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Abstract. In sectors like the agrifood industry, the complexity of the problems needing to be tackled often requires solutions that integrate expertise from very different disciplinary areas. From this point of view, the proposal made several years ago by economist Richard Normann to allow the development of a "value chain" towards the "value constellation" takes on a new meaning, not only for production processes, but also for the formulation of new strategies for the development of innovation. In order to enable the formation of the constellation in the innovation ecosystem, it becomes necessary to train those able to act as real "brokers" – or intermediaries – in the networks, connecting stakeholders who are not traditionally connected, but who create "new combinations" of technological solutions, essential for generating innovations. Following this, the chapter explores the instruments provided by digital technologies and cyber networks for improving interaction and consolidating an open and collaborative approach between different actors in the innovation systems. The vast range of new instruments/environments provided by the Web can contribute to the creation of an "ecosystem" in which the innovation brokers are supported in all the key processes connected with their work.

Keywords. Digital technologies – ICT– Web – MOOCs – Global – Innovation broker.

Nouvelles pratiques de transfert de la connaissance

Résumé. *La complexité des questions qui caractérisent des secteurs comme le secteur alimentaire exige souvent des solutions qui intègrent des expertises provenant d'un large éventail de disciplines. Dans cette perspective, la proposition faite par l'économiste Richard Norman il y a quelques années, consistant à faire évoluer le concept de "chaîne de valeur" vers le concept de "constellation de valeur", revêt une nouvelle signification non seulement dans les processus de production, mais aussi pour la formulation de nouvelles stratégies de développement de l'innovation. Afin de faciliter la formation de la constellation dans l'écosystème de l'innovation agroalimentaire, il apparaît nécessaire de former des sujets capables d'agir en tant que véritables "broker" - ou intermédiaires - dans les réseaux, en reliant les parties prenantes qui ne sont pas traditionnellement connectées mais qui peuvent donner lieu à "de nouvelles combinaisons" entre les solutions technologiques, ce qui est essentiel pour générer de l'innovation. Successivement, l'on examine les instruments que les technologies numériques et les cyber-réseaux rendent disponibles à ceux qui souhaitent améliorer l'interaction et renforcer une approche collaborative et ouverte entre différents acteurs des systèmes de l'innovation. La vaste gamme de nouveaux instruments/environnements mis à la disposition par le Web peuvent contribuer à créer un "écosystème" dans lequel l'innovation broker est soutenu dans tous les processus clés liés à son rôle.*

Mots-clés. *Technologies numériques – TIC – Web – MOOC – Global – Broker de l'innovation.*

In 1876 Menlo Park was simply a small village in New Jersey, but a few years later Charlie Street in Menlo Park was the first street in the world with electric lighting. The credit belongs to Thomas Alva Edison, the "Wizard of Menlo Park", who directed one of the most creative laboratories in history for over ten years at Menlo Park, birthplace of the phonograph and the commercial version of the incandescent light bulb.

Menlo Park produced more than 400 patents in six years. The key to this incredible output was that Edison firmly believed in the innovative power of recombining previously existent knowledge with a new operational outlook. Menlo Park was a success due to cooperation between scientists from different backgrounds, designers, and mechanics with experience of industrial machinery, who all worked together to design, develop and produce new technology. At the time, the connections between technological know-how in different sectors were extremely weak, and Edison was

the first to recognize that catalysing a horizontal integration process (between different fields of theoretical knowledge) and a vertical integration process (technical knowledge with operational knowledge of design and production) would have great potential to create new solutions.

In almost 150 years since the success of Menlo Park, the relationship between research, innovation and production has become much more complex, but the difficulty of devising new and more effective strategies to connect research and the world of production persists.

