



Museums: Not Just Visiting Spaces but a Driving Force for the Use of Advanced S&T in the Restoration of Artworks

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Abstract

Our paper analyses how museums not only play a traditional role in the cultural service but also act as a driving force for the use of science and technology in the conservation of artworks. Through a bibliometric approach and the use of social network analysis (SNA), we explore co-authorship of scientific articles and we detect how museums look for knowledge bases in science and technology. We also differentiate between institutions and geographical regions in order to find patterns in the cooperation with other institutions. Results indicate that European countries are important nodes in the cooperation for restoration and conservation, and patterns of cooperation indicate that museums look for knowledge bases mainly in restoration institutes and other museums in their own countries. This implies that museums look for analytical and synthetic knowledge out of the museums when they need to apply advanced science and technology in restoration.

Keywords: Museums, conservation & restoration, networks, creative industries.

Introduction

The conservation and restoration of artworks are included in the industries considered as creative or cultural industries (de-Miguel-Molina et al 2013). The UK Department for Culture, Media and Sports (DCMS) (2009), defined creative industries as “those industries that are based on individual creativity, skill and talent, and which have the potential to create wealth and jobs through developing intellectual property”.

The arts, heritage and recreation sectors come under the European classifications NACEs 90, 91, 92 and 93. NACEs 90 and 91 are also part of the Knowledge Intensive

Services (KIS) industries, which are those related to the knowledge-based economy (de-Miguel-Molina et al. 2012; Windrum & Tomlinson, 1999; Aslesen & Isaksen, 2007a; Bishop, 2008; Strambach, 2008).

In terms of the arts and cultures sector, Bakhshi and Throsby (2010) discussed the lack of studies on innovation, which has been ignored in studies conducted about creative industries. Although there are good studies about the use of science in the restoration of specific artworks (Casadio et al. 2010, Cotte et al. 2010, Doménech-Carbó et al. 2011, Baglioni et al. 2012, Doménech-Carbó et al. 2012), the literature about the importance of open innovation and cooperation between different institutions

in this subsector of creative industries is scarce. This paper tries to cover this gap.

In short, our paper's goal is to examine cooperation between museums and other institutions in the restoration and conservation of artworks. To reach this objective, we have put forward two questions with reference to cooperation in this activity:

RQ1: Are museums in European countries important participants in cooperation with other institutions?

RQ2: Does a pattern in the cooperation between museums and other institutions exist?

Data were taken from the bibliometric analysis of scientific co-authored papers searched in Elsevier's Scopus database. The final number of articles was 1,656. These data were cleaned through the VantagePoint software.

Important conclusions are inferred from the results. The first is that the participation of European countries for the application of science and technology in conservation and restoration of artworks is evidenced. The second is that, although many museums write papers by their own, when they co-author papers with other institutions, the latter are mainly located in their own country. These institutions are, mainly, research institutes and other museums. Results also illustrate that museums look for institutions that have different types of knowledge bases: symbolic (arts), analytical (physics and chemistry) and synthetic (engineering).

The Use of S&T in the Conservation and Restoration of Artworks

Lazzeretti (2012) has analysed the importance of cooperation between different institutions in the development of laser technology for restoring artworks. She explains how cooperation is mainly between local institutions, which can produce the development of a cluster, like the restoration cluster in Firenze (Italy). However, literature about cooperation in

arts activities in an innovation framework, like the scheme explained in the Oslo Manual (2005), is scarce.

The main problem in analysing activities like conservation and restoration is that there are no data in the innovation surveys that some countries elaborate. In the subsector covered in this paper, data for patents would be collected from national surveys if they were available, but it is not the case. One solution is the use of bibliometric approach to cover this gap, and especially scientific articles. Different authors have studied technologies, knowledge and networks (Youtie and Shapira 2008, Leydesdorff and Rafols 2011, Robinson et al. 2013). Abramo et al. (2009) mention that using a bibliometric approach to studying cooperation between institutions, as universities and industries, through co-authorship of scientific articles, also allows the diffusion of knowledge and skills. Moreover, Wall and Boschma (2009) refer to knowledge networks in innovation systems where dissemination occurs both between local and abroad actors. In applying a new technology, Boschma (2005) and Rafols et al. (2010) state that actors require cognitive proximity to absorb new knowledge. These authors also ask if the networks will be local, national or global, and if the proximity will be geographic or cognitive.

Conservation is cited by authors among the main activities in a museum, and essential to preserve its heritage (Papini and Persiani 2004, Kotler et al. 2008). At the end of the XVIII century and throughout the XIX, art collections and catalogues live with research in physics and chemistry applied to artworks restoration. Museum restoration laboratories and departments were set up during the XIX century (Moreira 2008). Therefore, analytical knowledge cooperation co-exists in museums since restoration departments were created.

Method

Data

The data used to measure collaboration are scientific co-authored papers. For bibliometric analysis, we searched keywords “paint*” AND “restoration” OR “conservation” in Elsevier’s Scopus database. We obtained publications in international journals about the restoration and conservation of painting artworks. The final number of articles was 1,656. These data were imported to VantagePoint software, which was used to clean up the institutions involved in restoration and conservation, and elaborate matrixes of co-authorship among museums, restoration institutes and universities. Matrixes were elaborated depending on papers: museums with other museums, museums with restoration and conservation institutes, museums with university physics and chemistry departments, and museums with university engineering and Information Technologies departments.

The number of institutions analysed was 222: 94 museums from 26 countries, 41 conservation and restoration institutes, 49 university physics and chemistry departments and 38 university engineering and Information Technologies university departments.

