

PUSHING TOWARDS TECHNOLOGICAL INNOVATION IN THE CULTURAL AND CREATIVE INDUSTRY OF SARDINIA

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Abstract

The paper aims at describing the current situation of the Cultural and Creative Industries (CCI) in Sardinia with respect to the newest technological trends.

The availability on the market of several innovations (such as Internet of Things, 3D graphics, advanced data mining systems, crowdfunding platforms, cloud and file sharing applications, augmented reality applications, digital publications etc) has enormously contributed to the development of innovative businesses and practical solutions for the operators of several sectors. However, while the CCI sector seems to be among the ones most affected by the digital revolution, there are still some relevant challenges and bottlenecks that are currently untackled.

The paper focuses on the single operators' views and foresights on the new technological assets and their impact in the next few years. Fifty Sardinian operators of the cultural industry have been interviewed in order to analyse their thoughts and orientations with respect to their motivations to innovate and the applicability of the latest technological innovation to their respective businesses. The paper evidences that although the Sardinian CCI operators are very much aware of the current technological trends, some issues impair the full adoption and diffusion of technologic advancements. The critical points are mainly an insufficient access to finance and technical or infrastructural problems.

Keywords: *Innovation, Cultural industry, Creative industry, Technology transfer and innovation.*

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1. Introduction

This paper aims at describing the current situation of the Cultural and Creative Industries (CCI) in Sardinia with respect to the newest technological trends and their influence on competitiveness. It tries to analyse the current situation through qualitative and quantitative methodologies in order to identify how these organisations respond to technological advancements.

The availability on the market of several innovations (such as IoT, 3D graphics, advanced data mining systems, crowdfunding platforms, cloud and file sharing applications, augmented reality applications, digital publications etc) has enormously contributed to the development of innovative businesses and practical solutions for the operators of several sectors. However, while the CCI sector seems to be among the ones most affected by the digital revolution, there are still some relevant challenges and bottlenecks that are currently untackled. Sardinia, administratively a region of Italy, is an island whose history, geographical position and political evolution created a specific and distinctive cultural heritage, made of language, music, culinary traditions, dance, poetry, landscapes, archaeological sites and historical buildings. Its position, in the western Mediterranean, has granted the island and the coastline areas most of all, a prominent position within the European tourism destinations, although with a highly variable season-related number of presences throughout the year. The vast tangible and intangible cultural heritage of Sardinia is currently only in part capable of generating stable growth and occupation and of creating real added value and attractive products/services that could help boost tourism in the low-season months. Although the regional government is currently implementing funding opportunities aimed at increasing innovation adoption and competitiveness in the CCI, there is no sufficient evidence to support this financial effort and its effectiveness in a way that ensures the actual take up of new technologies within the local CCI. The gap evidenced concerns the lack knowledge of the behaviour and expectations of Sardinian CCI regarding their technological needs. This paper aims to fill this gap by providing a model to analyse the influence, the impacts and the future trends of technology on small cultural and creative enterprises.

In order to study the positive impact of technology in this context, the authors focused their attention on the following research questions:

RQ1) Based on their field of activity, what are the most attractive and strategically relevant technologies for the Sardinian CCI?

RQ 2) How could the CCI operators active in Sardinia could be characterised in terms of attitude and needs of technology?

RQ 3) Given the current situation and the public funding opportunities available for CCIs, what are the main constraints and obstacles the Sardinian CCIs must overcome in order to increase their competitiveness through innovation adoption?

The paper is structured as follows: after a review of the most relevant literature available, the study gives a definition of the CCI boundaries, structure, relationships with technology and economic relevance. It then defines the methodology devised to analyse the behaviour of Sardinian CCI in relation to the research questions.

The criteria for creating the survey and selecting the respondents are explained together with the statistical tools used to determine patterns in behaviour. The results are then illustrated with the main findings of the paper.

2. State of the question

Creative and cultural industries are made of a combination of both traditional and innovative activities, shared by the presence of intangible added value linked to culture, creativity, aesthetics and the transfer of symbolic values and meanings. The CCI feed themselves cultural stimuli and reflect this exposure to different materials by producing new ones; their output is inhomogeneous and often difficult to classify, as it encompasses at the same time economic, intangible, artistic and social values, as well as both product and service components. Innovation plays a very important role within the CCI, whose nature is fluid and changing, as it is characterized by a strong interdependence between processes, art forms, approaches and disciplines. In an effort to effectively describe the state of the question, this section will summarize the main literature defining CCI in terms of nature, activities, organisation and structure. Subsequently, the analysis will shift towards a description of CCI in terms of size, occupation, and relevance in terms of share of GDP within the EU and Italian economies. The last part of the section will focus on the technological innovations which are expected to have an impact on the CCI sector.

2.1 Definitions, nature and structure of CCI

Creative and Cultural Industries are “those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property” (DCMS 2001).

The first definition of creative industry was drafted by the economists of the Frankfurt school (Adorno and Horkheimer 1944), that defined it with a

negative connotation, linked to the concept of commodification of art. The term was used to refer to activities that combined creation, production, marketing and consumption of creative and cultural immaterial contents. Immateriality in this case refers more to the utility connected with the cultural goods rather than their physical shape or container. The Cultural industry embraces a rather large range of activities that produce an output, be it a product or a service, containing an artistic or creative value, through a productive system composed of different techniques that can be used singularly or combined among themselves.

The C&C (Creativity and Culture) Report produced in 2012 by the ERVET agency of the Emilia Romagna Region (2012) identifies some of the typical CCI factors:

Use of cultural resources and creative abilities as inputs

Production characterized not only by the creation of functional value or usefulness of the goods and services realized, but also by aesthetic, symbolic values created through creative activity

Operational practice characterized by a constant applied research, non-standardization and non-seriality, research for novelty and uniqueness

