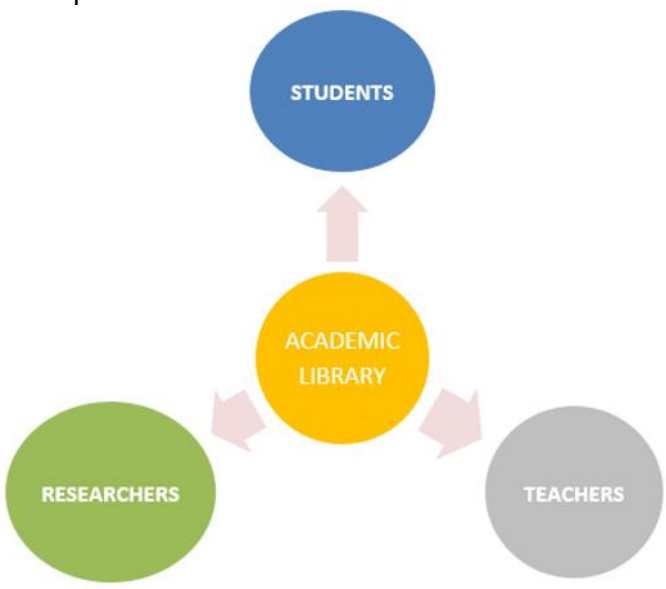

Figure 4: academic libraries traditional users

Today, in a smart environment, the border between innovation and human needs has become blurred; the data is no longer filtered or may not be filtered correctly; acting in a smart environment means shifting attention from the object to the connection between objects. In this context, what academic libraries need to draw from IoT and Open Innovation is the conceptual framework, founded first of all on the power of relationship.

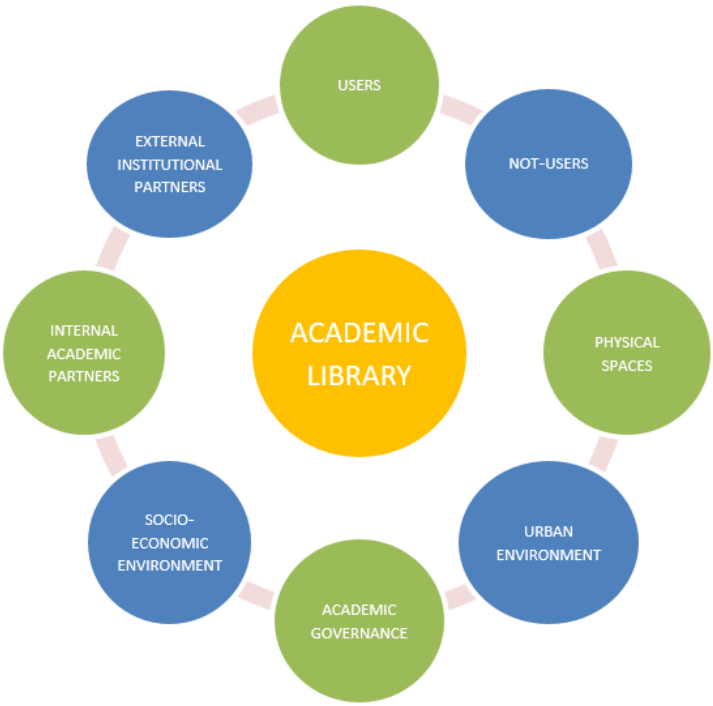

Figure 5: academic libraries relationships

A relationship is a reciprocal exchange: if a connection is healthy, the bond enriches both sides. The connected academic library absorbs stimulus from the environment and returns value in terms of good practices, high-quality spaces and education. To do this, the academic librarians have to widen their borders, establishing a two-way connection with users and non-users; walking along internal and external paths; being attentive to the cultural, social, and political environment; opening and sharing the smart technology and applications.

To analyze some of the principal directions in which academic libraries find their road to innovation, we have to put in the centre the power of relationships, and managing the initial assumption of Henry W. Chesbrough, that [firms] "***can and should use external ideas as well as internal ideas, and internal and external paths .***