Methodology

For bibliometric analysis, we used Elsevier’s Scopus database and the data were cleaned and prepared using three softwares: VantagePoint, WordStat and QDMiner. Matrixes were elaborated depending on: a) papers that were written by the museums or b) papers that were co-authored between a museum and: other museums (symbolic knowledge), restoration and conservation institutes (symbolic), physics and chemistry departments in universities (analytical), or engineering and Information Technologies departments in universities (synthetic). Moreover, institutions were defined

depending on their geographical location: Europe, USA & Canada, Central & South America, Asia, Africa, and Oceania. A total of 94 museums were analysed, 26 of which were located in the United States, 53 in Europe, 7 in Asia, 3 in Africa, 2 in Central & South America and 2 in Oceania.

Networks of 2-mode were represented by means of UCINET6 and NETDRAW software. Centralisation degree for affiliation matrixes was calculated in order to determine which institutions co-authored more papers with museums.

Results

In this section, we answer the two research questions posed at the start of this paper:

RQ1: Are museums in European countries important participants in cooperation with other institutions?

RQ2: Does a pattern in the cooperation between museums and other institutions exist?

In terms of the first research question, we focus on countries and the importance they have in the science of conservation and restoration of artwork. For this purpose, we elaborate a 1-mode matrix where columns and rows are each country, included in the same order. We have used the number of papers in which every country appears as attributes. Therefore, we represent, in Figure 1, co-authorship between countries, and the size of the nodes represents how important is every country. The figure shows that Italy and the United States are the most important countries. Also, the United Kingdom and Spain are between the most important participants in explaining how to use science and technology in conservation and restoration.

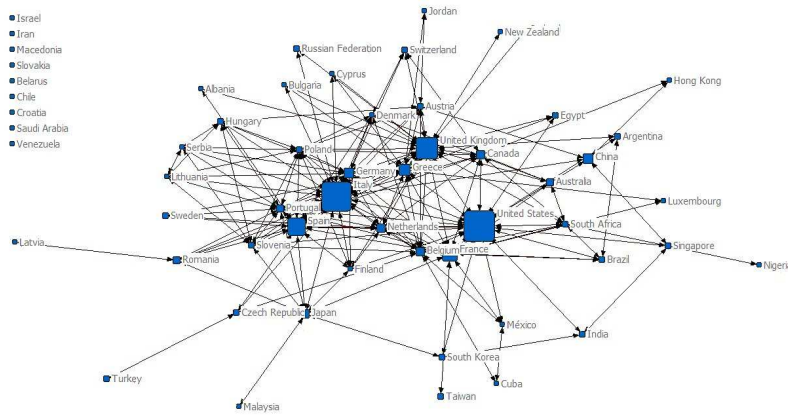


Figure 1: Ranking of countries in co-authorship of papers about conservation and restoration of artworks. Source: compiled by authors based on the Scopus database

In order to analyse in detail the countries that cooperate more in conservation and restoration, we need to eliminate those that do not cooperate. In this case, we eliminate the nodes that appear in the left side in Figure 1: Israel, Iran, Macedonia, Slovakia, Belarus, Chile, Croatia, Saudi Arabia and Venezuela. Once we had eliminated these nodes, we used social network analysis (SNA) to calculate the centrality *degree*,

which calculated how many nodes are connected. Table 1 indicates that Italy is the country with the highest degree of cooperation in papers. The second country in order of appearance is the United Kingdom and the third is the United States. Column “Nrm Degree” indicates that each one of these three countries has more than 10% of the total connections of the network.

Table 1: Centrality measure: degree

Country	Degree	Nrm Degree
Italy	105	13.67
United Kingdom	99	12.89
United States	82	10.68
France	59	7.68
Greece	56	7.29
Spain	52	6.77
Netherlands	50	6.51
Germany	47	6.12
Belgium	39	5.08
Portugal	30	3.91
Poland	22	2.86

Canada	19	2.47
Japan	15	1.95
Slovenia	15	1.95
Austria	12	1.56
Finland	11	1.43
Romania	9	1.17
South Africa	9	1.17
Hungary	9	1.17
Denmark	9	1.17
Australia	8	1.04
Serbia	8	1.04
Switzerland	7	0.91
Lithuania	7	0.91
China	6	0.78
Brazil	6	0.78
Egypt	5	0.65
Singapore	5	0.65
Sweden	5	0.65
Czech Republic	4	0.52
Argentina	4	0.52
México	4	0.52
Cyprus	4	0.52
India	3	0.39
South Korea	3	0.39
Albania	3	0.39
Bulgaria	3	0.39
Russian Federation	2	0.26
Hong Kong	2	0.26
Ireland	2	0.26
Cuba	2	0.26
Jordan	2	0.26
Luxembourg	2	0.26
Taiwan	1	0.13
Turkey	1	0.13
New Zealand	1	0.13
Malaysia	1	0.13
Nigeria	1	0.13
Latvia	1	0.13

Source: Compiled by authors based on the Scopus database

Next, we calculated the cliques where there are more than three countries. We have found 47 cliques: Italy appeared in 29 cliques, the United Kingdom in 22 and the United States in 17. Moreover, Germany is in 16, Spain in 14, Belgium in 11 and France in 9 cliques. Therefore, participation of European countries in cooperation for application of the science and technology in conservation and restoration of artworks is evidenced.