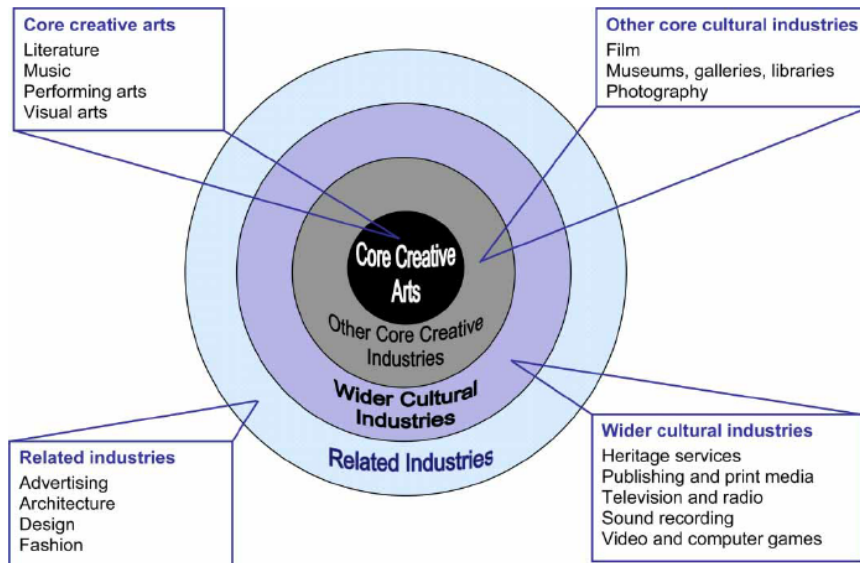
Production process is subject to constant adjustments and repeated trial and error trials

CCI activities tend to be innovative and organized based on individual projects, which often have a variable structure. Consequently, the result is not easily repeatable, and the production process is tailor-made for each new project. This involves high levels of organizational flexibility in the structure and operation of its members, whether they are artists/creative professionals and professional operators.

As stated, there are numerous approaches to the classification and perimeter of CCI. Approaches drawn up since the 1990s have attempted to classify the CCI based on criteria such as the inputs and outputs of the production system, the production system itself, the presence of copyrights, etc. Such approaches, which are severely influenced by other factors such as the geographical location of those applying the classification, have not yet reached the goal of becoming globally accepted. The demarcation between the two macro-components of the industry, the creative industries and the cultural industries is also subject to discussion.

On this subject, the literature has produced several contributions. Caves, in particular (2002), defined the seven creative properties characterizing creative industries. David Throsby (2008), defined the "concentric circles" model, a method for characterising the CCI based on the level of "cultural value" of their products/services.

Fig. 1 Concentric circles model of the CCI (Throsby 2008)



According to Scott (2001) there are several sectors of the economy that have some sort of symbolic cultural content, but culture itself is supplied in the form of goods and services that are brought to the market by the cultural industries. In this way, this sector's dynamics can be analysed through the same framework used for traditional industries, if above all, the main focus of the analysis is the consumption of these goods and services. This implies, according to Throsby (2001) that the production and consumption of cultural goods/services can be associated to industrial framework and that its outputs can be considered in the same terms as other products created within the economic system. The symbolic value of the production of the cultural industries is also stressed by Throsby in a following work (2008) in which it is suggested that, while all cultural goods and services requires some level of human creativity as an input for their production, they are means that carry symbolic messages to the ones that consume them, thus implying that the economic value of such goods relies mainly on the intellectual property rights that area to be attributed to the author or producer of the good.

This also implies that the growth of the cultural industries, the single firms and the culture-related economy as a whole, is strongly connected to the quantity and quality of cultural operators available on a territory (Scott 2010), and, in the times of global communication

and telework, on the network of such operators available on the web for any firm.

Globalisation and innovations in the communication systems have influenced the production of cultural goods and services (UNCTAD 2008). The combination of technology, culture and social/behavioural issues have modified the landscape of creativity with relevant positive implications in terms of social and economic growth (KEA 2009).

Technology, enterprises, culture and creativity are the gears of a complex system that is capable to produce positive consequences on the territory. The “Creative Economy” report published by the United Nations Conference on Trade and Development (UNCTAD 2008), underlined the relationship between culture, economy and technology, as “the ability to create and circulate intellectual capital, has the potential to generate income, jobs and export earnings while at the same time promoting social inclusion, cultural diversity and human development”.

The CCI sector is capable to contribute indirectly to industrial innovation through cross-contamination. This because they provide other sectors with creative goods and services that act as intermediary inputs which can be transformed into innovations (Cooke and Propris 2011, DCMS 1998, Müller et al., 2009). This vocation towards innovation implies that CCIs are more innovative than many other innovative sectors (Chapain et al., 2010); however, traditional models are inadequate to fully understand the innovation dynamics within the CCIs (Tommaso et al., 2017).

Market forces can drive innovations into the CCIs, but market alone is not capable to guarantee proper diffusion and exposes the CCIs to high failure rates (Galloway and Dunlop, 2007). Furthermore, Innovation requires the combination of diverse ideas with high creative content (Messeni et al., 2015) leading to high uncertainty of the results. This situation generates a predominant commercial orientation of the CCIs activity (Kong 2014), prioritising projects that have higher profits rather than others with higher innovative content. These arguments suggest underinvestment in the CCI which in turn explains the presence of public-funded innovation programmes for these industries (Oakley, 2009).

The search for technological solutions in the field of the CCI is influenced, as it happens in all other sectors, by a series of external or internal conditions that are sector-specific.

In order to better understand which these conditions are and how they influence the decision-making process, it is necessary to draft a logical framework capable of explaining the choices of adoption of a given set of technologies in the field of culture and creativity.

In this way, Bakhshi and Throsby (2012) defined the innovation needs of CCI companies and operators, taking under consideration the fact that a large share of the cultural and creative institutions and operators work in an environment where the presence of public funding is relevant and, sometimes, represents the main funding source if not the only one.

This implies that the theories on the growth and development of non-profit organisations such (Hansmann 1987; Rose-Ackerman 1996; Weisbrod 1977) and the notions on their business and operational practices (Hansmann 1981; Luksetich and Lange 1995; Netzer 2003; Throsby and Withers 1979) have to be considered when trying to define the CCI operators' behaviour.

2.2 Economic relevance of the CCI in the EU and Italian economy

According to the European Commission, in 2014 CCI were responsible for around 3.5% of all EU products and services annually, and employed 6.7 million people, or 3% of the European workforce. They represent a significant part of Europe's identity and growth, by offering a key source of creativity and innovation, as well as contributing significantly to social cohesion and well-being. Cultural and creative industries boast €558 billion in value added to GDP (4.4% of total EU GDP) according to the 2014 TERA - Forum d'Avignon Study.