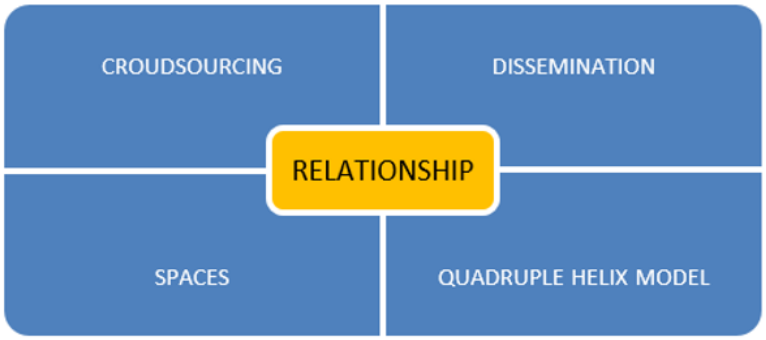

Figure 6

Crowdsourcing. Regarding the relationship with **users**, one of the best methods that academic librarians can import from Open Innovation is the "crowdsourcing". Crowdsourcing is the process of using a large group of people for their skills and ideas, to generate content or facilitate the creation of content or products. The sharing of ideas and the creative process is carried out via the webon open platforms, even through the launch of competitive ideas contests. Companies and organizations that practice crowdsourcing find in the university students a primary source for ideas and "lateral thinking", original points of view and "out of the box" innovation. According to many companies, the thought of university students is a valuable source because they have a recent university education; however, their thinking is not yet framed in the current business schemes. It is evident that

if companies find in university students a source for innovative ideas, this method must apply even more to the universities, where students are the most numerous component. Academic librarians must modify the relationship with students: investigating their needs and providing them with solutions and information but also collecting their proposals to solve problems and improving services with innovative and unconventional solutions.

Dissemination. Introducing the need to relate to **non-users**, we have to remind that relating to the non-academic world is a concept directly addressed by the open innovation system. The examples of the makerspace into the academic libraries in the USA that we have previously described is to share advanced technology instruments with a large community, not only within the academic boundaries. There are some similar experiences in Europe and also in Italy: Universities acquire and provide 3d scanners and 3s printer, but only academic users are allowed to use them, and in controlled spaces (usually into the Department or into high-tech-laboratory but not into the academic library). It is indicative in this sense that for example in Italy the best achievements of open innovation in libraries took place in public libraries and not in academic libraries (for example the San Giorgio library in Pistoia, Tuscany, which created one of the best European examples of shared Makerspace opened to the general public (Rasetti, 2015) . This is because public libraries are naturally open organizations, while Academic Libraries still have difficulties in enlarging their relationship, in going beyond their borders; and the academic governance often does not think of libraries as real innovation centres, reputing that complicated technology is not for all.

Spaces: Another critical step, related with the Internet of things, open innovation and generally smart cities is the relationship with **physical spaces**, both internal (taking care of their buildings, making them green and eco-sustainable) and external (setting a positive relationship with the urban environment and urban mobility) (Forrest & Bostick, 2015). When the library takes care of its buildings, also adopting green and eco-friendly solutions, it teaches respect for public affairs and the environment (Haucke, 2013); the presence of accessibility tools makes the library a model for good practices, teaching respect for disability and diversity (Romero, 2008). The same places of conservation have become places of digitisation, virtual windows through which the most inaccessible and protected materials of the libraries are revealed and distributed to the broadest public on the web. Italian and European academic libraries emerge with excellent and numerous realisations, and the European Union is seriously engaged in sponsoring examples and portals on the dissemination of knowledge and cultural heritage.

Quadruple helix model: this model, closely connected with the concepts of smart cities, bases innovation on the relationship between public administration, companies, academic world and active citizenship (local government, industry, university, people) The programme OI 2.0 illustrates the benefits of collaboration between these components of society; promotes teamwork, cooperation and sharing of ideas. Technology, of course, underlies this approach playing a crucial role in networking and connectivity. The idea of OI 2.0 is that working together, sharing projects and objectives in a coordinate view, brings together in a single goal the improvement of social conditions and the qualitative increase in company performance.

5. Biblioteche 2.0: a bridge to innovation

As mentioned above (see paragraph 1: **Unige at a glance: an archipelago of islands**), the recent collapse of the Morandi bridge brought Genoa on screen all over the world and was a truly shocking experience for Genoan and Italian people. In addition to the deep human pain, the town and the entire region was literally cut in two parts for days, and even when alternative roads were created, without the bridge mobility was still very difficult.

The terrible images of the collapse made us reflect on how much a city lives on its connections. How fundamental a simple bridge is for the life of the town; how much mobility and movement affects our lives. how much we have to take care of our relationships, and how important it is to respond to the trust that users place in public services; the image of bridges and islands as metaphors for relationship appeared to us in all its power and clarity.

Speaking about University Libraries, Genoa Library System has always been leader and forefront in Italy in the field of LIS and catalogue management; the quality of the paper and electronic collection is high. However, the situation of Academic libraries was hard because the system had been fragmented along the years in a large number of libraries and service points; moreover, Genoa university libraries are often located in historical buildings (XVII to XIX century): very beautiful ambiences but involving costly and often complicated maintenance, not always offering spaces ideal for studying (light, temperature, safety).

In this situation, despite the maximum and excellent effort by librarians to offer advanced information system, until 2017, student satisfaction with libraries was at around 3.8 /6.