Compared with Edison's time, it is even more evident now that the business strategies with the greatest short-term impact potentials are no longer those aimed at encouraging new "inventions", but rather those based on developing the capacity to recombine existing know-how in order to create operationally usable products/services that meet the real needs of businesses and citizens. This is even more the case of sectors like the agrifood sector, where complex problems often require solutions that combine expertise from very different disciplines. In this perspective, the proposal made some years ago by economist Richard Norman (2002) to develop the "value chain" concept towards the "value constellation" concept takes on a new meaning, not only for production processes, but also for the formulation of new strategies for the development of innovation. The impact of Norman's image was that, unlike a chain with links arranged and linked to each other in a fixed way, a constellation is a creative and modifiable conjunction between several fixed points - the stars - that contribute to create value added above and beyond their purely consecutive positions. The idea is that the system of subjects, processes and flows that generates the value is the result of a dense web of relations to be continuously and dynamically re-defined by creating new forms of fusion and integration in order to solve problems by finding new solutions. However, the limit of these dynamic processes is that they do not easily work autonomously and inertially, but require a smart active engine that not only systematically enriches the system of potential nodes, but also creatively stimulates the connections. They thus need a key figure having specific skills who may support animation.

Already a few years ago, many studies (Burt, 2004; Obstfeld, 2005) stressed that there was a need for individuals capable of acting as true brokers in networks to link stakeholders that are not traditionally connected, but from which it is possible to develop "new combinations" between technological solutions essential for generating innovations. In the agrifood sector, the fundamental role of the Innovation Broker is to collect, mediate and support the transformation of research into real value added for businesses and, as highlighted by Klerkx and Gildemacher (2012), this may take very different forms.

The simplest form is the "Innovation consultants" who mainly deal with single farmers, or farmers' associations and groups of Small and Medium Enterprises (SME). Their role is to connect farmers with innovative service and product providers, and to link farmers and SMEs that share the same interests, to facilitate access to innovative solutions and sources of funding for experimentation and implementation.

On the contrary, the "Peer network brokers" play a more structured role, bringing farmers together to exchange knowledge and experience at the interpersonal and group level in order to facilitate business development through "peer-to-peer learning", which includes extending network relations by inviting entrepreneurs from other regions or sectors, or specialists.

Quite interesting is the figure of the "Education broker" aimed at curricular innovation in support of innovative processes and at facilitating access to them.

Alongside these professional figures, Klerkx and Gildemacher identify more complex profiles, like institutions which may act as "systemic intermediaries" to support innovation at a higher systemic level (like an entire production chain), or research councils whose operational agencies can act as innovation leaders at the political-institutional level.

I – A digital ecosystem for the innovation broker

All the ways in which Klerkx defines the Innovation Broker in the agrifood context, describe a new and modern proactive figure that must be capable of acting in a complex context and needs specific support in order to develop adequately. What are then the conditions that may sustain the role of the innovation broker?[1] The discussion about the enabling conditions has highlighted many aspects requiring action: from the institutional aspect (political-regulatory context where the innovation broker acts), to procedure (operational modes to access funding, etc.), to the accessibility of information about innovations that have already reached the right level of applicability.

On the contrary, not a great deal has been said about the technological aspect, that is to say how the wide range of new tools/environments available on the Network may contribute to creating an ecosystem where the innovation broker is supported in all key processes related to the role:

- emergence of needs and their transformation into project challenges;
- real access to products and technological solutions;
- cross-fertilization between different fields in order to design products/services that meet needs;
- creation of an appropriate context for the use of a product/service;
- transfer of the successful practice and its diffusion.

What these processes all have in common is that they are based on the iterative collaboration between individuals of different origins and objectives, and are based in geographically distributed contexts: these are exactly the conditions in which the operational modalities of what is known as "e-Collaboration" can develop. By e-Collaboration[2] we mean the integrated system of recursive processes where several individuals interact online to achieve a common objective, using the collaborative tools available from the complex set of innovative solutions, known from an operational point of view as "Web 2.0", and from a technological point of view as "Cloud Computing".