1: United States Italy United Kingdom Spain France Greece Germany Netherlands Portugal

2: United States Italy United Kingdom Spain Germany Netherlands Finland

3: Italy United Kingdom Spain Germany Portugal Poland

4: Italy United Kingdom Spain Germany Poland Denmark

5: Italy United Kingdom Spain Germany Poland Finland

6: United States Italy United Kingdom France Greece Germany Belgium Netherlands

7: Italy United Kingdom Greece Germany Belgium Austria

8: Italy United Kingdom Germany Belgium Poland Austria

9: Italy United Kingdom Germany Belgium Poland Denmark

10: United States Italy United Kingdom France Netherlands Canada

11: Italy United Kingdom Canada Poland

12: Italy United Kingdom Russian Federation

13: Italy United Kingdom Greece Cyprus

14: Italy United Kingdom Greece Bulgaria

15: United States Italy China

16: Italy China Austria

17: Italy Spain France Japan Portugal

18: Italy Spain Japan Portugal Romania

19: Italy Spain Japan Portugal Slovenia

20: Italy Spain Japan Finland

21: Italy Canada Romania

22: Italy Belgium Czech Republic

23: Italy Spain Czech Republic

24: Italy Germany Portugal Poland Slovenia Hungary Lithuania Serbia

25: Italy Spain Germany Portugal Poland Slovenia

26: United States Italy Spain Germany Portugal Slovenia

27: Italy Germany Belgium Poland Slovenia

28: United States Italy Germany Belgium Slovenia

29: Italy Germany Poland Austria Hungary

30: United States United Kingdom France Canada Australia South Africa

31: United Kingdom Australia Denmark

32: United Kingdom Germany Switzerland Denmark

33: United Kingdom Canada Switzerland

34: United States India South Korea

35: United States India Singapore

36: United States United Kingdom Greece Egypt

37: United States France Belgium Brazil South Africa

38: United States Brazil Argentina

47: France Greece Luxembourg

39: United States United Kingdom
Argentina

40: United States United Kingdom France
Belgium South Africa

41: United States China Singapore

42: Spain Greece Netherlands Portugal
Sweden

43: United States France Belgium México

44: Belgium México Cuba

45: United Kingdom Spain Albania

46: Greece Austria Jordan

An interesting result is shown in Table 2, where we incorporate the co-membership matrix resulted from cliques. We only include, in the table, the most important countries. Results indicate the number of cliques in which every country in the diagonal participate, and the rest of cells represent in how many cliques there are coincidences between countries. For example, the United Kingdom coincides with Italy in 14 cliques; Italy and Germany are jointly in 15 cliques, and Spain and Italy concur in 12 cliques. It is evident that countries cooperated in a high rank with Italy and the United Kingdom.

Table 2: Clique co-membership matrix for the most important participants

	United States	Italy	United Kingdom	Spain	France	Greece	Germany	China	Belgium
United States	17	7	8	3	7	3	5	2	5
Italy	7	29	14	12	4	5	15	2	7
United Kingdom	8	14	22	6	5	6	10	0	5
Spain	3	12	6	14	2	2	7	0	0
France	7	4	5	2	9	3	2	0	4
Greece	3	5	6	2	3	9	3	0	2
Germany	5	15	10	7	2	3	16	0	6
China	2	2	0	0	0	0	0	3	0
Belgium	5	7	5	0	4	2	6	0	11

Source: compiled by authors based on the Scopus database

The second objective of this paper is to detect whether there is a pattern in the cooperation between museums and other institutions. Also, the paper looks into which type of knowledge base the museums look for when they are going to undertake the conservation or restoration of any artwork that they are not able to do or they do not have the knowledge needed to do it. For this purpose, we prepare a 2-mode network, where the rows are the museums and the columns are the institutions that cooperate with museums. We have differentiated between institutions depending on where they are

located, in the same country than the museum or abroad.

Firstly, we represent the entire network in Figure 2. This figure shows that museums write an important part of the papers alone. Moreover, there is no cooperation with institutions located in the left side of the Figure 2 (See Appendix for the meaning of codes). Because the main objective of this paper is to analyse cooperation, we eliminate both institutions that do not cooperate with museums and museums that write papers alone.

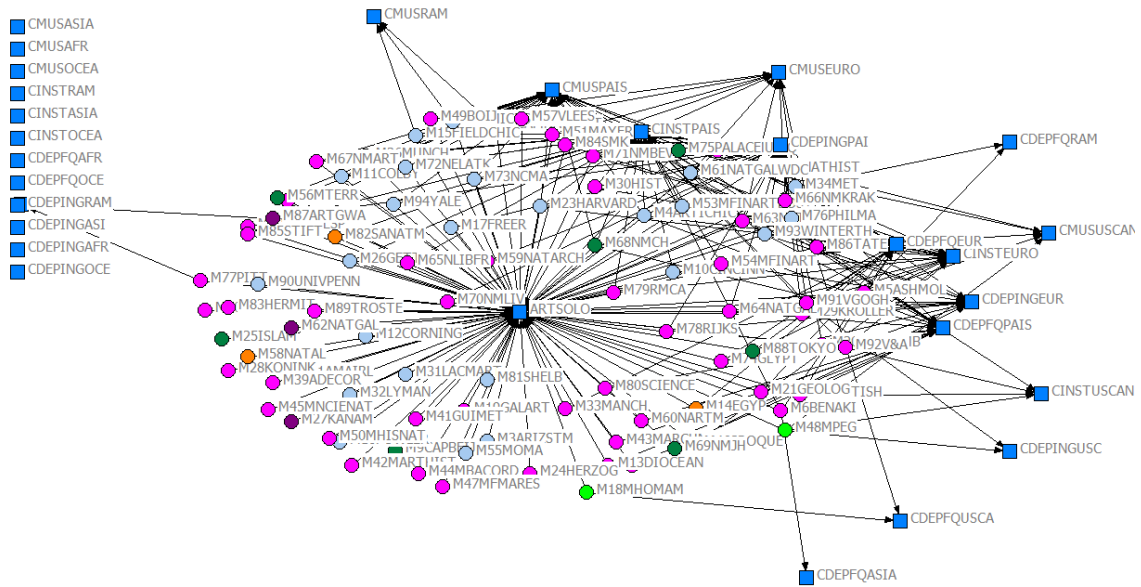


Figure 2: Museums and their cooperation with other institutions

Source: compiled by authors based on the Scopus database

Figure 3 includes the cleaned network. Looking at the figure, we may indicate that museums cooperate mainly with other museums and

restoration institutes located in their own country. In order to better determine patterns of cooperation, we calculated density, degree, closeness and betweenness.

