CPCL Vol.2 no.2 | 2019

CPCL
EUROPEAN JOURNAL OF
CREATIVE PRACTICES
IN CITIES AND LANDSCAPES

MAIN SECTION

A Makerspace Network as Part of a Regional Innovation Ecosystem, the Case of Emilia-Romagna

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ABSTRACT

Makerspaces and their various declinations are a widespread initiative of workshops that offer open access to digital and traditional production equipment, with the aim of democratizing access to technologies and supporting bottom-up innovation. They are recognized as a new form of 'third places' in a contemporary perspective. As the number of such places grows along with their active communities, business models, contamination projects with universities, companies, and civil society, many researchers have explored the ability of makerspaces to serve as innovation facilitators. Over the last few years, networks and coalitions of makerspaces have started to pop-up with a range of objectives, such as the advocacy and coordination of territorial or project-oriented coalitions; however, they remain largely unanalyzed and undocumented. The paper explores the phenomenon of these networks, drawing on a case study that describes the development of a makerspace regional network in Northern Italy, providing insights concerning its impact on both relationships at a local level and on the acceptance of third places within a regional innovation system, contributing to opening a new field of discussion about the potential of such networked organizations.

KEYWORDS

Makers; Fab Lab; Third Places; Regional Innovation Ecosystem.

PEER REVIEWED
https://doi.org/10.6092/issn.2612-0496/9536
ISSN 2612-0496

1 Introduction

Makerspaces are community places oriented towards supporting the learning of digital manufacturing technologies, with collaborative peer-production facilities, culturally rooted in tools and knowledge-sharing, widely considered innovative working and learning environments.[1] They are equipped with tools and machinery that allow members to design, prototype and build a wide range of products, from woodworking to 3D printing and electronics. Founder Niel Gernshenfeld defines Fab Labs (a particular makerspace format initiated at the MIT in Boston), as places where you can "make almost anything."[2]

The commitment to the themes of technical knowledge, open source approaches, collaboration between peers, distributed and decentralized production, the aptitude for collaborative work, and doing as learning, are interpreted as fundamental values of a new revolution in manufacturing.[3]

It is a growing global phenomenon[4], originating from the counterculture of the 1960s and evolving in the spaces for tools and knowledge of the first hackers, then in do-it-yourself workshops that included the early 3D printers.[5] They have different connotations and possible classifications according to the prevailing types of activities and forms of access and affiliation to specific networks, as for example in the case of Fab Labs.[6]

By the term "makerspace," the author refers to an extended family of collaboration spaces aimed at learning, prototyping, and producing with digital and manual technologies, the focus being "on making rather than merely consuming" as defined by Colegrove.[7]

Despite the fact that makerspaces share a solid common set of cultural norms[8] and sometimes even the same types of equipment and operating methods—as in the case of Fab Lab[9]—they are characterized differently, according to the models of governance, vocation, and the skills of the

1. Kylie Peppler et al., *Makeology: Makerspaces as Learning Environments (Volume 1)* (Abingdon-on-Thames: Routledge, 2016).

2. Neil Gershenfeld, "How to Make Almost Anything: The Digital Fabrication Revolution," Foreign Affairs 91, no. 6 (2012): 58

3. Andrew Jackson, "Makers: The New Industrial Revolution," *Journal of Design History* 27, no. 3 (September 1, 2014): 311–12.

4. Vasilis Niaros, Vasilis Kostakis, and Wolfgang Drechsler, "Making (in) the Smart City: The Emergence of Makerspaces," Telematics and Informatics 34, no. 7 (November 1, 2017): 1143–52.

5. Jarkko Moilanen, "Emerging Hackerspaces—Peer-Production Generation," in *Open Source Systems: Long-Term Sustainability*, ed. Imed Hammouda et al., IFIP Advances in Information and Communication Technology (Berlin, Heidelberg: Springer, 2012), 94–111.

6. "Fab Foundation—What Qualifies As A Fab Lab?," accessed August 11, 2019, https://www.fabfoundation.org/index.php/what-qualifies-as-a-fab-lab/index.html.

7. Patrick "Tod" Colegrove, "Editorial Board Thoughts: Libraries as Makerspace?," Information Technology and Libraries 32, no. 1 (March 30, 2013): 3.

8. Steven Levy, *Hackers: Heroes of the Computer Revolution* (Sebastopol, CA: O'Reilly Media, 2010).

9. Neil A. Gershenfeld, *Fab: The Coming Revolution on Your Desktop—from Personal Computers to Personal Fabrication* (New York: Basic Books, 2005).

FIG. 1 Inside a Makerspace, photo by the author, 2018

communities that live around them, thus defining a substantially unique profile for each space.[10]

As far as activities are concerned, some of them are mainly oriented towards the world of education and enhancing the technological skills of citizens, whereas others are more oriented towards working with companies and startups, evolving in a business-oriented direction **[Fig. 1]**.[11]

Numerous studies have been carried out in order to understand how makerspaces are organized, what kinds of communities support them, who is in charge of managing them and what their involvement is from a professional point of view.[12] Makerspaces can be classified as "third places" in keeping with Oldenburg's original description[13]—albeit one updated by recent re-interpretations[14]—and extending the concept by promoting higher levels of community engagement.[15] From this perspective of makerspace as a "third place," digital manufacturing does not only imply a re-appropriation of the means of production—enabling a "production

10. Teemu Mikkonen, Tere Vadén, and Niklas Vainio, "The Protestant Ethic Strikes Back: Open Source Developers and the Ethic of Capitalism," First Monday 12, no. 2 (February 5, 2007).

11. Eric van Holm, "What Are Makerspaces, Hackerspaces, and Fab Labs?," SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, November 7, 2014), https://papers.ssrn.com/abstract=2548211.

12. Massimo Bianchini et al., /Makers' inquiri. Un'indagine socioeconomica sui makers italiani e su Make in Italy (Milan: Libraccio Editore, 2015), http://makersinquiry.org.

13. *In The Great Good Place* Ray Oldenburg refers to the home as "first place," the workplace as "second place," defining the "third place" as a "home away from home," an informal place of expression and social interaction. See Ray Oldenburg, The Great Good Place (Cambridge, MA: Da Capo Press, 1989).

14. Nemania Memarovic et al., "Rethinking Third Places: Contemporary Design With Technology," *The Journal of Community Informatics* 10, no. 3 (2014).

15. Diane Slatter and Zaana Howard, "A Place to Make, Hack, and Learn: Makerspaces in Australian Public Libraries," *The Australian Library Journal* 62, no. 4 (November 1, 2013): 272–84.

systems with a personal dimension"[16]—but also constitutes a means of social connection.