In 2018 the University of Genoa started a programme, Library 2.0, that innovatively engaged libraries for over four years (2018-2021) as follows:

- weeding book collections to free up quality spaces for students
- physically reorganising the libraries, halving the service points
- opening study places in the evenings and weekends
- installing RFID solutions for self-check and implementing IoT solutions
- involving students /organising idea contests for students
- inserting the University libraries in tourist routes and cultural city events
- rethinking urban mobility by starting booking services and "on your desk" services
- carrying out actions in favour of social inclusiveness and environmental sustainability
- SmartLab project: equipping a laboratory for digitalisation and 3D technology, to share and promote active learning of digital humanities
- promoting smart work and telework also in the library area
- encouraging Open access and Open science and Open Innovation policies

Taking an innovative path was complicated, and the way for realizing a complete revolution will be long: but what is already reamarkable is that, as libraries started applying OI and IoT criteria, **in 2018 the students' satisfaction increased from 4.2 to 5.6 / 6 in only one year.**

6. "Future library": a successful crowdsourcing experience

In 2018 the University of Genoa launched "Future library", an architecture and design contest, aimed explicitly at and reserved for university students from all over the world. The challenge was to design an innovative learning space in a big hall previously occupied by the Library of Physics, and freed following a reorganization processes of scientific libraries. This contest was a huge success, who received more than 80 projects from more than 300 students from all over the world. The University exhibited the projects in the former Physics Department Library and will try to achieve the winner project.

The FL contest is the most structured example of a **crowdsourcing experience** that the Library System of Genoa implemented, but it is also an example of the Quadruple Helix Model because the project involved

1. **the academic governance**: the project was approved and financed by the University Board of Directors, the Academic Senate, and the Rector, and organized by teachers and librarians:
2. **private companies**: the jury of the prize was composed of major Italian and foreign architectural firms, which have constituted an element of attractiveness for students;
3. **regional and local institutions** and associations as partners of the initiative;
4. **active citizenship**: the participants were not professionals yet.

7. openscience@unige.it: no man is an island

In recent years (Koltay, 2019), openness themes represent a new frontier for academic libraries and a new challenge for librarians. As research (or science 2.0 or research 2.0 or e-science or data science) becomes more data-intensive and researchers face new challenges in managing and sharing research data, new forms of relationship are born, and the openness of scientific research is encouraged among different stakeholders. As reported by the Joint Task Force on librarians' competencies in support of e-research and scholarly communication (Calarco, Shearer, Schmidt & Tate, 2016, p.1):

> "As with all aspects of research, new technologies are transforming the way research is disseminated. The traditional system, in which they publish their results in subscription based on academic journals (or monographs), still prevails [...]. However, numerous initiatives and projects are challenging conventional models. These activities are being driven by technologies, policies, and more expansive notions of how research should be communicated. One significant component of this transformation is the move towards open access and open science. "

Even if the activities and information needs in humanities and social sciences differed substantively from those of researchers in the STM disciplines, in the last 5/7 years (Federer, 2018, p. 294) the support of all researchers' needs is a moving target. Science 2.0 is based not only on the efforts of researchers but also on the aid and the skills offered by the various research support services and by the academic libraries themselves.

In this new scenario, are academic libraries quietly reinventing or extending what librarians already do, or is a new set of competencies required? We think that this is a familiar territory, and this concerns the academic librarian key tasks. Nearly all the researchers' new needs have strong continuities with what we already expect to do as librarians. These tasks would consist in (Cox, 2018, p.1):

- "helping the researcher to find pre-existing data sources relevant to the research
- running a training or awareness session
- reviewing metadata associated with a potential deposit into a data repository
- investigating what researchers need in terms of support."

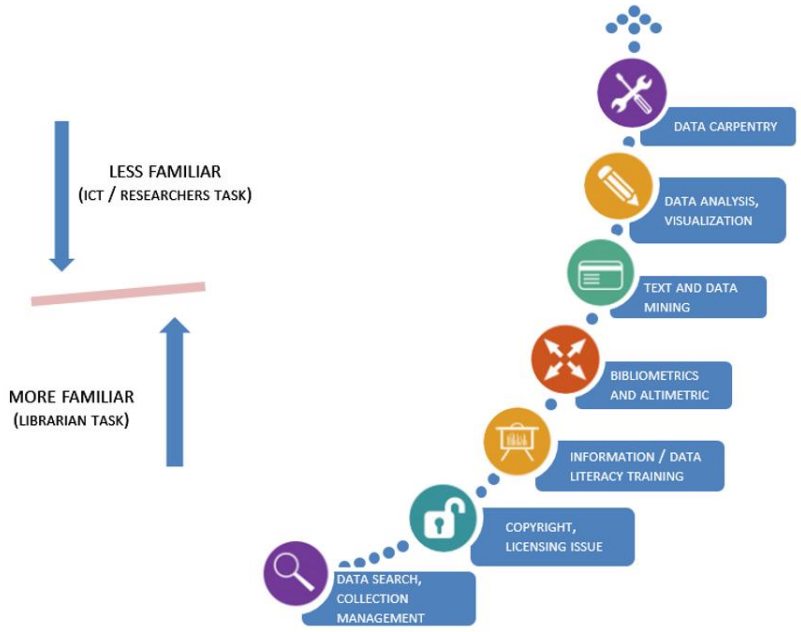

Figure 7: research librarian role spectrum – elaborated by the author on Cox 2018's inspiration