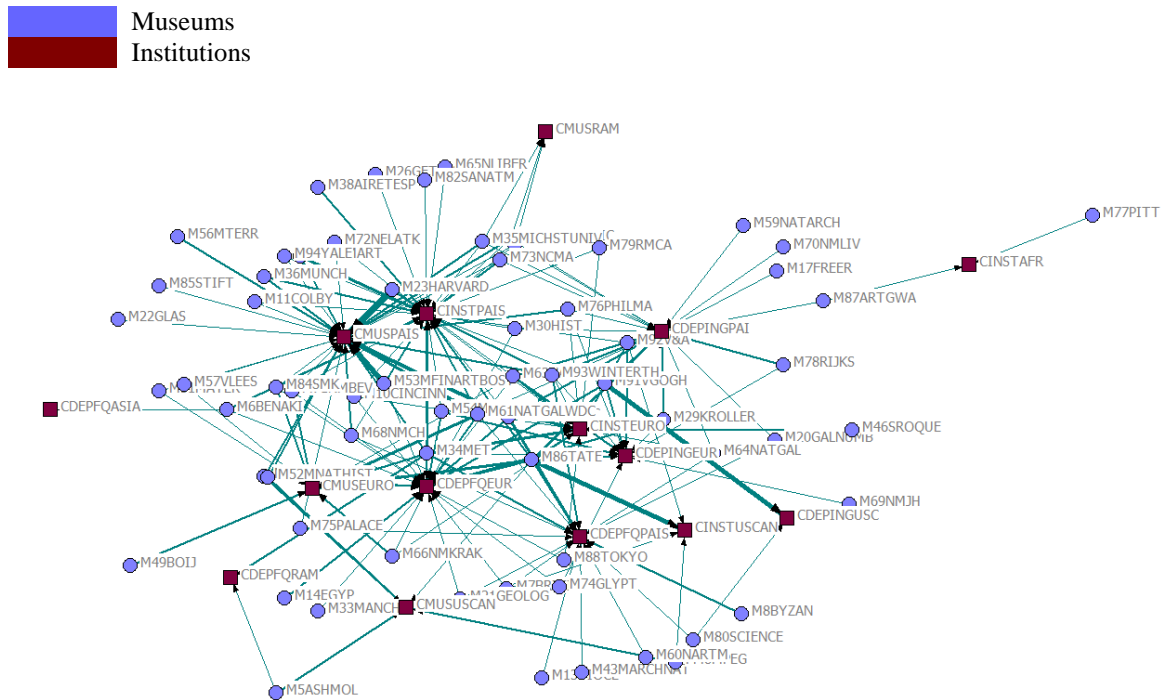


Figure 3: Cooperation between museums and institutions based on co-authorship of papers

Source: compiled by authors based on the Scopus database

Density indicates that in this network the 17.8% of potential relations is achieved. Moreover, the standard deviation is 2.96, representing high inequality in the distribution of the relations. In the degree column, the higher values are for the important museums, like the Tate (London), the Metropolitan Museum of Art in New York, the Van Gogh Museum (Amsterdam), the National Gallery in Washington DC, the National Gallery in Athens (Greece) and the Winterthur Museum (US). These museums appear in the centre of the network in Figure 3. Concerning the closeness, museums, with

more possibilities to coincide with other museums and cooperate with the same institutions, are the Tate, the National Gallery in Washington DC, and the Metropolitan Museum of Art in New York, the Winterthur Museum (USA) and the Art Institute of Chicago. With respect to betweenness, museums with higher values in the column are those that cooperate both with institutions that are important nodes and with institutions that few museums cooperate with. These museums will be in better position to get information from institutions and other museums. Examples in this group of museums are the Tate (London) and the Metropolitan Museum of Art in New York.

Table 3: Centrality, closeness and betweenness for rows (museums)

	Degree	Closeness	Betweenness	Eigenvector
M2AMNATHIST	0.27	0.71	0.02	0.16
M4ARTICHIC	0.33	0.82	0.04	0.22