There is a lot of evidence on the positive impact of makerspaces on local communities,[17] but very little has been written about the networks that these spaces seek to build at different spatial scales or around specific goals. These networks are born as an instrument of representation or coordination, but only in a few cases do they seem able to configure themselves in such a way as to impact other ecosystems at a higher level.

The author had the opportunity to participate in the evolution of the regional makerspace network in Emilia-Romagna, right from its early days. The Mak-ER network is aimed at connecting local makerspaces, Fab Labs and hackerspaces supporting the innovation capacity of communities, SMEs and professionals, with the ambition of becoming the first prototyped model framework to be replicated by other contexts.[18]

The purpose of this paper is to start a mapping of makerspace networks and their organizational structures, exploring their impact on territorial innovation ecosystems. The case study presented offers the opportunity to observe the local makerspace network in relation to the regional level.

2 Makerspace in the Context of Innovation

Numerous research projects show the capacity of the maker movement[19] to become a driver of innovation in social, educational and business fields. Makers highlight the independence of the concept of learning from that of school, redefining the relationship between the self and one's interaction with the educational experience.[20] Relating to the undergraduate education environment, they contaminate existing curricula strengthening technical, scientific and engineering skills through a holistic, creative relationship with the human sciences.[21]

Companies that grow out of makerspaces—managed by those who Troxler and Wolf call maker-entrepreneurs—seem to work and survive over time,

16. Stefano Maffei and Massimo Bianchini, "Microproduction Everywhere. Social, Local, Open and Connected Manufacturing," Social Frontiers The next Edge of Social Innovation Research (Milan, October 2013), accessed January 21, 2020, https://www.scribd.com/document/192022372/Microproduction-everywhere-Social-local-open-and-connected-manufacturing.

17. Nick Taylor, Ursula Hurley, and Philip Connolly, "Making Community: The Wider Role of Makerspaces in Public Life," in *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (New York: Association for Computing Machinery, 2016), 1415–1425.

18. Associazione Mak-ER, "Mak-ER / Statuto Dell'Associazione," 2018, accessed January 21, 2020, https://www.mak-er.it/wp-content/uploads/2019/06/Statuto\Mak\ER.pdf.

19. Dale Dougherty, "The Maker Movement," *Innovations: Technology, Governance, Globalization 7,* no. 3 (July 1, 2012): 11–14.

20. Erica Rosenfeld Halverson and Kimberly Sheridan, "The Maker Movement in Education," *Harvard Educational Review* 84, no. 4 (December 1, 2014): 495–504.

21. Eduardo Ferro dos Santos and Paul Benneworth, "Makerspace for Skills Development in the Industry 4.0 Era," *Brazilian Journal of Operations & Production Management* 16, no. 2 (May 26, 2019): 303–15.

thanks to an innovative approach to mixing technical skills, processes and a strong community influence in their business model design.[22] As ecosystems of open innovation[23] that facilitate agile development practices even for hardware products, makerspaces can effectively provide support for companies.[24] Likewise, much has already been written about makerspaces as enablers of social innovation and creators of business models that can positively impact local communities.[25]

3 Makerspaces and their Networks

The phenomenon of makerspace networks, however, does not appear to be as dynamic and expansive as that of makerspaces per se. In the absence of a single official registry and no previous research data, it is not possible to find an exact number of active organizations. However, through a web search on the most recognized web directories (see methodology and detailed results in Annex A, https://cpcl.unibo.it/article/downloadSuppFile/9536/35938), the author identified 43 existing networks (complete list in Annex B, https://cpcl.unibo.it/article/downloadSuppFile/9536/35939), most of which originated from Fab Labs. Networks are intended as organizations connecting multiple makerspaces, not owned or run by a unique subject. However, because it is difficult to collaborate on international projects, local networks seem to be effective substitutes. Makerspace networks are generally aggregations that aim to promote maker culture in their reference territories, but they do not involve structured affiliations or specific services. Most of them are not recognized legal entities. They can be classified by several criteria on the basis of geographical scale (international, national, regional, local, or urban), whether if they are generalist, project oriented (such as FabLab Net, a project funded by the European Commission), or focused on particular topics (such as Fab Lat Kids, a network of Fab Labs focused on education).

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22. Peter Troxler and Patricia Wolf, "Digital Maker-Entrepreneurs in Open Design: What Activities Make up Their Business Model?," *Business Horizons*, THE GENERATIVE POTENTIAL OF EMERGING TECHNOLOGY, 60, no. 6 (November 1, 2017): 807–17.

23. Open innovation "is the use of purposive inflows and outflows of knowledge to accelerate internal innovation" and it is usually represented as a model opposed to the traditional closed approach, where innovation is organized only inside the firm. See Henry Chesbrough, "Open Innovation: a New Paradigm for Understanding Industrial Innovation," in *Open innovation: Researching a new paradigm*, ed. Henry Chesbrough, Win Vanhaverbeke and Joel West (Oxford: Oxford University Press, 2006), 0–19.

24. Annette Isabel Böhmer, Andreas Beckmann, and Udo Lindemann, "Open Innovation Ecosystem---Makerspaces within an Agile Innovation Process" (ISPIM Innovation Summit, Brisbane, 2015), 1–11. Accessed January 16, 2020, https://mediatum.ub.tum.de/doc/1292171/1292171.pdf.

25. Patricia Wolf and Peter Troxler, "Community-Based Business Models: Insights from an Emerging Maker Economy," *Interaction Design and Architecture(s) Journal (IxD&A)* 30 (2016): 75–94.

3.1 Global, continental and international networks

The most active and the largest organization is the "Fab Lab Global Network," the body of makerspaces that acknowledges the Fab Lab model, coordinated by the Fab Foundation at the Center for Bits and Atoms of the MIT in Boston (USA). It consists of 1784[26] nodes, organizes its own annual global conference and promotes distributed training programs such as the Fab Academy. It does not provide any official service to affiliates, while the foundation provides consultancy services to third parties and supports the creation of new strategic nodes worldwide. Single Fab Labs must participate in the network by attending meetings or contributing to projects.[27] The European Cooperation of Fab Labs and Makerspaces is an example of a coordination attempt across the continent, aimed at overcoming the problem of unequal access to funding between those few larger labs and the smaller ones. Other continental scale networks such as FabLat (Latin America), and FabLab Asia Network have also been established.