According to an EU Parliament Report of 2016 the CCIs are "at the core of a dual and delicate ecosystem between large groups of internationally competitive and innovative SMEs, and start-ups, which constantly renew the area, preserve and promote diversity, create jobs, but are sometimes fragile, particularly in their access to markets and finance. The same report offers more recent figures on the EU CCIs: according to it, over 12 million full-time jobs (7,5 % of the EU's work force) derive from the CCIs. These companies create 509 billion euros in value added to GDP (5,3 % of the EU's total GVA). Finally, the CCIs in Europe employ 2,5 times more people than automotive manufacturers and five times more than the chemical industry (European Parliament 2016). The Italian scenario of CCI is equally relevant and interesting. According to the yearly report "Io sono Cultura" (I am Culture, 2016) published by Fondazione Symbola and Unioncamere the overall system of Culture and Creativity, which comprises not only the CCI but also the historical and artistic heritage, produces 6,1% of the national GDP, equal to 89,7 billion Euros. The report evidences also a leverage effect triggered by the CCI: according to the research, the ratio is equal to 1,8, meaning that 1 Euro produced through culture generates indirectly additional 1,8.

Euros of wealth. This implies that the sum of the direct and indirect revenue generated by culture is of nearly 250 billion euros, equal to 17% of the total Value Added. The system of Culture and Creativity employs 1,5 million people (6,1% of the total) with a feeble but constant growth in the last 5 years (2011-2015). These figures may seem irrelevant, but it must be considered that they refer to a time of crisis and recession where, the overall economic indicators scored negative values. One last significant point is the relationship with tourism. More than one third (37,5%) of the tourism-related expenditure is related to culture. If we consider the situation on a more local level, each region of Italy has its own specific characteristics which are influenced by demographics, heritage, geography and local economic structure. For instance, the Aosta Valley, Veneto and Molise regions show significant levels of architecture-related activities; other regions that host large metropolitan areas such as Latium and Lombardy have a large number of companies active in the field of communication (advertisement, graphic design etc...). The field of specialisation of Emilia Romagna and Marche is design, since these two regions are known for their manufacturing sector. Latium is also strong in cinema and TV productions thanks to the presence of the National Television (RAI) and the movie district of Cinecittà. The videogames sector is well represented in Trentino Alto-Adige, Lombardy, Piedmont and Friuli-Venezia Giulia. The southern regions are home to several publishing companies and Sardinia's heritage promotion and valorisation activities stand out (Symbola and Unioncamere 2016).

2.3 Technological innovations for the Creative and Cultural Industries

In order to analyse the attitude of Sardinian CCI towards technology and innovation a mapping of the available technologies that are relevant to the CCI sector has been carried out. The methodology used to select these technologies is based on previous research carried out by Bellini (2015) and Balata (2018). The rationality behind the methodology is to select the technologies that have been identified and developed thanks to targeted EU calls, namely the projects funded within the DigiCult domain. The term "DigiCult" was created by the EU Commission during the 5th framework programme for research and technologic development, active between 1998 and 2002 (FP5). The research activities funded within the scope of the sub-programme IST (Information Society Technology) and oriented to the CCI sector have been included in the DigiCult project domain. Such projects were focused on introducing information technology

in various aspects of the operations of cultural and creative businesses and institutions. The DigiCult projects continued throughout FP 6 and FP7 and included initiatives in the fields of digitisation technologies, digital preservation, digital cultural experiences and research capitalisation and best practice diffusion. The analysis of the main technological innovations implemented in the DigiCult projects allows to determine which types of innovations are the most relevant to the CCI in the long run. Table 1 includes a list of technologies and innovations used for this research together with a short definition.

Tab. 1 – List of technologies included in the analysis

Technology	Definition
Social Media and Live media	Web based platforms allowing the interaction between users based on shared multimedia content and live broadcasting of videos.
Cloud Services and Co-Creation	Shared file storage systems which allow group-work, modification and integration of the content and multiple users contributing at the same time to new content creation
E-Books	Paperless publishing methods with online distribution of books and text/images content
Document and Archive Digitisation	Digitisation, indexing and online distribution/searchability of content previously not available online
Creative Learning	Innovative teaching methods using visualisation, graphics and multimedia interaction as a tool for improved learning performance
Search Engine Tools/ Data Mining Tools	Data search engines and algorithms designed to improve search results and indexing of online content. Big data and artificial intelligence applications to vast amount of textual a visual information.
Cultural Heritage preservation and Conservation	Digital technologies applied to the cultural heritage, both tangible and intangible. It can include the elaboration of physical and chemical data to improve conservation of endangered heritage.
Crowdfunding-Crowdsourcing	Use of online platforms to gather funds, expertise and ideas in order to create new cultural/creative products.
Digital Storytelling	Use of visual technologies and online/social sharing to reach wider audiences for cultural products
Mobile Technologies	Use of mobile devices to convey or gather information on cultural product/services or heritage.
Social Web Crawling, Analysis and Data Mining	Analysis of data published online and on social media platforms aimed at understanding behaviours and trends and to identify patterns.
Conservation Planning	The process of locating, configuring, implementing and maintaining areas of interest (cultural, archaeological, natural) using datasets and planning techniques (e.g. GIS technologies)
Augmented Reality/ Virtual Reality	Technology that either superimpose a computer-generated image on a user's view of the real world, thus providing a composite view or reproduce real existing spaces via 3-d rendering of the reality, allowing navigation within them.
OCR, Language Technologies	Hand written text recognition and digitisation, language software for computational linguistics, automated translation, digital philology etc.

3d Models	Digital three-dimensional rendering of real objects, for study purposes
Internet of Things	Networking and connection to the web of physical devices for various purposes (remote control, data acquisition and exchange, automation)
Digital Fabrication	Reproduction of physical objects and 3d models using additive or subtractive printers.

The approach towards adoption of new technologies within a firm can be broken down in two main types, incremental and radical. With regard to the CCI sector both types of approached can be observed although in a variable way depending on the kind of activity carried out by the firm. Incremental innovations could be e.g. for publishers or musicians the use of e-books or online streaming of contents to reach a wider audience; augmented reality applications could allow users to access extra content when visiting a museum or an archaeological site. Digital Fabrication could help students to manipulate delicate or ancient manufactures avoiding the risk of damage. Virtual reality could be seen as a more radical type of innovation if used to reproduce interactive scenarios described in literature or to re-create a physical space (museum, building, gallery) in order to allow access to users who live far away from the site or to disabled people. The economic impact of such innovation can be estimated in terms of wider audience reach, increased sales, differentiation of the service or goods offer. The choice of how to apply innovation is strictly correlated to the innovation motivations set out by (Bakhshi and Throsby 2012), which are also taken in consideration in the methodology used for this study.

3. Methodology

The paper focuses on the single operators' views and foresights on the new technological assets and their impact in the next few years.

Fifty Sardinian operators of the cultural industry have been interviewed in order to analyse their thoughts and orientations with respect to their motivations to innovate and the applicability of the latest technological innovation to their respective businesses.

The sample was selected based on a series of internet searches for which a set of keywords applicable to the CCI were used.

