

The global dissemination of scholarly tourism outputs from 1976-2016: evidence from Australia

ABSTRACT

This paper explores the growing breadth and depth of networks and collaborations in the expansion of tourism scholarship. By using bibliometric techniques and mining data from 25 top tourism (and hospitality) journals, the authors provide a visualization of how the field has developed. Focusing on the example of Australia, it shows a process of intensifying internationalization with leading institutions in the UK and Hong Kong, though with minimal representation from institutions in less developed countries. The paper confirms previous findings about the growth of multi-authorships and an increasing propensity for tourism scholars to collaborate with counterparts at other institutions.

Keywords: authorship network, collaboration, bibliometric analysis

INTRODUCTION

In attempting to understand the development of tourism knowledge over recent decades, it is important to chart how networks of individuals and institutions have evolved within and between countries. Networks and collaborations are central to the creation and discussion of knowledge. This paper explores a country that has been a major global player in the generation and dissemination of tourism related knowledge – Australia. As an island continent in the southern hemisphere, Australia is geographically remote from the traditional hubs of higher education provision - Europe and North America. However, Australia-based researchers have benefitted from the greater connectedness arising from developments in ICT and from globalization. The progressive development of the internet has allowed previously isolated researchers in Australia to “go global”. As a nation with 40 public universities of international repute and a tourism sector that has expanded massively over the past four decades, Australia is a suitable setting to explore the changing nature of tourism knowledge creation and diffusion. It is also proximate to the world’s fastest growing tourism region – Asia - and hence Australian scholars may be responsible for the trending of knowledge creation and dissemination within Asia and beyond. It is acknowledged that the researchers could have considered alternative jurisdictions as the focus of this study, for example the United States, Europe or China. However, the United States was eliminated as an option because it is too large relative to the overall global knowledge production in tourism. Europe was not considered because of the substantial differences that were anticipated across national jurisdictions (eg the English speaking United Kingdom and Spain which has substantial knowledge production in Spanish covering Latin America). Finally though China was a possibility, its growth has been very recent and much of the more significant contributions have been in Chinese language meaning that measurements in English might not be adequately representative. On this basis the

authors proceeded with Australia as a relatively uniform and substantial jurisdiction that has made progressively impacts on the field over an extended period.

Two events have characterized the development of tourism knowledge creation and dissemination in Australia – one relates to the establishment of educational programs and the other to research. Interest in the contributions of international tourism to the Australian economy developed in the 1980s, in line with the removal of tariffs and floating of the currency. Recognition of the growing economic significance of tourism prompted various higher education providers to produce graduates for the service industries notably in the case of tourism by offering degree courses. The growth of tourism education provision started in the 1980s, and accelerated into the 1990s. Once the programs were in place, partnerships emerged that were designed to build research capacity between the various institutions with government and the tourism industry. This led to the establishment of the Sustainable Tourism. Cooperative Research Centre (STCRC), a network encompassing 16 Universities as well as industry and government partners. During its 12 year existence the STCRC stimulated partnerships between Universities and in association with industry. It mobilized the network of Universities and provided a fertile climate for collaborative research initiatives (De Lacy & Boyd, 2000).

LITERATURE REVIEW

Bibliometric analysis and Social Network Analysis

Bibliometric Analysis

Bibliometric analysis is a quantitative method for analyzing contributions, themes and trends in a particular field (Benckendorff 2009). It offers a range of methods and measures to investigate the structure and process of scientific collaborations and communications, evaluate scientific productivity and compare the recognition of individuals, groups, fields, universities,

nations, and other aggregates (Borgman and Furner 2002). Bibliometric quantitative methods can be used to describe, assess and monitor scientific outputs (e.g. published articles) providing a systematic, quantifiable, objective and transparent review process, thereby increasing the quality of reviews (Acedo *et. al.* 2006; Borgman and Furner 2002; Nerur *et.al.* 2008; Zupic and Čater 2015). Based on bibliographic data from publication databases, bibliometric techniques are widely used to construct structural images of scientific fields (Zupic and Čater 2015).