M5ASHMOL	0.13	0.48	0.00	0.01
M6BENAKI	0.20	0.65	0.03	0.11
M7BRITISH	0.20	0.61	0.01	0.08
M8BYZAN	0.07	0.51	0.00	0.03
M10CINCINN	0.20	0.67	0.00	0.14
M11COLBY	0.13	0.64	0.00	0.11
M13DIOCE	0.07	0.51	0.00	0.03
M14EGYP	0.07	0.55	0.00	0.04
M15FIELDCHIC	0.27	0.71	0.02	0.16
M17FREER	0.07	0.54	0.00	0.04
M20GALNUMB	0.13	0.60	0.00	0.07
M21GEOLOG	0.13	0.60	0.00	0.07
M22GLAS	0.07	0.56	0.00	0.05
M23HARVARD	0.20	0.67	0.01	0.15
M26GETTY	0.07	0.59	0.00	0.06
M29KROLLER	0.27	0.67	0.01	0.15
M30HIST	0.20	0.71	0.01	0.15
M33MANCH	0.07	0.55	0.00	0.04
M34MET	0.53	0.83	0.08	0.27
M35MICHSTUNIV	0.27	0.71	0.02	0.16
M36MUNCH	0.13	0.64	0.00	0.11
M37MUSIQ	0.20	0.67	0.01	0.10
M38AIRETESP	0.07	0.59	0.00	0.06
M43MARCHNAT	0.07	0.51	0.00	0.03
M46SROQUE	0.07	0.52	0.00	0.03
M48MPEG	0.20	0.49	0.00	0.02
M49BOIJ	0.07	0.49	0.00	0.02
M51MAYER	0.13	0.58	0.00	0.07
M52MNATHIST	0.20	0.67	0.01	0.10
M53MFINARTBOST	0.27	0.71	0.01	0.19
M54MFINART	0.20	0.67	0.01	0.14
M56MTERR	0.07	0.56	0.00	0.05
M57VLEES	0.13	0.58	0.00	0.07
M59NATARCH	0.07	0.54	0.00	0.04
M60NARTM	0.07	0.51	0.00	0.03
M61NATGALWDC	0.40	0.84	0.05	0.24
M63NATGAL	0.40	0.78	0.03	0.23
M64NATGAL	0.27	0.66	0.01	0.13
M65NLIBFR	0.07	0.59	0.00	0.06

M66NMKRAK	0.20	0.60	0.00	0.10
M67NMART	0.13	0.64	0.00	0.11
M68NMCH	0.20	0.70	0.01	0.14
M69NMJH	0.07	0.51	0.00	0.03
M70NMLIV	0.07	0.54	0.00	0.04
M71NMBEV	0.27	0.71	0.01	0.18
M72NELATK	0.13	0.64	0.00	0.11
M73NCMA	0.20	0.71	0.01	0.15
M74GLYPT	0.13	0.58	0.00	0.07
M75PALACE	0.13	0.61	0.00	0.07
M76PHILMA	0.27	0.71	0.01	0.15
M77PITT	0.07	0.35	0.00	0.00
M78RIJKS	0.13	0.57	0.00	0.07
M79RMCA	0.13	0.62	0.00	0.10
M80SCIENCE	0.07	0.51	0.00	0.03
M82SANATM	0.07	0.59	0.00	0.06
M84SMK	0.27	0.71	0.01	0.18
M85STIFT	0.07	0.56	0.00	0.05
M86TATE	0.60	0.88	0.10	0.27
M87ARTGWA	0.13	0.55	0.05	0.04
M88TOKYO	0.13	0.58	0.00	0.08
M91VGOGH	0.40	0.76	0.05	0.21
M92V&A	0.33	0.71	0.02	0.17
M93WINTERTH	0.40	0.83	0.04	0.24
M94YALE	0.13	0.64	0.00	0.11

Source: compiled by authors based on the Scopus database

Institutions that are more demanded by museums to cooperate in restoration and conservation are included in Table 4. The

higher degree, closeness and betweenness are for institutions located in the museum's own country, being the most important restoration institutes and other museums.

Table 4: Centrality, closeness and betweenness for columns (institutions)

	Degree	Closeness	Betweenness	Eigenvector
CMUSPAIS	0.41	0.52	0.22	0.42
CMUSEURO	0.15	0.44	0.05	0.19
CMUSUSCAN	0.08	0.42	0.03	0.06
CMUSRAM	0.05	0.34	0.00	0.05
CINSTPAIS	0.47	0.56	0.28	0.55
CINSTEURO	0.24	0.47	0.08	0.30

CINSTUSCAN	0.06	0.40	0.01	0.06
CINSTAFR	0.03	0.28	0.03	0.00
CDEPFQPAIS	0.24	0.46	0.16	0.22
CDEPFQEUR	0.35	0.51	0.18	0.39
CDEPFQRAM	0.03	0.38	0.01	0.03
CDEPFQASIA	0.02	0.31	0.00	0.01
CDEPINGPAI	0.32	0.50	0.22	0.36
CDEPINGEUR	0.20	0.45	0.06	0.24
CDEPINGUSC	0.03	0.36	0.00	0.03

Source: compiled by authors based on the Scopus database

A broad analysis of data shows that the institutes that cooperate most with museums are the Getty Conservation Institute (Los Angeles), the Courtauld Institute of Art in London, the Centre for Research and Restoration of the Museums of France, and the Institute of Fine Arts in New York. It is important to indicate that the Getty Institute cooperates especially closely with the Tate Gallery.

In this paper, we point out that museums look for analytical and synthetic knowledge. Analytical knowledge is related to chemistry and physics, and museums cooperate with departments in universities related to this type of knowledge. Some examples about the departments which have cooperated with museums are: the Physics Department of the Politecnico di Milano (Italy), the School of Science in Birkbeck College (London), and the Department of Chemistry in Northwestern University (US). In relation to synthetic knowledge, that is, engineering skills, museums have cooperated with university departments like the Department of Material Science and Engineering in Delft University of Technology (Netherlands) or the Bioengineering and Radiology Department in the University of Washington (Seattle, United States).

Papers about the use of science and technology in the restoration and conservation of artworks tend to focus on the different applications of the spectroscopy, like gas chromatography-mass spectrometry. Other important groups of papers cover the use of the electron microscopy and the X-ray diffraction. The use of such advanced

techniques explains why museums need to cooperate with other institutions.