The keyword pattern used for the search is shown in the following table (the keywords shown are translated in English, the search was carried out in Italian):

Tab. 2 – List of keywords used for the database search

First keyword (geographic)	Second keyword (CCI sector and/or activities)	Third Keyword (type of operator)
Sardinia, Sardinian	Literature, Poetry, Prose	Association, Foundation, Co-Op, enterprise, firm, limited company
Sassari, Nuoro, Oristano, Cagliari	Theatre plays Opera Music, Concerts, Songs Productions Musicians, Groups Performing Arts, Theatre, Shows Events Dancing and ballets Television, Radio Cinema-Movies Museums, Exposition, Art Galleries, Collections Ethnography Archive, Library Publisher Figurative arts, Photography, Sculpture Painting, Drawing, Illustration, Animation Architecture Conceptual Art Historical, Archaeological, immaterial Heritage, Landscape Sardinian historical languages, (Sardinian, Algherese, Tabarchino, Sassarese, Gallurese) Festivals, Salons, Fairs, Expositions Additional keywords: Traditional, protections, preservation, valorisation, training.	

The result of this was a list of approximately 200 websites of entities active in the CCI sector. The websites were checked to ensure that they met with the following criteria:

- Active entity (last update of the website, presence of active social network pages, activity calendar etc)
- Based in Sardinia, according to the headquarters' address available in the contact page
- Effectively part of the CCI sector, based on the concentric circles model (Throsby 2008).

We then used a spider software to extract the email messages from the webpages. At the same time, an online survey was created with the following structure:

1. Interviewee profile (6 questions, including age, education, decision powers, technology awareness etc.)
2. Technology present use and forecast (2 questions)
3. Motivation to innovate with definitions based on (Bakhshi and Throsby 2012)(1 question)
4. Contact details for further questions and clarifications

The survey was anonymous, unless for those who wished to be contacted for further questions. We sent the survey to all members together

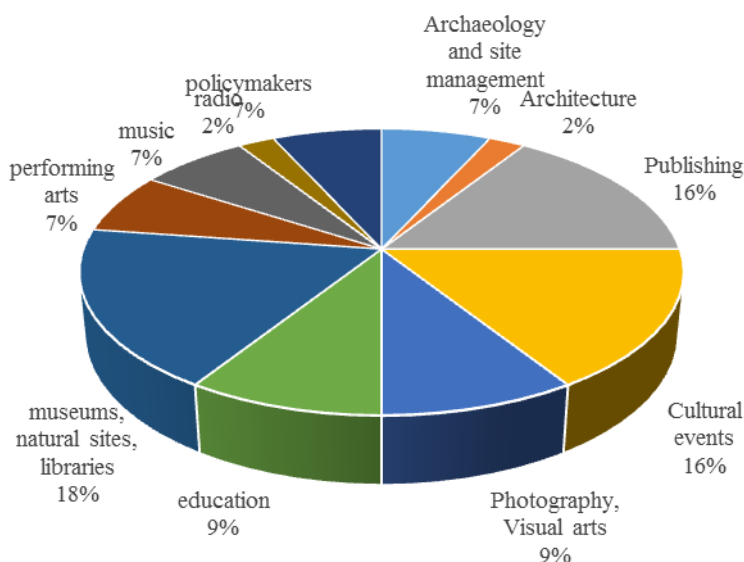
with a short cover letter describing the purpose of the research. Out of the 214 email messages sent, 50 contacts answered the survey (23.3%). Of these, forty-four respondents asked to be contacted again to complete the survey by answering the last question. The further question posed to this last group of respondents was: "List and describe the main obstacles that are preventing your organisation to implement the innovations you cited in the survey". This last question was posed in an open way and was left purposefully for a one-to-one telephone interview with the aim to collect insights that are more detailed on the subject and stimulate an in-depth analysis of the problem. The data obtained through the questionnaires was analysed in order to obtain a description of the current situation.

4. Results and discussion

The 50 respondents of the questionnaire had an age comprised between 25 and 67 years. The average age is 40.9 years. The average level of technology awareness is quite high (3.93) in the considered sample as well as the position of the interviewees in the hierarchy of their respective organisations. The average level of education within the sample is 2.64 in a 4-point scale with the most present level being the Masters' degree (43.2% of the sample). Overall, 77.3% of the sample hold some sort of university degree (Bachelors', Masters' or PhD).

The following pie chart shows the distribution in the different sectors:

Fig. 2 Sample occupation distribution



Tab. 3 - descriptive data of the sample. Items are ordered from the highest to the lowest mean value.

Descriptive data	Mean	Std.Dev..
Age	40.91	10.589
Decision powers within the organisation (1-5 Likert scale)	3.98	1.045
Tech awareness of the interviewee (1-5 Likert scale, self-evaluation)	3.93	0.873
Education levels (1-4 Likert scale)	2.61	1.061
Use of technology		
Social Media and Live media	2.20	1.002
Cloud Services and Co-Creation	1.59	1.168
E-Book	1.59	1.019
Document and Archive Digitisation	1.55	1.109
Creative Learning	1.55	1.170
Search Engine Tools/ Data Mining Tools	1.52	1.210
Cultural Heritage Preservation and Conservation	1.39	1.316
Crowdfunding-Crowdsourcing	1.30	1.091
Digital Storytelling	1.30	1.069
Mobile Technologies	1.25	1.164
Social Web Crawling, Analysis and Data Mining	1.16	1.219
Conservation Planning	1.00	1.181
Augmented Reality/Virtual Reality	0.95	1.120
OCR, Language Technologies	0.93	0.925
3d Models	0.84	0.987
Internet of Things	0.75	0.991
Digital Fabrication	0.61	0.945

Table 3 shows the first result of our research. Among our interviewees, the highest level of usage is found in the Social media and Live media category. This is understandable since it is self-evident that social networks have become a part of everyday practice, both on the professional and the personal level. The fact that Facebook offers the possibility to diffuse information on events and cultural activities in general makes this type of technology the most used overall in our sample. If we look at the bottom of the table, we can affirm that the least used group of technologies are the ones where specific hardware (and therefore, investments) is needed for implementation.

Digital fabrication for instance, is used in different fields, from rapid prototyping to sculpture reproduction. The cost of hardware needed to use this technology is still quite high, although steadily

decreasing. However Digital Fabrication requires also specialised operators.

These causes (high investments and skilled workforce) might be at the base of the low diffusion of this type of techniques. The same framework can be applied to IoT applications, 3D modelling, language technologies and OCR and Virtual/Augmented reality.