But in what types of activities can e-Collaboration be especially advantageous to the Innovation broker? Let's start listening to the needs. The Innovation Broker must be capable of developing sophisticated **listening to the needs** of farmers and territories, which cannot be limited to superficial interactions bringing out only needs already openly expressed. To maximize the role as a development promoter, the Innovation Broker has to succeed in intercepting the wide range of territorial needs that intersect with the agrifood sector. E-Collaboration tools can support it in different ways. In this perspective, quite interesting is the possibility of participating in the informal networks set up by professional operators and citizens in social networks. If we explore the most popular social networks like Facebook, we realize that the idea that using these tools is still alien to the agrifood sector is mostly a prejudice. On the most popular social networks there are already many groups dealing with these themes, and some in Italy have several thousand members (see the Facebook group "*Gruppo trasversale agricoltori*" with over 1,700 members or the "*Gruppo Coltivare Condividendo*", with over 3,800 members), who discuss and share news and thoughts related to the agrifood chain and rural areas. Participation in existent groups or the creation of new thematic groups can be an interesting way to recognize problems and needs as the starting point for developing the work of the Innovation Broker. Web listening could also be one of the useful support tools to monitor the major issues and timely grasp emerging problems. These tools have various levels of sophistication and range from the simple and free-of-charge systems (like *Social Mention*[3], or *Talkwalker Alerts*[4]) to the more sophisticated paid systems (like *Radian 6*[5]), but they all make it possible to monitor the level of interest in a topic broadcast on a specific set of web channels worldwide or in a given geographical context. Web listening systems not only

automatically signal the publication of new contents, via e-mail alerts, but also monitor various parameters related to the topic of our interest. These include the number of users who have created contents related to the topic of our choice, the probability that this subject is discussed on the web, and what is known as "sentiment", meaning the rate of positive quotes about our topic out of the total. In short, they are a kind of "barometer" of the Network that may help identify the issues for which a certain interest is developing.

Other e-Collaboration tools can be useful for needs identification: from the oldest tool useful for this purpose, the forum, to those for designing and easily managing online questionnaires even complex ones, which can be sent out by email, or quick surveys that can be created on the social networks.

E-Collaboration strategies make it easier to reach individuals with the most disparate experiences and professional backgrounds, independently of their geographical or organizational position. Therefore, they can also be useful to the Innovation Broker in **constructing the networks** required to identify useful technologies and integrate them into solutions that satisfy needs.

For this purpose, general research-oriented (*ResearchGate*[6]*, Academia.edu*[7], etc.) or specific subject-oriented (*Feeding Knowledge*[8], a food security network) social networks, where researchers worldwide share their results, can be useful. Professional-oriented networks (*Linkedin*[9]) can be useful for identifying the right players to stimulate for transforming innovations into operational services.

Other possibilities that e-Collaboration offers to the innovation brokering process consist of managing **communication** easily and rapidly and of making communication with whoever is to be involved in our processes economically sustainable, independently of their geographical position. For a while, systems like *Skype*, *Messenger*, and *Twitter* have been providing rapid contact with our interlocutors, either individually or in a group. In addition, the communication functions of the social networks can be used to send messages or chat in real-time with individuals or groups.

Finally, e-Collaboration can also be useful to the innovation brokering processes in **constructing and sharing contents with the subjects involved in the process.** This means all forms of content: from the most "traditional" (e.g. texts, spread sheets, presentations, logical maps), to the more complex (e.g. videos, animations), to lighter and **extemporary** forms (e.g. posts, messages, comments, reviews, personal profiles). Web 2.0 has made it considerably simpler to create media contents, even complex ones (e.g., videos can be produced and edited on YouTube), by allowing real-time collaboration with others (Google Drive[10], for instance, allows online collaboration to create texts, presentations, spread sheets and so on) and the results can be made available immediately to anyone with access to the Web.

All these possibilities certainly have very interesting potentials, but the Network environments where all these possibilities come together to achieve a specific objective of innovation processes are even more interesting.

II – The case of OpenIDEO: from problem formulation to collaborative construction of an innovative solution

When dealing with supports to innovation processes, the potentials of e-Collaboration can yield quite interesting results when they are aggregated in consistent contexts capable of supporting complex processes, ranging from establishing the problem to the identification of possible solutions.