Libraries, as Ranganathan's fifth law states, are "a growing organism" and have always been used to riding changes (Convegno Stelline, 2019, p.20). Therefore, academic libraries must step out of their comfort zone again and shift their focus adding to collection services also research services, trying to bridge the skills and management gaps that today distantiate them from the researchers' needs. Indeed, researchers and librarians seem to be islands far apart from each other (Faniel and Connaway 2018, p. 110):

> "Despite researchers 'perceptions about the library's role, librarians wanted to engage, educate, and support researchers' RDM efforts. Librarians saw it as one way to transform perceptions about librarians and value libraries provide to their campus communities. "

Moving from these considerations, the openscience@unige.it project was born, as a virtual bridge between different islands.

The road to openness in Unige started in 2005, with the signing of the Messina Declaration and the Berlin Declaration, but only in 2015 a blended "Support Team" of librarians and research staff was set up. The tasks of this team were:

- to take care of the deposit, the dissemination of the scholarly publications and the related metadata in the Institutional Repository, IRIS-Unige
- to provide technical and legal assistance to the scholarly authors
- to help draft a University Open Access policy

The Policy on open access to the scientific literature of Genoa University was issued in autumn 2017 and the support Team had the further task of monitoring the state of its implementation.
The collaboration among different departments, people and skills raised the awareness that no man is an island. The librarians usually engage in high levels of interaction with researchers, and they still have the skills required by Science 2.0 / Open Science (see Figure 7).

The design of the site, curated by the system librarian Anna Maria Pastorini, started initially from the needs of the research supporting service on Open Access and from the information needs of researchers, students and graduate students.

The challenges launched by the European Commission funders extended the analysis to the Open Science topics. The openscience@unige portal is designed by mapping the different islands-Open Science with what is already active between Genoa University's islands-skill (see above, figure 3).

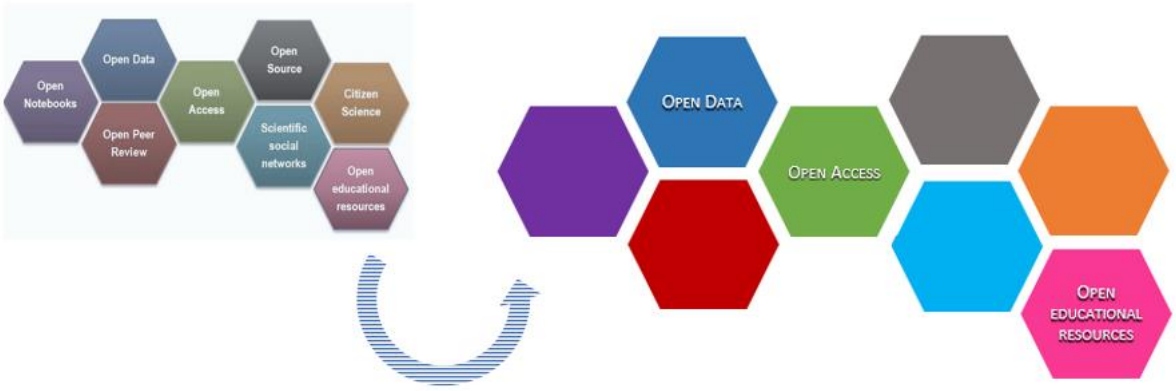

Figure 8: islands-Open Science → islands-UNIGE Open Science

Each topic is entrusted to the competent support services, and the actors involved are all the academic ones: teachers, researchers, support staff, students and librarians. The purpose of the openscience@unige project is to become a vehicle for collaborative learning, coaching and development of new sets of competencies in the fields

of research data and Open Science. In this scenario, the librarians' traditional skills, those that Cow, 2018 defines as familiar tasks, create the foundations for (re)building bridges. The world of academic research and the support that academic libraries can offer is enhanced by the synergy of skills of the various actors that constitute, within the openscience@unige virtual community, first a self-learning community and therefore a coaching community.

Here the boundaries of the island competences merge to interpenetrate one another and complete each other.

Acknowledgments

Marcella Rognoni wrote paragraphs 2-6.

Anna Maria Pastorini, who thanks the essential confidence of Marcella Rognoni and Carmen Spisa and the whole OS@unige Group for having concretely believed that no man is an island, wrote paragraphs 1; 7.

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