Tab. 4 - Usage levels

	No use		Not now, but probably in the future		Sporadic use, not fundamental		Large use, fundamental	
	f.	%	f.	%	f.	%	f.	%
AR/VR	23	52.3	5	11.4	11	25.0	5	11.4
Cloud services and co-creation	9	20.5	15	34.1	5	11.4	15	34.1
Conservation planning	23	52.3	5	11.4	9	20.5	7	15.9
Cultural heritage preservation and conservation	18	40.9	5	11.4	7	15.9	14	31.8
Creative learning	10	22.7	14	31.8	6	13.6	14	31.8
Crowdfunding-sourcing	15	34.1	7	15.9	16	36.4	6	13.6
Digital fabrication	30	68.2	2	4.5	11	25.0	1	2.3
Document and archive digitisation	9	20.5	14	31.8	9	20.5	12	27.3
E-book	7	15.9	14	31.8	13	29.5	10	22.7
IoT	26	59.1	5	11.4	11	25.0	2	4.5
Mobile technologies	14	31.8	16	36.4	3	6.8	11	25.0
3d models	22	50.0	10	22.7	9	20.5	3	6.8
OCR, language tech	17	38.6	16	36.4	8	18.2	3	6.8
Social web crawling, analysis & data mining	19	43.2	9	20.5	6	13.6	10	22.7
Social media and live media	1	2.3	15	34.1	2	4.5	26	59.1
Digital storytelling	12	27.3	15	34.1	9	20.5	8	18.2
Search Engine tools Data Mining tools	11	25.0	14	31.8	4	9.1	15	34.1

More specifically, table 4 shows the same data of table 3, disaggregated by levels of usage. One of the purposes of this paper is to identify, among the interviewees, a pattern of usage of the latest trending technologies. In order to do so, the data resulting from section 2.a (technology usage level) of the questionnaire have been studied using the Factor Analysis method. The analysis took into consideration all usage level variables except Cloud Services and Co-creation, Creative Learning Methods. Cultural Heritage Preservation and conservation, Social web crawling and data mining and Augmented/

Virtual Reality. These variables were excluded from the analysis in order to create more definite factors, as they were found responsible of cross-loadings in the correlation matrix. Cross-loadings make difficult to identify clearly underlying factors when carrying out factor analysis. The technology awareness variable was then added to the analysis because it is believed to have an influence on the capability to adopt a technology and on the way each subject deals with an innovation in the field of ICT. All elaborations were carried out using IBM SPSS ver. 23. The data set was firstly tested through Cronbach's alpha in order to check its reliability and consistency. The value obtained is 0,761, that is considered to be acceptable (Cronbach 1951).

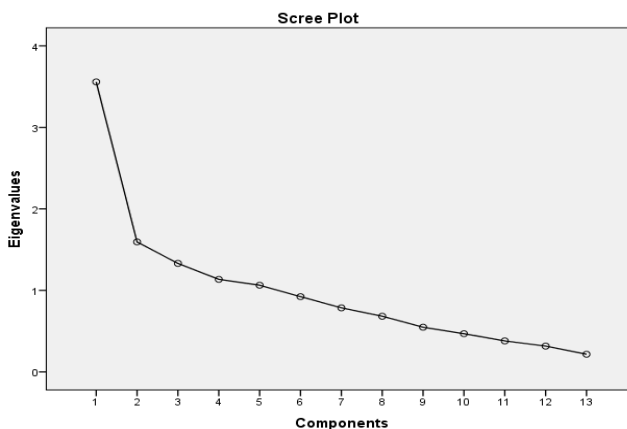
Furthermore, the KMO test for sampling adequacy and Bartlett's Sphericity tests were carried out in order to check the quality and significance levels of the proposed analysis. The results, shown in table 4 are positive as the KMO test value is over 0,6, meaning the data set is acceptable, while Bartlett's Test of Sphericity also returns positive results in terms of significativity (Cerny 1977; Kaiser 1974).

Tab. 5 - KMO and Bartlett's Test results for the sample

Kaiser-Meyer-Olkin sampling adequacy measure		0.643
Bartlett's Sphericity	Chi-square approx..	132.690
	Degrees of freedom	78
	Sign.	0.000

The method used to treat the data was Exploratory Factor Analysis through Principal Components Analysis; at first the software was set to identify factors by excluding items with eigenvalues lower than 1. The programme produced a covariance matrix and a Scree Plot that were useful to identify the presence of underlying factors.

Fig. 3 - Scree plot evidencing the presence of two to five possible components



Tab. 6 - Technology usage levels, total explained variance matrix

Components	Initial Eigenvalues			Extractions sum of squares loadings			Rotated sum of squares loadings		
	Total	% Var. explained	% Cumulative	Total	% Var.	% Cumulative	Total	% Var.	% Cumulative
1	3.558	27.370	27.370	3.558	27.370	27.370	2.063	15.869	15.869
2	1.594	12.265	39.635	1.594	12.265	39.635	1.972	15.172	31.041
3	1.331	10.236	49.870	1.331	10.236	49.870	1.747	13.441	44.482
4	1.135	8.732	58.602	1.135	8.732	58.602	1.566	12.044	56.526
5	1.063	8.174	66.776	1.063	8.174	66.776	1.333	10.250	66.776
6	0.923	7.103	73.879						
7	0.785	6.040	79.919						
8	0.682	5.248	85.167						
9	0.548	4.215	89.382						
10	0.469	3.605	92.987						
11	0.380	2.920	95.907						
12	0.316	2.431	98.338						
13	0.216	1.662	100.000						

Table 6 and Figure 3 indicate numerically and visually that there could be up to five underlying dimensions capable to describe the dataset in terms of use and diffusion of technology and that these five dimensions or components are responsible for 66,78% of the variance in the analysed data. Further refining of the analysis, allowed to reduce through orthogonal rotation (Varimax with Kaiser Normalisation) the number of components. The rule of thumb used to determine in a reliable way the actual number of components is that at least 3 to 5 items are required to define one component. Also, the fact that the use of Likert Scales tends to overestimate the number components yielded in factor analysis, convinced us to adopt a cautious approach. The fifth, fourth and third components and the relative items, that showed lower and less significative loadings in the Rotated Component matrix, were excluded.