OpenIDEO[11] is a very interesting case from this point of view, because it is a web-based innovation platform where everyone can work together to develop innovative solutions for societal

challenges. Launched in 2010 by British design company IDEO (famous for its methodologies modelled on "human centred collaborative design"), the platform is open to anyone (individuals, no-profit organizations, etc.) wishing to submit a challenge related to a social problem. OpenIDEO staff evaluate the importance of the issue, and if they judge it to be significant, they formulate it in terms of a "Challenge" and publish it on the site. Then, three successive steps are developed:

- *inspiration*, the community logged on to the site is invited to upload and share any useful references to products, services, initiatives - even developed in other sectors - which may give others ideas for solving the problem that is the "challenge";
- *concepting*, developing and sharing of project concepts by any member of the community;
- *evaluation*, multiple-step selection by the community of the most interesting solutions.

Users of the platform participate in each of the three steps through a kind of collective brainstorming session and receive points that increase their DQ - Design Quotient - a kind of indicator of the reputation gained in the field as "Designer of innovative solutions". At the end of the process, which usually takes place over about three months, the community assesses the most interesting solutions. The winning projects can be used by anyone: all concepts developed are generated under a Creative Commons licence that authorises sharing, recombination and reusability.

It is interesting to note that the first challenge launched by the portal concerned precisely the agrifood sector: well-known English chef Jamie Oliver launched the topic "How can we make kids aware of the importance of consuming fresh food?"

After a ten-week session involving hundreds of people of all kinds (designers, nutrition experts, teachers, entrepreneurs, citizens), 180 proposals emerged, and from these the community selected 17 winning concepts.

The selected concepts proposed very different types of solutions: supermarket organisation strategies to attract children's attention to fresh food; *Apps* mid-way between socialization tools and online games encouraging children to express their opinions of a wide range of fresh foods; proposals for a policy to regulate automatic snack machines to keep a number of slots for fresh foods; "smart" shopping trolleys that encourage customers to buy fresh foods.

With over 20,000 members in more than 170 countries, OpenIDEO has successfully created a community of "creative thinkers", willing to contribute to social innovation processes by sharing inspiration, proposed solutions, selection and assessment skills. In some cases, OpenIDEO even goes beyond the simple creative challenge and supports the search for sponsors to turn the idea produced by the community into reality.

The potential of open innovation social networks like OpenIDEO is still to be discovered, but can easily be recognized for contexts like innovation in the agrifood sector, where cross-fertilization and sharing between all active territory-based players are the indispensable ingredients for design and implementation of sustainable situations.

III – Massive Online Open Courses: a working space for Education Brokers

Continuing our exploration of the Network's contribution towards Innovation Brokering, it is quite interesting to consider one of the many profiles identified by Klerkx and Gildemacher for innovation in the agrifood sector: the "Education broker" involved in training who supports innovative processes and facilitates access to them.

From this point of view, we can think of an additional interesting process that could be explored to enrich the online ecosystem supporting Innovation Brokers: it includes all the new ways of sharing online know-how, which means first of all the MOOCs (Massive Online Open Courses) which are revolutionising free (or low-cost) training available online.

These were launched in spring 2012 (the best known are Coursera[12], EdX[13] and Udacity[14]) with the support of top-level university institutions (MIT, Harvard, Princeton, Stanford, etc.), which propose online courses free of charge, and mostly held by teachers with international standing. The number of participants in each course is on average equal to several thousands (that's why the word "massive" is present in the acronym). The key point for the birth of MOOC philosophy was Stanford in September 2011, when a free online course on artificial intelligence held by Peter Norvig and Sebastian Thurn attracted more than 160,000 students from all over the world, suggesting the launch of Coursera, the most aggressive MOOC start-up.

At present, the two leading American MOOC start-ups - Coursera and edX - are having outstanding worldwide success. Coursera has over 13 million members and edX has more than 5 million, but there are also many European MOOCs (iVersity15, FUN[16], Futurelearn17, ECO[18]). Any institution can propose its own MOOCs and find a platform to host them, provided the course quality is high. It will be up to the users to decide to what extent this is successful.

Unlike "traditional" e-learning courses, MOOCs are the result of true "knowledge sharing" strategies, by which institutions make their knowledge available to all those interested via quick and highly communicative formats. This is a huge phenomenon: just three years after the first MOOCs were launched, in January 2015 the European Commission's Open Education Europe initiative counted over 3800 MOOCs worldwide, and this figure is expected to increase on average by more than 50% between 2013 and 2018. Of course, such a wide system offering high-level training brings new opportunities in the configuration of the learning processes that must accompany the development and application of an innovation.