Conclusion

This paper focuses on analysing the cooperation between museums and other institutions in the use of science and technology when they are going to restore any artwork. The literature about cooperation in creative activities is scarce, especially in relation to the use of advanced science and technology. Lazzaretti's (2012) analysis of the restoration cluster in Firenze, Italy, is circumscribed to laser technology.

Our paper analyses the activity of restoration and cooperation in artworks in a global approach, so we are able to differentiate if networks are national or global, and which countries are more important in cooperation.

Data were obtained through a bibliometric analysis of papers' co-authorship, which gives a wide quantity of data about cooperation in restoration. Then, we have applied network analysis to represent cooperation.

Results indicate that European countries are important participants in the cooperation with both other European and abroad countries. Moreover, there is a pattern in the cooperation between museums and other institutions. Museums tend to cooperate with research institutes and with other museums located in their own countries. Finally, there are important collaborations with university departments of physics, chemistry and engineering. This

implies that museums look for analytical and synthetic knowledge out of the museum when they need to apply advanced science and technology in restoration.

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Appendix

Code	Institution
CMUSPAIS	Cooperate with museums in their own country
CMUSEURO	Cooperate with museums in Europe
CMUSUSCAN	Cooperate with museums in USA and Canada
CMUSRAM	Cooperate with museums in rest of America
CMUSASIA	Cooperate with museums in Asia

CMUSAFR	Cooperate with museums in Africa
CMUSOCEA	Cooperate with museums in Oceania
CINSTPAIS	Cooperate with research institutes in their own country
CINSTEURO	Cooperate with research institutes in Europe
CINSTUSCAN	Cooperate with research institutes in USA and Canada
CINSTRAM	Cooperate with research institutes in rest of America
CINSTASIA	Cooperate with research institutes in Asia
CINSTAFR	Cooperate with research institutes in Africa
CINSTOCEA	Cooperate with research institutes in Oceania
CDEPFQPAIS	Cooperate with departments of physics and chemistry in their own country
CDEPFQEURO	Cooperate with departments of physics and chemistry in Europe
CDEPFQUSCAN	Cooperate with departments of physics and chemistry in USA and Canada
CDEPFQRAM	Cooperate with departments of physics and chemistry in rest of America
CDEPFQASIA	Cooperate with departments of physics and chemistry in Asia
CDEPFQAFR	Cooperate with departments of physics and chemistry in Africa
CDEPFQOCEA	Cooperate with departments of physics and chemistry in Oceania
CDEPINGPAIS	Cooperate with departments of engineering and IT in their own country
CDEPINGEURO	Cooperate with departments of engineering and IT in Europe
CDEPINGUSCAN	Cooperate with departments of engineering and IT in USA and Canada
CDEPINGRAM	Cooperate with departments of engineering and IT in rest of America
CDEPINGASIA	Cooperate with departments of engineering and IT in Asia
CDEPINGAFR	Cooperate with departments of engineering and IT in Africa
CDEPINGOCEA	Cooperate with departments of engineering and IT in Oceania

COUNTRY	REGION	NMUSEUM	Museum
UNITED STATES	NORTH AMERICA	M1AMAIRL	American Airlines C.R. Smith Museum, Forth Worth, TX, United States
UNITED STATES	NORTH AMERICA	M2AMNATHIST	American Museum of Natural History, Interdepartmental Laboratories, Central Park West at 79th Street, New York, NY 10024, United States
UNITED STATES	NORTH AMERICA	M3ARIZSTM	Arizona State Museum, University of Arizona, United States
UNITED STATES	NORTH AMERICA	M4ARTICHIC	Art Institute of Chicago, United

			States
UNITED KINGDOM	EUROPE	M5ASHMOL	Ashmolean Museum, College of Arts, Oxford, United Kingdom
GERMANY	EUROPE	M6BENAKI	Benaki Museum, Conservation Department, Koumpari 1, 10674 Athens, Greece
UNITED KINGDOM	EUROPE	M7BRITISH	British Museum, Great Russell Street, London, WC1B 3DG, United Kingdom
GREECE	EUROPE	M8BYZAN	Byzantine Museum of Thessaloniki, Leoforou Stratou St 2, 546 40 Thessaloniki, Macedonia, Greece
CHINA	ASIA	M9CAPBEIJ	Capital museum Beijing, Division of Preservation and Conservation, Beijing 100045, China
UNITED STATES	NORTH AMERICA	M10CINCINN	Cincinnati Art Museum, 953 Eden Park Drive, Cincinnati, OH 45202, United States
UNITED STATES	NORTH AMERICA	M11COLBY	Colby College Museum of Art
UNITED STATES	NORTH AMERICA	M12CORNING	Corning Museum of Glass, United States
SPAIN	EUROPE	M13DIOCE	Diocesan Museum of Sacred Art, Bilbao, Spain
EGYPT	AFRICA	M14EGYP	Egyptian Museum, Department of Restoration, Ministry of Antiquities, Cairo, Egypt
UNITED STATES	NORTH AMERICA	M15FIELDCHIC	Field Museum, Chicago, United States
UNITED STATES	NORTH AMERICA	M16FOWLER	Fowler Museum, University of California, Cotsen Institute of Archaeology, Los Angeles, CA 90095-1510, United States
UNITED STATES	NORTH AMERICA	M17FREER	Freer Gallery of Art, Arthur M. Sackler Gallery, Smithsonian Institution, Washington, DC 20560-0707
BRAZIL	CSAMERICA	M18MHOMAM	Fund. Museu do Homem Americano, São Raimundo Nonato, Piaui, Brazil
ROMANIA	EUROPE	M19GALART	Galeriile de Artă Transilvania, Braşov, Romania
ITALY	EUROPE	M20GALNUMB	Galleria Nazionale dell'Umbria, Corso Vannucci, 06123 Perugia, Italy
SWITZERLAND	EUROPE	M21GEOLOG	Geological Museum of the Canton Vaud, Bâtiment Anthropole, 1015 Lausanne, Switzerland
GERMANY	EUROPE	M22GLAS	Glasmuseum Hentrich, Stiftung museum kunst Palast,