Tab. 7 Rotated Component Matrix

	Component	
	1	2
3D models	0.711	0.055
digital fabrication	0.707	0.267
IoT	0.682	-0.007

mobile tech	0.616	0.130
Social media & live media	0.402	0.246
Documents and archives digitisation	0.138	0.834
E-book	-0.066	0.740
Search engine tools/ data mining techniques	0.249	0.676

In the case studied there are two meaningful components identified in the study are described as follows:

- “Cyber” Users: interested or active in the field of virtualisation of the cultural heritage in order to create both physical (e.g. through IoT) and virtual (e.g. through Social Media) interaction with the cultural objects; Such users are more active in initiatives that are aimed at diffusing the knowledge and the cultural value of their products and using technology to increase their value proposition by creating the grounds for new productions
- “Perpetuator” Users: interested in conservation and perpetuation of the cultural heritage, these users prefer to use tools that are capable to reproduce in digital format the deep values portrayed by the cultural heritage items in order to make them available to a specialised audience, for study and research purposes.

It is interesting to note which technologies are bound to increase their presence in the CCI sectors. The technologies with the highest penetration potential are mobile technologies, OCR and Language Technologies, social media & live media, cloud services and co-creation, digital storytelling. This consideration is based on the number of times the technology type was evaluated 2 on the 4-point scale of usage intensity.

In order to better understand why some technologies experience a higher and faster diffusion than others we must consider their field of application.

In this way, we could highlight that there are some cross-cutting or transversal technologies that are likely to be used in different sectors, while other technologies are tightly linked to just one or two sectors.

If we consider the occupation variable of the sample and the type of technology, we can highlight which technological category is most used in the different sectors.

Cloud services, social media and live media and search engine tools are used widely by most sectors; for this reason, we can conclude that these are cross-cutting technologies.

The following table shows which technologies will affect the most each sector, based on the survey. The table was built extracting the technology types that had the maximum score in the future impact item of the survey and associating them with the sector of the respondents.

Tab. 8 Future impact of technology associated to the sector

AR/VR	Cloud services and co-creation	Conservation planning	Cultural heritage preservation and conservation
Architecture	Publishing	Museums, Nat. Sites, Libraries	Archaeology, site management
Archaeology, site management	Cultural event		Museums, Nat. Sites, Libraries
Cultural events	Visual arts		Performing arts
Visual arts	Policymaking		
Education	Performing arts		
Museums, Nat. Sites, Libraries			
Music			
Performing arts			
Creative learning	Crowdfunding-sourcing	Digital fabrication	Document and archive digitisation
Archaeology, sites management	Cultural events	Cultural events	museums
Museums, Nat. Sites, Libraries	Policymaking	Museums, Nat. Sites, Libraries	Archaeology, site management
Visual arts	Music	Performing arts	performing arts
Performing arts			
Education			
Cultural events			
E-book	IoT	Mobile technologies	3d models
Publishing	Music	Museums, Nat. Sites, Libraries	Cultural events
Policymaking	Performing arts	Visual arts	Museums, Nat. Sites, Libraries
Visual arts	Museums, Nat. Sites, Libraries	Publishing	Performing arts
Museums, Nat. Sites, Libraries			Visual art
OCR, language tech	Social web crawling, analysis & data mining	Social media and live media	Digital storytelling
Publishing	Museums, Nat. Sites, Libraries	Cultural events	Archaeology, site management
Policymaking	cultural events	Archaeology, site management	Policymaking
		Museums, Nat. Sites, Libraries	Museums, Nat. Sites, Libraries
		Performing arts	Performing arts
Search Engine tools/ Data Mining tools			
Architecture			
Publishing			

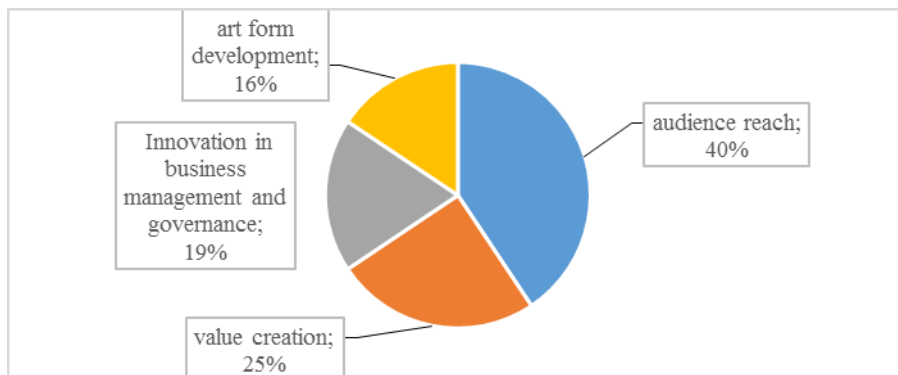
It is interesting to note that creative learning methods, based on interactive tools, are together with Augmented/Virtual reality, E-books and 3D models are the sector-specific technologies that, according to the interviewees, will affect strongly or, even revolutionise, the way business is done in their respective field of activity. The following table shows the detail of each technology related to its future impact.

Tab. 9 - Forecast of future impact, frequencies and percentages

	no foreseeable influence		minor influence		major influence		Ground-breaking influence		Can't tell	
	F	%	F	%	F	%	F	%	F	%
AR/VR	5	11.4%	4	9.1%	13	29.5%	18	40.9%	4	9.1%
Cloud services and co-creation	2	4.5%	4	9.1%	18	40.9%	16	36.4%	4	9.1%
Conservation planning	6	13.6%	7	15.9%	17	38.6%	6	13.6%	8	18.2%
Cultural heritage preservation and conservation	2	4.5%	8	18.2%	19	43.2%	11	25.0%	4	9.1%
Creative learning	1	2.3%	5	11.4%	22	50.0%	12	27.3%	4	9.1%
Crowdfunding-sourcing	2	4.5%	6	13.6%	18	40.9%	11	25.0%	7	15.9%
Digital fabrication	11	25.0%	5	11.4%	12	27.3%	12	27.3%	4	9.1%
Document and archive digitisation	4	9.1%	9	20.5%	19	43.2%	7	15.9%	5	11.4%
E-book	1	2.3%	9	20.5%	14	31.8%	11	25.0%	9	20.5%
IoT	6	13.6%	7	15.9%	13	29.5%	10	22.7%	8	18.2%
Mobile technologies	1	2.3%	5	11.4%	22	50.0%	11	25.0%	5	11.4%
3d models	11	25.0%	6	13.6%	17	38.6%	6	13.6%	4	9.1%
OCR, language tech	4	9.1%	7	15.9%	17	38.6%	7	15.9%	9	20.5%
Social web crawling, analysis & data mining	5	11.4%	4	9.1%	23	52.3%	5	11.4%	7	15.9%
Social media and live media	1	2.3%	2	4.5%	21	47.7%	18	40.9%	2	4.5%
Document and archive digitisation	2	4.5%	8	18.2%	19	43.2%	11	25.0%	4	9.1%
Search Engine tools / Data Mining tools	1	2.3%	11	25.0%	24	54.5%	2	4.5%	6	13.6%

Regarding the purpose of innovation, the interviewees were asked to choose from a multiple-choice list, which innovation objectives they might achieve thanks to innovation. The innovation objectives were taken from (Bakhshi and Throsby 2012).