MOOCs are generally based on a set of ad hoc materials (mostly high-quality short videos) by teachers selected not only for their reputations but also for their excellent communication skills, and the videos are often produced using the most innovative video and animation techniques. Generally, the contents are supplemented with exercises where peer-to-peer exchanges are very important (for instance, it is the core of evaluation exercises) and this ensures the sustainability of a learning context with a high rate of social interaction and a very large number of users. An attendance certificate is issued at the end of the course, free of charge in most cases, although some Universities are now experimenting with issuing recognized University credits for a fee (a few dozen dollars), and in some cases they ask students to supplement the course with specific assessed assignments.

Although the offer in French, Spanish and Italian is steadily growing, for the moment MOOCs are mostly in English. Course contents are mainly in STEM areas (Science-Technologies-Engineering-Math), but the agrifood sector now has an increasing number of MOOCs.

The National Virtual Academy for Indian agriculture (NVAforIA) promotes a very interesting course on the IT BombayX platform, a platform belonging to the big family generated by OpenedX (the open source platform for MOOCs developed by MIT). This is entitled "Diseases of Horticultural Crops and their Management",[19] and is a training course funded by the government to encourage young people to study agronomy.

OSU (Oklahoma State University) pursues a similar objective. With "Farm to Fork: A Panoramic View of Agriculture",[20] it aims to encourage students to look at the agrifood sector proactively by taking part in debates on controversial themes, and this is also the case with the "Agriculture and the world we live in" MOOC developed by Massey University in New Zeeland.

Copenhagen Business School offers a MOOC called "Social Entrepreneurship"[21] on the Coursera platform, which looks at the issues involved in the relationship between innovative entrepreneurs and social innovation. Among other things, it also focuses on issues related to the agrifood sector and the rural context. Agreenium, the French consortium for economic and veterinary research and education, proposes "Agroécologie"[22], a MOOC in French, aimed at stimulating an active approach to understanding the complexity of the agrifood sector and its relationships with the environment.

MOOCs focus especially on topics related to food security and sustainability in a global perspective. Lancaster University has launched "Global Food Security: Addressing the Challenge" on the platform of MOOC Britannica FutureLearn;[23] this MOOC deals with food security in its various technological, economic and social terms. The University of Reading proposes "Our Hungry Planet: Agriculture, People and Food Security"[24] that deals with food security with a special focus on the role of family farming.

Wageningen University (The Netherlands), known for its advanced studies on innovation in the agrifood sector, offers a MOOC called "Growing our Future Food: Crops"[25] on the edX platform (promoted by MIT and Harvard); it examines the relationship between sustainable approaches to farm production and food security.

An increasing number of MOOCs cover subjects not strictly related to the agrifood sector, but essential in any innovation project: from methodologies for the adoption and implementation of start-ups, to significant contents for the rural context like social innovation and sustainability. This area is growing continuously, and every institution can contribute by creating alliances with the managers of large international platforms and by making contents available that are useful for the prospects of innovation to be promoted together with local entrepreneurs.

IV – Conclusions

A quick exploration of the web-based tools that can support the process of Innovation Brokering, shows that Innovation Brokers can benefit from using web-based tools in all the steps of the process. This means starting from context analysis, in order to recognize needs and opportunities (available technologies, funding, training opportunities, specific policies), and following on with the construction of partnership networks (by selecting those with complementary knowledge, technology and funding resources) to arrive at the formulation of innovative solutions and the creation of the cultural and operational context for their integration. However, the challenge is to integrate all the opportunities offered by the web into a real ecosystem aimed at specific needs of broker innovation in the agrifood sector. This means that the tools for listening to needs, for networking, training and the collaborative construction of solutions must be developed synergically around a new professional profile, that integrates e-Collaboration skills with innovation process skills and specific sector-based knowledge in support of a new Innovation e-Broker for the agrifood sector.

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Notes

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