			Düsseldorf, Germany
UNITED STATES	NORTH AMERICA	M23HARVARD	Harvard University Art Museums, 32 Quincy Street, Cambridge, MA 02138, United States
GERMANY	EUROPE	M24HERZOG	Herzog Anton Ulrich-Museum, Museumstraße I, D38100 Braunschweig, Germany
MALAYSIA	ASIA	M25ISLAM	Islamic Arts Museum, Curatorial Affairs Department, Kuala Lumpur, Malaysia
UNITED STATES	NORTH AMERICA	M26GETTY	J. Paul Getty Museum, Los Angeles, CA, United States
AUSTRALIA	OCEANIA	M27KANAM	Kanamkek-Yile Ngala Museum, Wadeye, NT 0822, Australia
BELGIUM	EUROPE	M28KONINK	Koninklijk Museum voor Schone Kunsten, Antwerp, Belgium
NETHERLANDS	EUROPE	M29KROLLER	Kröller-Müller Museum, Conservation Department, Houtkampweg 6, NL-6731AW Otterlo, Netherlands
AUSTRIA	EUROPE	M30HIST	Kunsthistorisches Museum, Conservation Science Department, Burggring 5, A-1010 Vienna, Austria
UNITED STATES	NORTH AMERICA	M31LACMART	Los Angeles County Museum of Art, Los Angeles, United States
UNITED STATES	NORTH AMERICA	M32LYMAN	Lyman Allyn Art Museum, 625 Williams St., New London, CT 06320, United States
UNITED KINGDOM	EUROPE	M33MANCH	Manchester Museum, University of Manchester, Manchester M13 9PL, United Kingdom
UNITED STATES	NORTH AMERICA	M34MET	Metropolitan Museum of Art, New York, United States
UNITED STATES	NORTH AMERICA	M35MICHSTUNIV	Michigan State University Museum, East Lansing, MI 48824, United States
NORWAY	EUROPE	M36MUNCH	Munch Museum, Teyengata 53, 0578, Oslo, Norway
FRANCE	EUROPE	M37MUSIQ	Musée de la Musique, Laboratoire de Recherche et de Restauration, Cite la Musique, 221 avenue Jean Jaures, 75019 Paris, France
FRANCE	EUROPE	M38AIRETESP	Musée de l'Air et de l'Espace, Aéroport du Bourget, BP 173, 93352 Le Bourget Cedex, France
FRANCE	EUROPE	M39ADECOR	Musée des Arts décoratifs, Ucad, 107 Rue de Rivoli, 75001

			Paris, France
FRANCE	EUROPE	M40LOUVRE	Musée du Louvre, Département des Objets d'Art, F-75058 Paris Cedex 01, France
FRANCE	EUROPE	M41GUIMET	Musée Guimet
SWITZERLAND	EUROPE	M42MARTHIST	Musées d'Art et d'Hist., Laboratoire de Recherche, CP 3432, CH-1211 Genève 3, Switzerland
ITALY	EUROPE	M43MARCHNAT	Museo Archeologico Nazionale, P.zza Duomo 13, 33043 Cividale del Friuli Udine, Italy
SPAIN	EUROPE	M44MBACORD	Museo de Bellas Artes de Córdoba, Spain
SPAIN	EUROPE	M45MNCIENAT	Museo Nacional de Ciencias Naturales (CSIC), C/ Jose Gutierrez Abascal 2, E-28006 Madrid, Spain
PORTUGAL	EUROPE	M46SROQUE	Museu de S. Roque, Santa Casa Misericordia Lisboa, Largo Trindade Coelho, 1200-470 Lisboa, Portugal
SPAIN	EUROPE	M47MFMARES	Museu Frederic Marès, Conservation Department, Institut de Cultura de Barcelona, Pça Sant Iu 5-6, 08002 Barcelona, Spain
BRAZIL	CSAMERICA	M48MPEG	Museu Paraense Emilio Goeldi (MPEG), Universidade de São Paulo, C P 399, CEP 66000, Belém, PA, Brazil
NETHERLANDS	EUROPE	M49BOIJ	Museum Boijmans Van Beuningen, Museumpark 18- 20, 3015 CX Rotterdam, Netherlands
FRANCE	EUROPE	M50MHISNAT	Muséum d'Histoire Naturelle, 28 Boulevard des Belges, 69000 Lyon, France
BELGIUM	EUROPE	M51MAYER	Museum Mayer van den Bergh, Lange Gasthuisstraat 19, 2000 Antwerpen, Belgium
FRANCE	EUROPE	M52MNATHIST	Museum National d'Histoire Naturelle de Paris, UMR 5198, CNRS-MNHN, Departement de Prehistoire du Institut de Paleontologie Humaine, 1 rue Rene Panhard, 75013 Paris, France
UNITED STATES	NORTH AMERICA	M53MFINARTBOST	Museum of Fine Arts, Boston, MA 02115, United States
HUNGARY	EUROPE	M54MFINART	Museum of Fine Arts, Dózsa Gy. út 41, H-1146 Budapest,