Fig. 4 Innovation objectives



It appears that the first concern of the interviewees is to reach their audience and to create a wider group of consumers.

In this way, this need is matched correctly with the current use well-spread use of social media and with the future intention to use augmented / virtual reality to boost the diffusion of their products.

Regarding the “art form development” objective, this is comparatively lower than the others. A partial explanation of this might be found in the fact that the sample is made by a relatively large percentage of operators that are active in fields such as museum and archaeological sites management or libraries and archives. These professionals are naturally more interested in increasing the number of visitors rather than producing new forms of art. The fact that value creation and business models are less represented among the answers to this question of the survey can be justified by the last question of the survey. The question was: “List and describe the main obstacles that are preventing your organisation to implement the innovations you cited in the survey”. This question was asked in a second occasion, after the first set of answers were analysed. The question was posed in an open way and was left purposefully for a one-to-one telephone interview with the aim to collect more detailed insights on the subject and to stimulate an in-depth analysis of the problem. According to the cultural operators interviewed, the main and most common issues that affects diffusion of innovation in the Sardinian CCIs are of different nature:

- the business model and revenue model
- the financial structure
- the governance and long-term strategy in response to the size /networking problem
- the training issue

The first and most evident problem lies within the organisations' business model. The interview did not focus specifically on the structure of the business model of each respondent but a common feature that we evidenced in several interviews was an overall weakness of the business model adopted by the CCIs in Sardinia. Although there are several levels of variability within the sample, their operations are built on a rather simple structure, often family-based, which relies heavily on public funding as a key resource. The other main asset of these companies is the cultural or creative capital (the musicians, the actors, the tangible cultural goods) that acts as the engine of the organisation and the network of contacts that the cultural operators have cultivated during their careers.

The need for public funding to operate is, in the words of a cultural operator of the events sector:

"[...] connected to a failure to understand our clients and to communicate with them. Our product is of high value, but we fail to convey this value to the market in terms of 'something worth buying a ticket for' on a regular basis. In the years, tourism promotion in Sardinia was fuelled by free events. Now the people, both the tourists and the locals, have interiorised this attitude and expect to pay nothing for a concert or a show. But in order to keep tourists happy, the territory has to provide for entertainment and activities, so the public hand tries to cover for that need. We are forced to apply for funding because otherwise we wouldn't have enough resources to cover the costs and the ordinary operations. This leaves very little room for investments. We understand that investments are vital to increasing competitiveness, but we have no access to other resources. It's a cyclic problem."

If on one side there appears to be a problem on the customer relations, commercial channels, value proposition and resources components of the business model, on the other side, the flexibility of their cost structure and the high quality of their key activities are two strong points from which the organisations could start renewing their operations. In this way technology is seen as a strategic asset to achieve more visibility on the market and to enrich the value proposition of the CCIs. Further research in this direction is needed to understand how to increase competitiveness in this field.

As mentioned before, the financial structure of the operators is characterised by the presence of subsidies granted by public institutions or by other private organisations such the culture/charity-oriented Foundations linked to banking groups. For cultural events this kind of contributions are normally subordinate to the implementation of cultural projects that are submitted for funding to the financing organisation. The budget for recurring activities, such as subsequent editions of the same festival, depend on the yearly al-

location of the founding source and may vary significantly in time. It's the case of the "Musica Sulle Bocche" International Jazz Festival, organised yearly since 2000 in Santa Teresa Gallura by the cultural association Jana Project. During the interview, its director told us:

"There were more resources in the past. We had large contributions from the City Council of Santa Teresa and from other regional entities. Private sponsorship is also something we could rely on. But in time, and especially after the crisis years (2010-2014) the public funding for such initiatives decreased abruptly. We're talking about 50% less. This had an impact on our capabilities. Even now, it seems that although the general situation is improving, both small local bodies such as a city council or a regional ministry, have far less resources to invest in culture."

Museums, archives, libraries, archaeological sites and other conservation institutions are mostly public or managed under a tender contract won by a private contractor. These enterprises are generally non-profit entities, very frequently organised in cooperative enterprises with social utility goals. This kind of organisations have a less innovation-oriented business model, because their activities are more focused on achieving full employment of the members of the cooperative and less on innovating their business practice or producing innovative contents. Their income is somewhat fixed, certain and predictable. New technologies that are experiencing a fast-growing trend in this sector, such as Augmented reality, mobile technologies or 3d models need investments to be implemented. The investments, most of the times, are not part of the contractor's agreement, as they are under the responsibility of the Public Administration.

On the other hand, the private, profit-oriented operators such as architects, graphic designers, musicians, who tend to operate autonomously, are more interested in innovating not only their commercial channels but also their production process or management models. Their income uniquely depends on their competitiveness and on the capacity of attracting new customers on the market.

This group has also comparatively higher average values for "technology awareness" and "decision powers" than the previous group. Regarding the size of the CCI organisations in Sardinia, the data show that, according to the EU parameters found in Recommendation (2003/361/CE) the majority of the operators are organised in small or micro enterprises. Sardinia is among the least populated regions of Italy in terms of population per square km. Such small enterprises are often family-based. This combination suggests the need for networking as a way to reduce the limitations derived from this condition. Other experiences such as the case of the Swedish music industry (Hallencreutz et al, 2003) or the architecture Cluster of To-

ronto Canada (Avilés Ochoa et al. 2018) demonstrate that the creation of clusters of cultural industries is capable to boost the economic results of the companies involved, to increase occupation and value added, to foster enterprise creation and to push internationalisation. Today, the local bodies of Sardinia are restructuring their territorial organisation. The former provinces were abolished in 2016 and a network of municipalities should take their place. These new bodies, called Metropolitan Networks, are supposed to manage the regional funds for local development and territorial planning. This process is still underway so there are not enough elements as per now to determine if the new territorial configuration could facilitate, i.e. through specific policies and incentives, the creation of cultural clusters.