3.2 National and State Networks

National networks are organizations aimed at promoting maker culture, but their activity often does not go beyond the establishment of a website aggregating events and occasional meetings. These networks are often represented by simple collective names without any formal organization, or non-profit associations that bring together individuals rather than makerspaces as legal entities. This does not technically qualify them as makerspace networks, although their role as relationship facilitators is undeniable. Some remarkable examples of these initiatives are Fab Lab Nation in Canada, providing high-quality collaborative tools[28] and a great variety of stakeholders, and the Nation of Makers in the USA,[29] providing its members with online resources available online and numerous initiatives together with public administrations. The German Verbund Offener Werkstätten network is probably the most structured in terms of services, including an insurance policy for makerspaces.

Another relevant case is the CCC Maker Initiative,[30] a network of 35 California Community College makerspaces with a 17-million dollar invest-

26. "Labs Map | FabLabs," FabLabs.io - The Fab Lab Network. Accessed December 30, 2019, https://fablabs.io/labs/map.

27. "Getting Started with Fab Labs," accessed December 30, 2019, https://fabfoundation.org/getting-started/#fablabs-full.

28. "Home - Fab Labs Nation," accessed December 30, 2019, https://wiki.fablabsnation.ca/index.php/Accueil/en.

29. "Nation of Makers - A National Nonprofit Dedicated to Helping Support America's Maker Organizations through Advocacy, Resource Sharing, and the Building of Community within the Maker Movement and Beyond." Accessed December 30, 2019, https://nationofmakers.us/about.html.

30. CCC is the largest provider of workforce training in the state and nation, offering postsecondary technical education in 175 fields, and educating more than 100,000 individuals each year in industry-specific workforce skills.

ment and probably the best-documented project in the world.[31] Its model is based on co-design activities aimed at bringing out the most relevant aspects for each local reality, as well as on a network of makerspaces supported by a core implementation team including a project manager, a technical assistance provider, an organization development/strategic management leader, a communications director, a grant accountant and a statewide advisory committee.[32]

3.3 Regional Networks

There are several networks active on a regional level. They seem to be more active and project-oriented compared to national and continental networks. Moreover, they show a greater variety in terms of governance models, quality and quantity of activities. Most of the regional networks, like the networks operating on a larger scale, are meant to provide connections among affiliate organizations. Some of them, however, are committed to specific activities. For instance, rather than simply representing local makers, FabCube in Veneto (Italy) developed a "startup studio" service where several Fab Labs cooperate, joining competences and facilities. Other regional networks are committed to the establishment of a strong presence within their economic and political context, as in the case of Mak-ER in Emilia-Romagna, Italy, which aspires to become a reproducible prototype for this type of organization.

3.4 Local Networks

At this level, networks can be interprovincial, provincial, metropolitan, or urban. One of the most interesting example is Roma Makers (Rome, Italy), the Rome metropolitan network that represents the evolution of a makers community into a polycentric city layer, made up of several Fab Labs, mini Fab Labs and school ateliers, characterized by an advisory service for citizens' institutions interested in setting up and running a Fab Lab.[33]

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31. Five reviewed papers published between 2016 and 2018. See https://cccmaker.com/about/ccc-maker-initiative/, accessed May 10, 2019.

32. Carol Pepper-Kittredge, Deborah Bird, and Brie Lindsey, "Growing A Network of Makerspaces in California Community Colleges: Moving Towards Implementation and Adoption" (International Symposium on Academic Makerspaces, Stanford, CA, 2018). Accessed January 16, 2020, https://cccmaker.com/wp-content/uploads/2018/08/CCCMaker-FINAL-submission.pdf. Carol Pepper-Kittredge and Paul A Devoe, "Creating a Network of Community Colleges with Makerspaces: California's CCC Maker Model" (International Symposium of Acadamic Makerspaces, Boston, MA, 2016), 221–224.

33. Alessandra Fasoli and Silvio Tassinari, "Engaged by Design: The Role of Emerging Collaborative Infrastructures for Social Development. Roma Makers as A Case Study," *The Design Journal* 20, no. sup1 (July 28, 2017): S3121–33.

4 Case Study—Mak-ER the Emilia-Romagna Regional Makerspace Network

Emilia-Romagna is located in northern Italy, it has one of the highest national levels of income per capita and it has been considered a laboratory of innovation in the context of industrial districts.[34]

In recent years, its Regional Innovation System (RIS), has shifted toward a model where more companies adopt open and distributed innovation strategies.[35]

In Autio's definition[36], RIS are made by the interaction of two sub-systems in the context of a specific socioeconomic and cultural settings. The first is responsible for knowledge generation and diffusion (institutions for workforce mediation, education and research, technology mediation), while the second is responsible for knowledge exploitation and application (industries with their value and supply chains).

The regional dimension of innovation systems is becoming of key importance due to its relations with industrial specialization, knowledge spillovers, tacit knowledge exchange, and institutions.[37] RIS seems to be the perfect environment for the grafting of makerspaces—as well as their networks—due to a shared compatibility with open innovation practices.[38]

4.1 From Informal Coalition to Recognized Agent of Regional Innovation

The Mak-ER network was founded in 2014 on the initiative of two laboratories: Fab Lab Reggio Emilia and MakeInBo. Supported by ASTER, the regional consortium for innovation and industrial research (now ART-ER), Mak-ER coordinates the activities of local makerspaces, supporting the spread of the cultural and methodological approach of makers. According to the research carried out, this is the first example of a network structured on a regional scale in Italy [Fig. 2].

By 2014, 15 labs from eight different provinces had joined the project (almost all the makerspaces and Fab Labs in the region). They were very different in terms of typology (hackerspace, Fab Lab or makerspace), and

34. Annaflavia Bianchi and Patrizio Bianchi, "Keeping Emilia-Romagna Strong: An Integrated Industrial Policy Approach," *Wirtschaftsdienst* 99, no. 1 (April 1, 2019): 65–70.

35. Fiorenza Belussi, Alessia Sammarra, and Silvia Rita Sedita, "Learning at the Boundaries in an 'Open Regional Innovation System': A Focus on Firms' Innovation Strategies in the Emilia Romagna Life Science Industry," *Research Policy* 39, no. 6 (July 1, 2010): 710–21.

36. Erkko Autio, "Evaluation of RTD in Regional Systems of Innovation," *European Planning Studies* 6, no. 2 (April 1, 1998): 131–40.

37. Franz Tödtling and Michaela Trippl, "One Size Fits All?: Towards a Differentiated Regional Innovation Policy Approach," *Research Policy*, Regionalization of Innovation Policy, 34, no. 8 (October 1, 2005): 1203–19.

38. Lindomar Subtil de Oliveira et al., "Analysis of Determinants for Open Innovation Implementation in Regional Innovation Systems," *RAI Revista de Administração e Inovação* 14, no. 2 (April 1, 2017): 119–29.