			Hungary
UNITED STATES	NORTH AMERICA	M55MOMA	Museum of Modern Art, Conservation Department, 11 West 53d St., New York, NY 10019
CHINA	ASIA	M56MTERR	Museum of the Terracotta Warriors and Horses of Qin Shihuang, Lintong, 710600, China
BELGIUM	EUROPE	M57VLEES	Museum Vleeshuis, Vleeshouwersstraat 38-40, 2000 Antwerpen, Belgium
SOUTH AFRICA	AFRICA	M58NATAL	Natal Museum, Private Bag 9070, Pietermaritzburg 3200, South Africa
GREECE	EUROPE	M59NATARCH	National Archaeological Museum of Greece
BELARUS	EUROPE	M60NARTM	National Art Museum of the Republic of Belarus, 20 Lenin St., Minsk 220030, Belarus
UNITED STATES	NORTH AMERICA	M61NATGALWDC	National Gallery of Art, Scientific Research Department, Fourth and Constitution Avenue NW, Washington, DC 20565, United States
AUSTRALIA	OCEANIA	M62NATGAL	National Gallery of Australia, Conservation Department, GPO Box 1150, Canberra, ACT 2601, Australia
GREECE	EUROPE	M63NATGAL	National Gallery, Alexandros Soatzos Museum, Athens, Greece
UNITED KINGDOM	EUROPE	M64NATGAL	National Gallery, Scientific Department, Trafalgar Square, London WC2N 5DN, United Kingdom
FRANCE	EUROPE	M65NLIBFR	National Library of France, Paris, France
POLAND	EUROPE	M66NMKRAK	National Museum in Kraków, ul. Krupnicza 26, 31-123 Kraków, Poland
NORWAY	EUROPE	M67NMART	National Museum of Art, Architecture and Design, P.b 7014 (St Olavs Plass), NO-0130, Oslo, Norway
CHINA	ASIA	M68NMCH	National Museum of China, Center for Conservation, Beijing, 100006, China
JAPAN	ASIA	M69NMJH	National Museum of Japanese History, Museum Science Division, Research Department, 117, Jonai-cho,

			Sakura-shi, Chiba 285-8502, Japan
UNITED KINGDOM	EUROPE	M70NMLIV	National Museums Liverpool, Conservation Technologies, National Conservation Centre, Whitechapel, Liverpool, United Kingdom
DENMARK	EUROPE	M71NMBEV	Nationalmuseets bevaringsafdeling, IC Modewegsvej, Brede, DK-2800 Kgs. Lyngby, Denmark
UNITED STATES	NORTH AMERICA	M72NELATK	Nelson-Atkins Museum of Art, Kansas City
UNITED STATES	NORTH AMERICA	M73NCMA	North Carolina Museum of Art, 2110 Blue Ridge Road, Raleigh, NC 27607, United States
DENMARK	EUROPE	M74GLYPT	Ny Carlsberg Glyptotek, Dantes Plads 7, Copenhagen 1556, Denmark
CHINA	ASIA	M75PALACE	Palace Museum, Technology and Science Department, Beijing, 100009, China
UNITED STATES	NORTH AMERICA	M76PHILMA	Philadelphia Museum of Art, Box 7646, Philadelphia, PA 19101
UNITED KINGDOM	EUROPE	M77PITT	Pitt Rivers Museum, University of Oxford, United Kingdom
NETHERLANDS	EUROPE	M78RIJKS	Rijksmuseum, Department of Conservation and Restoration, Netherlands
BELGIUM	EUROPE	M79RMCA	Royal Museum for Central Africa, Laboratory of Wood Biology and Xylarium, Belgium
UNITED KINGDOM	EUROPE	M80SCIENCE	Science Museum London, Chemistry, United Kingdom
UNITED STATES	NORTH AMERICA	M81SHELB	Shelburne Museum Conservation, PO Box 10, 5555 Shelburne Road, Shelburne, VT 05482, United States
SOUTH AFRICA	AFRICA	M82SANATM	South Africa's National Museum, Rock Art Department
RUSSIA	EUROPE	M83HERMIT	State Hermitage Museum, Scientific Department
DENMARK	EUROPE	M84SMK	Statens Museum for Kunst (SMK), Sølvgade 48-50, DK-1307 Copenhagen K, Denmark
GERMANY	EUROPE	M85STIFT	Stiftung museum kunst palast, Ehrenhof 4-5, 40479 Düsseldorf, Germany
UNITED KINGDOM	EUROPE	M86TATE	Tate Britain, Millbank, London SW1P, 4RG, United Kingdom
AUSTRALIA	OCEANIA	M87ARTGWA	The Art Gallery of Western Australia, Perth Cultural

			Centre, Perth WA 6000, Australia
JAPAN	ASIA	M88TOKYO	Tokyo National Museum, Dept. of Cultural Properties, Conservation Division, 19-9 Ueno-Koen, Taito-ku, Tokyo 110-8712, Japan
UNITED KINGDOM	EUROPE	M89TROSTE	Trostre Wk. Cottage/Indust. Museum, Corus Packaging Plus, Trostre Works, Llanelli, Carmarthenshire
UNITED STATES	NORTH AMERICA	M90UNIVPENN	University Museum, University of Pennsylvania, United States
NETHERLANDS	EUROPE	M91VGOGH	Van Gogh Museum, Paulus Potterstraat 7, 1070 AJ Amsterdam, Netherlands
UNITED KINGDOM	EUROPE	M92V&A	Victoria and Albert Museum, Conservation Department, Science Section, South Kensington, London SW7 2RL, United Kingdom
UNITED STATES	NORTH AMERICA	M93WINTERTH	Winterthur Museum, Winterthur, DE, United States
UNITED STATES	NORTH AMERICA	M94YALE	Yale University Art Gallery