The last obstacle witnessed by the Sardinian CCIs is the lack of appropriate training opportunities. As mentioned in the study, some technologies are not only expensive to acquire but they also require specific training to operate them. As reported by extant research, the firm innovation in CCIs is dependent on their context-specific knowledge stock, embedded in both tangible products and cultural artefacts (Asheim et al., 2007, Martin and Trippel, 2014, Zhou et al, 2018). It appears that the CCIs are struggling to find professionals with specific expertise due to financial reasons (certain professional profiles are highly expensive) and for low availability of know-how on the market. One case emerged during the interviews. The respondent is a young sound engineer, specialised in electronic music. *"I started my career when I was out of high school, as a hobby, self-taught. I realised it could become my job, so I started to study and looked for opportunities to achieve a formally recognised certification. I found a school for sound engineers in mainland Italy and I went there to train. It is not a public institution and I'm not sure if my diploma is really recognised as a school certification. However, thanks to the job placement opportunities provided by the school, I found side jobs in the sector that are keeping me independent as well as providing me with opportunities to build a professional background. I now have several clients in northern Italy. I have almost completed my course, but I realise that I can't go back to Sardinia now because any job I could get there will be underpaid compared with what I can get here."*

A regional cluster of CCIs could create synergies with universities and the public-school system to provide the local operators with the exact skills that are needed to develop the sector. Funding could be drawn from regional resources, structural funds, managed by the local metropolitan networks through specific calls and grants.

5. Conclusions

The paper evidences that although the Sardinian CCI operators are very much aware of the current technological trends, some issues impair the full adoption and diffusion of technologic advancements.

Regarding the research questions formulated at the beginning of the study, we can conclude, based on the evidence gathered, that the most relevant fields of technological innovation for the Sardinian CCI (RQ1) are mobile technologies, OCR and Language Technologies, social media & live media, cloud services and co-creation and digital storytelling.

The study also identified two types of technology users among the respondents to the survey (RQ2): a group of “cyber Users”, interested mainly in using technological innovations to digitalise and disseminate their cultural production or goods while creating interaction with the public and stimulating value creation thanks to the feedbacks received and a group of “Perpetuator” users that are more focused on preserving and making available the cultural goods they manage to a more specialised audience for study and research purposes rather than for commercial goals. This demonstrates, as highlighted in the paper, that technology adoption is strongly connected to the user profile, validating the distinction between “cross-cutting technologies” and “sector-specific technologies”. RQ3 focused on the constraints and obstacles the Sardinian CCIs must overcome in order to increase their competitiveness through innovation adoption. The study evidences that the critical points identified by the sector’s operators are a fragile business model, insufficient access to finance, excessive relying on public funding, lack of governance and local networking, lack of appropriate training opportunities. The business model of some of the operators is among the causes of lagging in the adoption of innovations that are otherwise recognised as useful or even fundamental for the business. These obstacles are connected to an alteration in the diffusion process modelled by Rogers (2003) in his most important work “Diffusion of innovations”. The presence of an authority or of external pressure or limitations such as a signed agreement, interferes with the natural adoption process which includes connected steps such as knowledge, persuasion, decision, implementation and confirmation. For instance, if the contracting body decides that a certain museum managed by an external company must adopt augmented reality solutions, the latter has no choice except to abide the decision of the former, introducing the innovation notwithstanding its will to do so. The results highlighted in this study have some interesting managerial and theoretical implications.

5.1 Managerial implications

The profiling of the Sardinian CCI in relation to the most appealing types of technology could be of interest for the public authorities, as it could support the decision-making process related to the funding programmes, especially considering the undergoing reshaping of the territorial organisation and the launch of the new funding programmes for the 2021-2027 period. Among the points evidenced by the study, the lack of an appropriate cluster strategy and of efficient training opportunities could also be the target of improved policies aimed at increasing the competitiveness of the Sardinian CCIs. These policies should stimulate networking and foster collaboration activities, with the aim of increasing the exchange of experiences and best practices among operators. The creation of a cluster could also help to overcome the training/know-how deficit if efforts are directed to map the expertise available on the territory or abroad in order to provide high level tutorship or training opportunities to CCI operators in order to develop the use of new technologies. Some of the financial difficulties to innovate may be overcome thanks to some new public funds that were recently made available by the Regional Government. These initiatives are aimed at introducing innovative projects in the cultural industries in the framework of the current positioning of the European institutions, that aim to valorise the cultural assets and to increase their fruition. In this direction, for instance, the EU commission has included in the EU2020 strategy for growth and development the CCI sector. The principal axes of the European policies in terms of smart growth, innovation, young and new entrepreneurs, sustainable growth and cohesion are outlined in communication 537 issued on September 26.9.2012, under the title "Promoting cultural and creative sectors for growth and jobs in the EU". The Regional Government has destined relevant resources to the CCI in its Operational Regional Programme of the ERDF (European Regional Development Fund) for the period 2014/2020. Over 13 million euros have been put forward for 2016 only, while the total endowment reaches 72 million euros that will be invested by the end of 2020. Approximately two million euros are already available through calls for proposals aimed at developing the sector. The most recent examples are the call for projects related to the Culture Lab and the Identity Lab initiatives, respectively closed in May and in July. At the time of the writing, the proposals have been evaluated and approximately 20 projects are in the implementation phase.

This study, whose methodology was experimented for the first time, could be repeated in the future to evaluate if any progress has been made on the issue of innovation diffusion in the CCIs of Sardinia.

5.2 Theoretical implications

Altogether, the theoretical contribution of this dissertation to the literature on innovation in the CCI sector is three-fold. This research contributes to (1) a better understanding of the relationship between innovation adoption, motivation and constraints in the CCI sector for small enterprises. (2) It evidences the presence of cross-cutting technological innovations and sector-related innovations that are variable based on the firms/institution typical activity, nature and goal orientation. Furthermore, (3) the research shows that the influence of availability of public funding aimed at innovation adoption is important but it is not the only determinant of new technology-related investments if these are not supported by other wider measures in complementary fields such as education and training, clustering and cooperation.

5.3 Limitations and future research

The study has some limitations which might represent the starting point of future research. The size of the sample is the main limitation; a larger and improved sample could provide more detailed information on the impact of technology and innovation in the CCI of Sardinia. Furthermore, the sample was obtained randomly, by identifying the CCI companies or organisations and inviting them to take part to the study on a voluntary basis, resulting in a composition of the sample might over-represent certain sectors of activity compared to others. One way to solve this issue could be to establish a collaboration with the regional administration in identifying exactly how many CCI companies are currently active in Sardinia and inviting them to collaborate to the study. The involvement of the authorities and other relevant organisations (regional ministry for culture, national ministry for culture, other entities managing public or private funding instruments) could prove useful to analyse the trends related to the participation of the Sardinian CCI to grant applications, innovation projects and internationalisation activities.

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