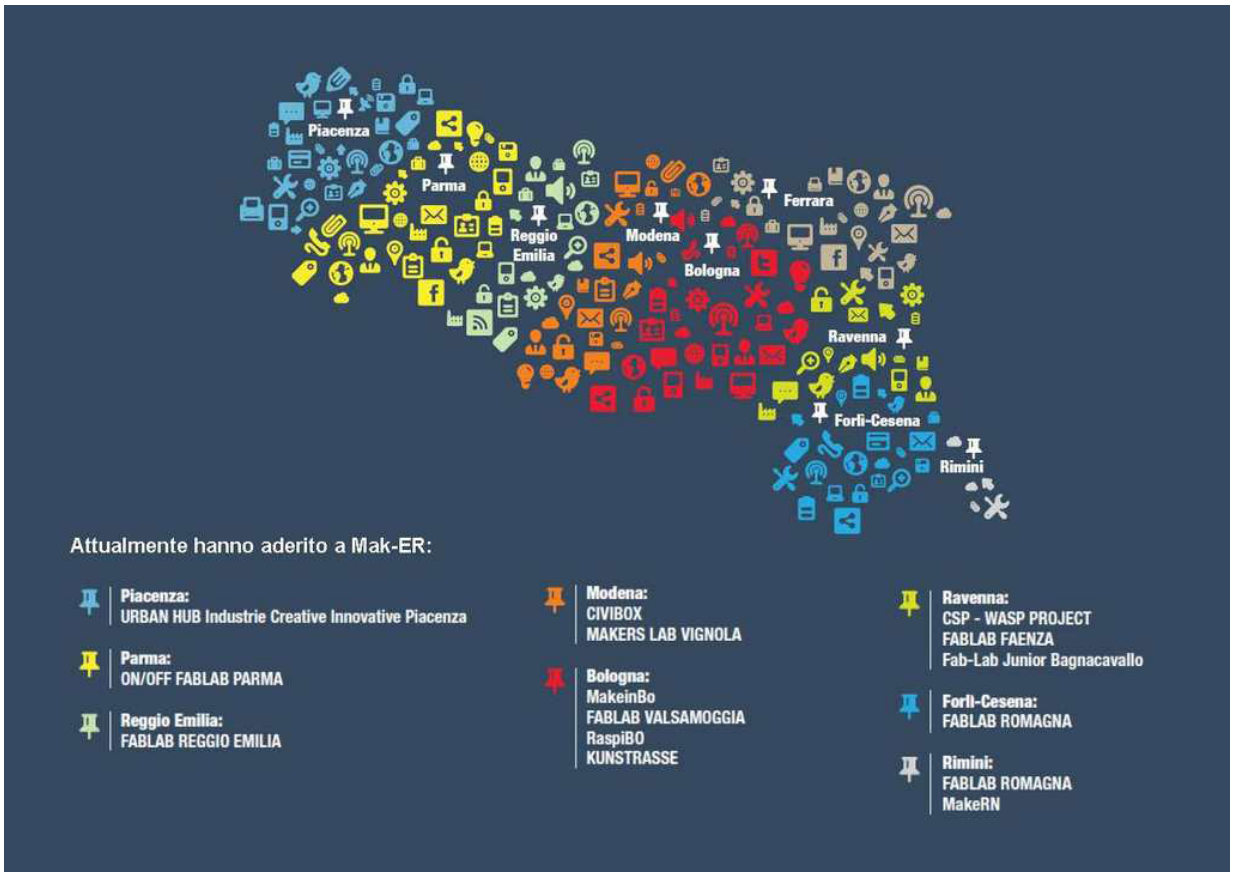

FIG. 2 The first Mak-ER Network Map, graphic by ASTER, 2014

of governance model (public, semi-public, private or public-private partnerships). At the early stages of its development, the network focused more on strengthening member relationships and on designing the brand, without considering gaining legal recognition. At that time, the priorities were the creation of possible actions to be carried out locally and the representation of makers' instances **[Fig. 3]**.

In 2014, the first version of the Manifesto—aimed at defining the purposes and attributes of the network—were subscribed by members and publicly shared.

The nodes of the network are always made up of a set of places, equipment, and people: all three elements must always be present in order to participate in the activities of the network.[39] Subsequently, Mak-ER began to attend events and fairs with its own stand, starting to promote the most important projects of the individual nodes such as Rimini Mini-Maker Fair 2015, in which the network launched the first joint project then called Maker's Beach, with the aim of implementing the prototype of the shoreline infrastructure of the future.

In 2016 "Fab 2 Business" was organized: the first European event dedicated to research on business models for Fab Labs.

39. "Manifesto della rete Mak-ER," mak-er, accessed December 30, 2019, https://www.mak-er.it/chi-siamo-con-testi-vecchi/.

FIG. 3 European makers joining Mak-ER in R2B Bologna, photo by BAM Agency, 2016

Also in 2016, a public call for proposals launched by the regional administration to support small and medium-sized enterprises for the first time listed Fab Labs as qualified innovation suppliers, together with research centers, universities and other innovation facilities.[40] This recognition marked a significant turn: today also local institutions and the Provincial Chambers of Commerce also include Fab Labs among the centers for innovation where companies can spend public funds.

In 2017 Mak-ER implemented a Charter of Values as a tool for communication and guidance, outlining its principles and showcasing its first map of network services.[41]

Mak-ER reached its historic high of 19 nodes before establishing itself as a legally recognized association. Among the subjects that have joined over time and then left the network, some have closed, others have changed their purpose (Fab Lab Terre di Castelli, which has become an internal facility for Tecnopolo of Modena, used exclusively as a startup incubator). Others have decided not to participate in the activities of the network due to the lack of resources and of alignment with the vision. On November 12, 2018, the first nine makerspaces signed the charter of the association, in the presence of the Regional Councilor for Productive Activities.

4.2 The Essential Contribution of the Public

Makerspaces has been perceived by local authorities as a potential new interface between the world of business, cultural and creative industries, civil society and education. Their effective capability to use alternative

40. "Servizi innovativi per le pmi 2016," Programma operativo regionale, accessed December 30, 2019, https://fesr.regione.emilia-romagna.it/opportunita/2016/servizi-innovativi-per-le-pmi.

41. "La Carta dei Valori di Mak-ER," mak-er, July 27, 2017, https://www.mak-er.it/la-carta-dei-valori-di-mak-er/.

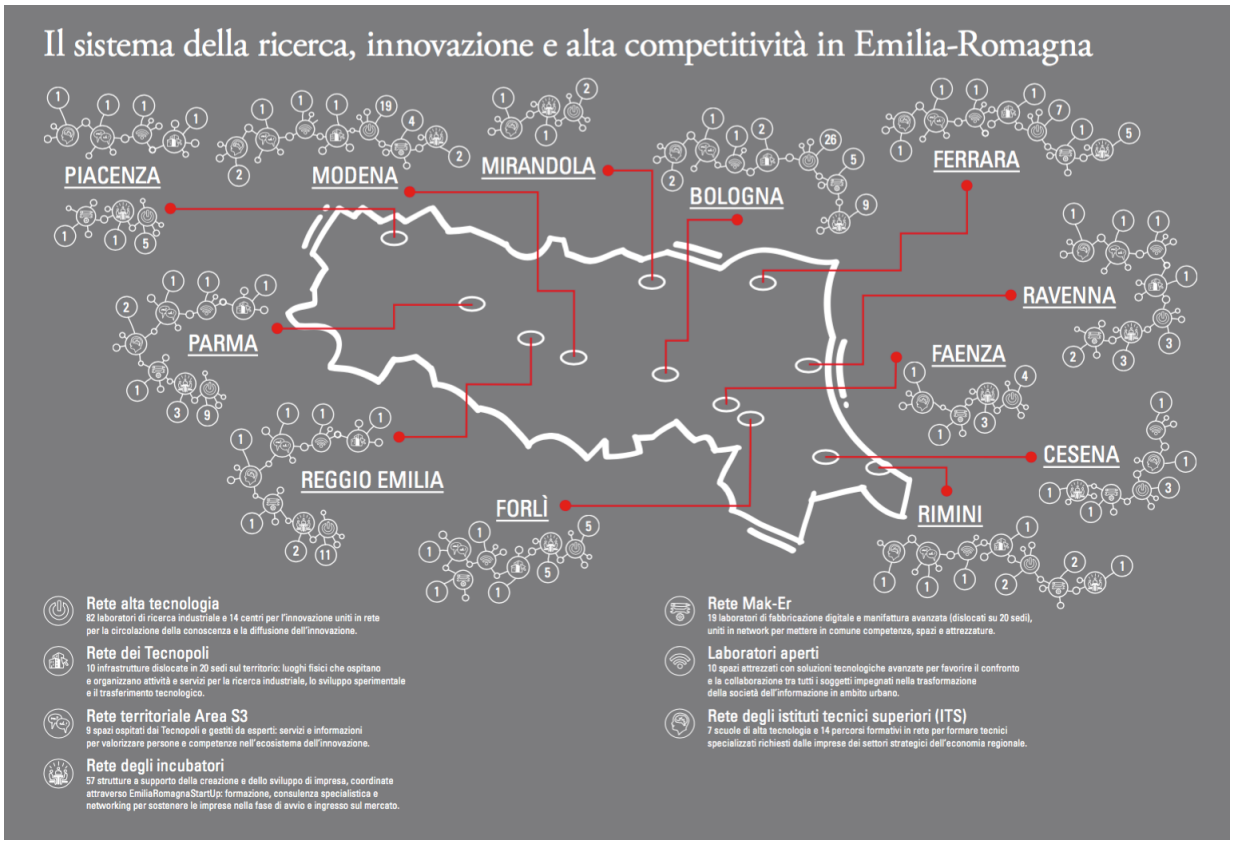

FIG. 4 Emilia-Romagna Regional Innovation Ecosystem, from Con L'Emilia-Romagna Ce L'Abbiamo Fatta, published by Regione Emilia-Romagna, Bologna, 2017.

languages and methodologies compared to that of universities, business incubators, and research centers has played a key role in this perception [Fig. 4]. Hence, the pivotal support of the Region performed by the ASTER consortium[42] may be found at various levels:

1. **promotion of Mak-ER within the regional innovation system**: through the organization of institutional meetings to which representatives of the network were invited in order to promote their skills and potential values connecting schools, enterprises and intermediate bodies;
2. **enhancement of the logistical coordination of the network**, through participation in events and the organization of internal meetings held at the various members' facilities (more than 20 in four years);
3. **indirect economic support for participation in fairs and public initiatives**, through the sponsorship of stands or promotional material;
4. **legal support and administrative guidance**, in particular when the network began to plan its evolution from informal coalition to association.

42. ASTER "is the consortium company for innovation and technology transfer between the Emilia-Romagna Region, Universities, national public research bodies CNR, ENEA, INFN and the regional system of Chambers of Commerce." Accessed May 13, 2019, https://www.aster.it/.

4.3 Governance and Organization

The path that led to the foundation of the association and the drafting of its statute[43] was not linear. It is worth mentioning that the divergence of opinions regarding the mission and strategic orientations, the expediency of establishing the association and the cost of membership fees proved divisive elements. Other causes include those related of a logistical-organizational nature—such as geographical distance or the interference of the associates' main work activity—and the different nature of the members (for example, nodes operated by associations are slower than others in interacting with the network due to their internal democratic mechanisms).

The 2018 statute is based on the necessity to change the informal nature of the Mak-ER Network towards an official associative entity. It is based on the standard model made available by the Emilia-Romagna Region and its articles were collectively discussed with the support of a lawyer who was instrumental in making comprehensible to everyone the arrangements and mechanisms of the organization.

- The association's budget—sized to cover minimum coordination costs—is funded by:
- annual membership fees;
- contributions from members and/or private individuals;
- contributions from the state, public and international bodies, institutions;
- reimbursements deriving from conventions;
- income from marginal commercial and productive activities;
- donations.

The functioning of the association is regulated by the statute, while the more practical issues are gradually addressed by the Council and the Assembly through the regulations. Technical issues are addressed by specific commissions that return opinions and guidelines to the Council and the Members' Assembly. Participation in the commissions is voluntary and each of the nodes must participate with its members. The possibility is under discussion for a fraction of the membership fees to be quantified by measuring the participation, thus decoupling it from money and leveraging more collaboration **[Fig. 5]**.

The network works mainly through web-based applications. Direct communication takes place on a multi-channel chat and meetings are preferably performed via online video-conferencing software; coordination and operations are carried out on collaborative project management tools; all assets and documents are managed via the cloud.

43. "Mak-ER / Statuto dell'Associazione."

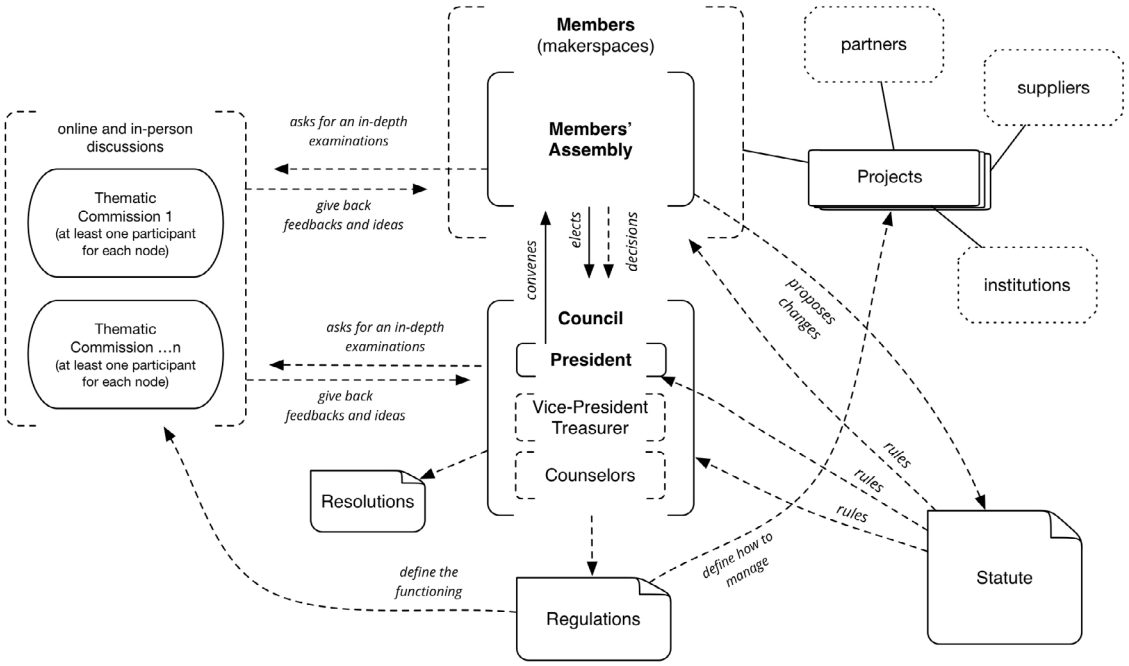

FIG. 5 Mak-ER Association governance

4.4 Node Services vs. Network Services

The objective that Mak-ER pursues is to qualify itself as an interlocutor able to provide services on a regional scale, through the agile mobilization of internal resources. This can only happen by differentiating its offer of services from that of the individual nodes, because one of the obstacles perceived by many of the members concerns the possible overlap—and therefore competition—between nodes and the infrastructure [Tab. 1]. Since Mak-ER's market orders are carried out through a selection of project team members on the basis of skills and only secondarily on a geographical basis, this approach risks widening the gap between the more business-oriented and the more education-oriented nodes. In this regard, a model internally defined as the "learning machine" is under discussion, based on the principles of networked learning[44] and on the vision of the network as an opportunity for its members to continuously enhance their own competencies.

44. David Jackson and Karen Seashore Louis, "From Professional Learning Community to Networked Learning Community," in *Professional Learning Communities: Divergence, Depth and Dilemmas. Professional Learning*, ed. Louise Stoll and Karen Seashore Louis (Columbus, OH: Open University Press, 2007), 1–24. Accessed January 16, 2020, http://www.learnersfirst.net/private/wp-content/uploads/From-professional-learning-community-to-networked-learning-community.pdf.

Nodes services	Mak-ER network services
Access and training to local machines and resources	Search machines availability in the whole network *
Local educational programs	Distributed educational programs
Local B2B and members training activities	Distributed B2B training programs
Prototyping and parts manufacturing (small batches)	Coordination of distributed manufacturing projects
Design, product development, and consultancy (B2B/ B2C and open projects)	Coordination of distributed teams for B2B and open projects

Sources: The list of services of the nodes is a summary of the information given by the members through self-updated description sheets of their makerspaces (accessed May 2019). Here only services provided by all nodes excluding the one provided only by some of them are listed.

Mak-ER services have been defined by the author matching information provided by the official website and assembly reports available in June 2019.

* planned services.

TAB. 1 Comparison between local makerspaces vs network services

4.5 Relevant Collaborative Projects

This section describes two projects implemented jointly by Mak-ER. The first is related to the ability to coordinate skills and equipment distributed among the various nodes of the network to co-produce small batches of smart devices, while the second is related to the transfer of internal skills aimed at providing standardized training throughout the territory.

4.5.1 Distributed production of electronic devices

In 2017, Lepida SPA (developer and maintainer of regional ICT infrastructures), contracted Mak-ER for the production of a technological device. The project consisted of a small Bluetooth anti-theft tracker working through a smartphone app (OEM), incorporated in a 3D printed plastic chassis, to be produced in 200 units within two months. Although the concept design of the device was basically ready, the order confirmation received in mid-September had left only two weeks for the execution of the plastic chassis to be printed in 3D, assembled and delivered. The network acted as a single infrastructure distributing parts of the process among their most qualified nodes, and delivered the product on time.

4.5.2 Distributed training

Between February and May 2018 Mak-ER provided training to 140 people from public administrations in the Emilia-Romagna region, on the themes of service and interaction design. The 11 workshops lasted four hours and were held at five different locations so as to allow participants to choose the nearest or most convenient place to attend the activity. The training module, designed with the customer's representatives, focused on the use of the analysis and design tools of the service and interaction design.

- Specifically, Mak-ER was responsible for the following work packages:
- shaping the training project;
- setting up the system for measuring quality and impact;
- creating a "prototype" event to try out the format;
- making a promotional video;
- managing the various locations;
- preparing the trainers of the network aligning them to a common quality standard;
- carrying out the training activity.

The satisfaction measured through an anonymous questionnaire filled in by 55 participants at the end of the activity recorded an average score of 4.2 (scale from 1 to 5).

It is relevant to report that the vertical competence on service and interaction design was possessed only by a few members, who trained the others through intensive workshops. The purpose of this model— although a significant part of the revenues was used to cover internal training costs— was to speed up the attainment and transfer of skills within the network, improving its overall efficiency. This acceleration of knowledge transfer could take place because the strengthening of links between nodes is positively connected to the learning level that takes place within alliances.[45]

45. Andrew C. Inkpen and Eric W. K. Tsang, "Social Capital, Networks, and Knowledge Transfer," *Academy of Management Review* 30, no. 1 (January 1, 2005): 146–65.

5 Conclusion

This research was limited by two main factors: the analysis and observation of a single case study and the lack of quantitative measurement of the network impact on the RIS.

However, it offers an overview of the most significant aspects emerged in establishing a third-place network oriented towards operating as an independent organization and recognized as part of the territorial innovation system [Tab. 2].

Barriers	Enablers
Heterogeneity of nodes (reference, affiliation, mission, governance models, competences, local context, culture).	Administrative, technical, legal, promotional and logistical support from regional institutions.
Difficult alignment on vision, values, mission and governance model for the network.	Institutional commitment to makers' inclusion in the regional innovation system.
Different levels of involvement and motivation among members.	Fab labs official recognition as innovation providers in public regional tenders.
Members fearing that better structured nodes could profit more from the network.	Identification of a system of network services that do not compete with those of the nodes.
Irregular and sporadic in-person meetings.	Incentives such as learning opportunities in collaborative projects.
Lack of resources for active members' participation.	
Competitive pressure among nearby nodes.	
Lack of shared knowledge on collaborative network organization principles.	
Difficult and slow implementation of effective remote collaboration tools.	

TAB. 2 Critical issues implementing Mak-ER

By collaborating as a network—thanks to a shared capital of resources that can be easily mobilized—makerspaces can structure a distributed platform of homogeneous services and competences, overcoming limitations on individual skills and resources, allowing for the deployment of projects that they would be unable to handle alone. Challenges posed by structuring a network that cannot bear founding and running costs similar to those of a network of enterprises (coordination, project management, trade representation, etc.), seem to be effectively addressed by adopting an organizational design approach based on incentives for collaboration— forging trustworthy ties between nodes—and leveraging knowledge transfer. Furthermore, structuring a joint service offering which does not compete against that of individual nodes can mitigate the impact of internal competitive dynamics. Qualitatively, the network also has a positive

"downward" impact, namely across each node territory (especially in the case of bottom-up initiatives), raising the authority of the makerspace in the eyes of its members, local authorities and organizations.
Among other factors, institutional support has been pivotal, by committing resources, adopting cost-free but impactful measures and facilitating relations between makerspaces and RIS clusters. Having personally observed the genesis of the network and having participated in numerous meetings with regional institutions and stakeholders, it seems clear to me how the network of makerspaces impacts positively "upwards," on the perception of these kind of third places—of their culture and methodologies—as reliable partners for other RIS actors. Furthermore the recognition of makerspaces as innovative solution providers in public tenders has positively impacted the RIS, enriching the offer of open innovation approaches and accessible research and development practices for SMEs. As makerspaces are recognized as social innovation vehicles, the network's ability to impact on a wider audience allows the RIS to include more bottom-up pressure for innovation.

This article is intended to be a starting point for the understanding of the makerspace networks phenomenon. Further and more structured research should consider ways to perform a methodical comparison among makerspace networks and with those of other organizational typologies, conducting quantitative measuring of their systemic effects on the RIS (also considering other systemic approaches), towards the definition of a general framework for performance analysis of new types of collaborative projects.

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Bibliography

Associazione Mak-ER. "Mak-ER / Statuto Dell'Associazione," 2018. Accessed January 16, https://www.mak-er.it/wp-content/uploads/2019/06/Statuto_Mak_ER.pdf.

Autio, Erkko. "Evaluation of RTD in Regional Systems of Innovation." *European Planning Studies* 6, no. 2 (April 1, 1998): 131–40. https://doi.org/10.1080/09654319808720451.

Belussi, Fiorenza, Alessia Sammarra, and Silvia Rita Sedita. "Learning at the Boundaries in an 'Open Regional Innovation System': A Focus on Firms' Innovation Strategies in the Emilia Romagna Life Science Industry." *Research Policy* 39, no. 6 (July 1, 2010): 710–21. https://doi.org/10.1016/j.respol.2010.01.014.

Bianchi, Annaflavia, and Patrizio Bianchi. "Keeping Emilia-Romagna Strong: An Integrated Industrial Policy Approach." *Wirtschaftsdienst* 99, no. 1 (April 1, 2019): 65–70. https://doi.org/10.1007/s10273-019-2434-8.

Bianchini, Massimo, Massimo Menichinelli, Stefano Maffei, Francesco Bombardi, and Alessandra Carosi. */Makers' inquiry. Un'indagine socioeconomica sui makers italiani e su Make in Italy/*. Milan: Libraccio Editore, 2015. http://makersinquiry.org/.

Böhmer, Annette Isabel, Andreas Beckmann, and Udo Lindemann. "Open Innovation Ecosystem---Makerspaces within an Agile Innovation Process," 1–11. Brisbane, 2015. Accessed January 16, 2020, https://mediatum.ub.tum.de/doc/1292171/1292171.pdf.

Chesbrough, Henry. "Open Innovation: a New Paradigm for Understanding Industrial Innovation." In *Open innovation: Researching a new paradigm*, ed. Henry Chesbrough, Win Vanhaverbeke and Joel West, 0–19. Oxford: Oxford University Press, 2006.

Colegrove, Patrick "Tod." "Editorial Board Thoughts: Libraries as Makerspace?" Information Technology and Libraries 32, no. 1 (March 30, 2013): 2–5. https://doi.org/10.6017/ital.v32i1.3793.

Dougherty, Dale. "The Maker Movement." *Innovations: Technology, Governance, Globalization* 7, no. 3 (July 1, 2012): 11–14. https://doi.org/10.1162/INOV_a_00135.

"Fab Foundation—What Qualifies As A Fab Lab?" Accessed August 11, 2019. Accessed January 16, 2020, https://www.fabfoundation.org/index.php/what-qualifies-as-a-fab-lab/index.html.

Fasoli, Alessandra, and Silvio Tassinari. "Engaged by Design: The Role of Emerging Collaborative Infrastructures for Social Development. Roma Makers as A Case Study." *The Design Journal* 20, no. sup1 (July 28, 2017): S3121–33. https://doi.org/10.1080/14606925.2017.1352819.

Gershenfeld, Neil A. Fab: *The Coming Revolution on Your Desktop---from Personal Computers to Personal Fabrication*. New York: Basic Books, 2005.

———. "How to Make Almost Anything: The Digital Fabrication Revolution." *Foreign Affairs* 91, no. 6 (2012): 42–57.

"Getting Started with Fab Labs." Accessed December 30, 2019, https://fabfoundation.org/getting-started/#fablabs-full.

Halverson, Erica Rosenfeld, and Kimberly Sheridan. "The Maker Movement in Education." *Harvard Educational Review* 84, no. 4 (December 1, 2014): 495–504. https://doi.org/10.17763/haer.84.4.34j1g68140382063.

Holm, Eric van. "What Are Makerspaces, Hackerspaces, and Fab Labs?" SSRN Scholarly Paper. Rochester, NY: Social Science Research Network, November 7, 2014. Accessed January 16, 2020, https://papers.ssrn.com/abstract=2548211.

"Home - Fab Labs Nation." Accessed December 30, 2019, https://wiki.fablabsnation.ca/index.php/Accueil/en.

Inkpen, Andrew C., and Eric W. K. Tsang. "Social Capital, Networks, and Knowledge Transfer." *Academy of Management Review* 30, no. 1 (January 1, 2005): 146–65. https://doi.org/10.5465/amr.2005.15281445.

Jackson, Andrew. "Makers: The New Industrial Revolution." Journal of Design History 27, no. 3 (September 1, 2014): 311–12. https://doi.org/10.1093/jdh/ept048.

Jackson, David, and Karen Seashore Louis. "From Professional Learning Community to Networked Learning Community." In *Professional Learning Communities: Divergence, Depth and Dilemmas. Professional Learning*, edited by Louise Stoll and Karen Seashore Louis, 1--24. Columbus, OH: Open University Press, 2007. Accessed January 16, 2020, http://www.learnersfirst.net/private/wp-content/uploads/From-professional-learning-community-to-networked-learning-community.pdf.

mak-er. "La Carta dei Valori di Mak-ER," July 27, 2017. Accessed January 16, 2020, https://www.mak-er.it/la-carta-dei-valori-di-mak-er/.

FabLabs.io - The Fab Lab Network. "Labs Map | FabLabs." Accessed December 30, 2019, https://fablabs.io/labs/map.

Levy, Steven. *Hackers: Heroes of the Computer Revolution*. 1st edition. Sebastopol, CA: O'Reilly Media, 2010.

Maffei, Stefano, and Massimo Bianchini. "Microproduction Everywhere. Social, Local, Open and Connected Manufacturing." Social Frontiers The next Edge of Social Innovation Research. Milan, October 2013. Accessed January 16, 2020, https://www.scribd.com/document/192022372/Microproduction-everywhere-Social-local-open-and-connected-manufacturing.

mak-er. "Manifesto della rete Mak-ER." Accessed December 30, 2019. https://www.mak-er.it/chi-siamo-con-testi-vecchi/.

Memarovic, Nemania, Sidney Fels, Junia Anacleto, Roberto Calderon, Federico Gobbo, and John M. Carrol. "Rethinking Third Places: Contemporary Design With Technology." *The Journal of Community Informatics* 10, no. 3 (2014).

Mikkonen, Teemu, Tere Vadén, and Niklas Vainio. "The Protestant Ethic Strikes Back: Open Source Developers and the Ethic of Capitalism." *First Monday* 12, no. 2 (February 5, 2007). https://doi.org/10.5210/fm.v12i2.1623.

Moilanen, Jarkko. "Emerging Hackerspaces—Peer-Production Generation." In Open *Source Systems: Long-Term Sustainability*, edited by Imed Hammouda, Björn Lundell, Tommi Mikkonen, and Walt Scacchi, 94–111. IFIP Advances in Information and Communication Technology. Berlin, Heidelberg: Springer, 2012. https://doi.org/10.1007/978-3-642-33442-9.

"Nation of Makers—A National Nonprofit Dedicated to Helping Support America's Maker Organizations through Advocacy, Resource Sharing, and the Building of Community within the Maker Movement and Beyond." Accessed December 30, 2019, https://nationofmakers.us/about.html.

Niaros, Vasilis, Vasilis Kostakis, and Wolfgang Drechsler. "Making (in) the Smart City: The Emergence of Makerspaces." *Telematics and Informatics* 34, no. 7 (November 1, 2017): 1143–52. https://doi.org/10.1016/j.tele.2017.05.004.

Oldenburg, Ray. *The Great Good Place*. Cambridge MA: Da Capo Press, 1980.

Oliveira, Lindomar Subtil de, Márcia Elisa Soares Echeveste, Marcelo Nogueira Cortimiglia, and César Giovani Colini Gonçalves. "Analysis of Determinants for Open Innovation Implementation in Regional Innovation Systems." *RAI Revista de Administração e Inovação* 14, no. 2 (April 1, 2017): 119–29. https://doi.org/10.1016/j.rai.2017.03.006.

Pepper-Kittredge, Carol, Deborah Bird, and Brie Lindsey. "Growing A Network of Makerspaces in California Community Colleges: Moving Towards Implementation and Adoption." Stanford, CA, 2018. Accessed January 16, 2020, https://cccmaker.com/wp-content/uploads/2018/08/CCCMaker-FINAL-submission.pdf.

Pepper-Kittredge, Carol, and Paul A Devoe. "Creating a Network of Community Colleges with Makerspaces: California 's CCC Maker Model," 221–224. Boston, MA, 2016.

Peppler, Kylie, Erica Halverson, Yasmin B. Kafai, Erica Halverson, and Yasmin B. Kafai. *Makeology: Makerspaces as Learning Environments (Volume 1)*. Abingdon-on-Thames: Routledge, 2016. https://doi.org/10.4324/9781315726519.

Santos, Eduardo Ferro dos, and Paul Benneworth. "Makerspace for Skills Development in the Industry 4.0 Era." *Brazilian Journal of Operations & Production Management* 16, no. 2 (May 26, 2019): 303–15. https://doi.org/10.14488/BJOPM.2019.v16.n2.a11.

Programma operativo regionale. "Servizi innovativi per le pmi 2016." Accessed December 30, 2019, https://fesr.regione.emilia-romagna.it/opportunita/2016/servizi-innovativi-per-le-pmi.

Slatter, Diane, and Zaana Howard. "A Place to Make, Hack, and Learn: Makerspaces in Australian Public Libraries." *The Australian Library Journal* 62, no. 4 (November 1, 2013): 272–84. https://doi.org/10.1080/00049670.2013.853335.

Taylor, Nick, Ursula Hurley, and Philip Connolly. "Making Community: The Wider Role of Makerspaces in Public Life." In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 1415–1425. New York: Association for Computing Machinery, 2016. https://doi.org/10.1145/2858036.2858073.

Tödtling, Franz, and Michaela Trippl. "One Size Fits All?: Towards a Differentiated Regional Innovation Policy Approach." *Research Policy*, Regionalization of Innovation Policy, 34, no. 8 (October 1, 2005): 1203–19. https://doi.org/10.1016/j.respol.2005.01.018.

Troxler, Peter, and Patricia Wolf. "Digital Maker-Entrepreneurs in Open Design: What Activities Make up Their Business Model?" *Business Horizons*, THE GENERATIVE POTENTIAL OF EMERGING TECHNOLOGY, 60, no. 6 (November 1, 2017): 807–17. https://doi.org/10.1016/j.bushor.2017.07.006.

Wolf, Patricia, and Peter Troxler. "Community-Based Business Models: Insights from an Emerging Maker Economy." *Interaction Design and Architecture(s) Journal (IxD&A)* 30 (2016): 75–94.