Three categories of bibliometric technique have been deployed frequently by researchers: evaluative, review, and relational (Zupic and Čater, 2015). Evaluative approaches assess the impact and contributions of scholarly work that has been produced by two or more individuals, groups or institutions in the form of ranking or rating of outlets, authors or institutions. Review studies employ meta-analysis or structured literature review. Meanwhile meta-analysis is a powerful approach that considers quantitative studies to discuss progress within a field through a structured literature review that provides in-depth analysis and understanding of contextual issues. This helps researchers to identify the evolution of a field via diverse methodological approaches. However, meta-analysis is limited because it is time-consuming to conduct a systematic literature review involving a broad range of studies, and can be prone to researcher bias. Relational methods provide a more comprehensive, and quantitative approach to analyze progress in the field because they use co-occurrence among studies. Since they consider all types of applicable studies, they are more macro focused than other methods, more systematic, transparent, and offer a reproducible review process. As mentioned previously, though review or evaluative studies may use in-depth analysis, bibliometric methods can provide graphical descriptions of a research field by using a wide range of studies extending to hundreds or even thousands of studies (Zupic and Čater 2015). The following analytical techniques have been applied to relational methods: co-word (title,

keyword), co-author, author citations, citations, document and author co-citations and social networks (Benckendorff 2009). In the case of the present study, the co-authorship relational method is deployed in order to grasp patterns prevalent across the field.

There is a difference between co-authorship and co-citation analysis. Papers form the nodes in a co-citation network and the links between them are citations. In the case of co-authorship networks, nodes are authors of studies and co-authorship are the links between them (Newman 2004). While co-citation analyses are employed to identify the body of knowledge or intellectual structure of the field, co-word analysis is used to elucidate equivalent lines of research (Koseoglu, et al. 2016). On the other hand, co-authorship analysis identifies key researchers and the nature and social structure of formal relationships amongst members of a research community within a field (Racherla and Hu 2010). Co-authorship analysis is useful for addressing the following types of question: which factors determine co-authorship? what is the effect of collaboration on the impact? are co-authored articles more cited? do more prolific authors collaborate more frequently? are internationally co-authored papers more cited? what is the social structure of the field? (Zupic and Čater 2015). Researchers contributing to the literature, have primarily used social network analysis and the current investigation follows this approach.

Social network analysis

The popularity of social network analysis has increased in recent decades, as researchers have become more accepting of social network analysis as an effective way of understanding networks, organizations, and phenomena (Borgman and Furner 2002; Hollenbeck and Jamieson 2015). Newman (2001: 404) has defined a social network as a collection of people, ‘each of whom is acquainted with some subset of the others. Such a network can be represented as a set of points (or vertices) denoting people, joined in pairs by lines (or edges) denoting acquaintance’. An actor

is the fundamental unit in a network and the link between actors is a relational tie. The relational tie forms a dyad between two actors. A triad is formed when a third actor is added to this dyadic relationship. A triadic relationship exists when an actor serves as the link between two actors who do not have other links (Hollenbeck and Jamieson 2015: 375).

Social network analysis can determine the most important actors within a network by measuring the degree of centrality. This is a proportional measure of the ‘number of direct ties an actor has out of the total number of possible ties’. The higher the number of actors to whom a focal actor is connected, the higher will be their degree centrality score within a defined social network (Hollenbeck and Jamieson 2015: 377). Social network analysis offers a method to evaluate relationship networks by mapping and analyzing relationships amongst individuals, groups, departments and institutions. It enables researchers to investigate communication and collaborative mechanisms between members of scientific groupings. Visual representations can enhance explanations of large and complex research communities and clustering of social networks (Borgman and Furner 2002; Racherla and Hu 2010). It is possible to understand the structure and behaviors of research communities by representing connections or relationships between actors as a network of links (Baggio, Scott and Cooper 2010).

METHOD

Data collection

The present study considers articles and research notes published in academic journals on the basis that these categories constitute a type of certified knowledge (Ramos-Rodríguez & Ruíz-Navarro, 2004). The investigation consisted of four successive steps to collect related data - journal selection, article selection, extraction of authors affiliated with Australia, and organizing

and cleaning the data for analysis. Firstly, the top 25 tourism and hospitality journals were identified in order, taking account of the Social Science Citation Index (SSCI) and Emerging Sources Citation Index (ESCI). Gursoy and Sandstrom's (2016) updated ranking was used as a supplementary reference because it recognizes the role of reputation amongst leading researchers. The researchers identified the earliest journal issues to ensure that articles from the earliest possible date would be included. All issues of the relevant journals that appeared up to the end of 2016 were scanned for related articles. The listing of relevant journals is presented as Table 1.

The second step involved the selection of full-length articles and research notes published in these journals by authors affiliated with Australian universities. These were determined on the basis of institutional attributions. This procedure yielded a sample of 2,409 articles which generated the subsequent bibliometric analysis. As is evidenced in Table 1, while the largest single contribution of articles has been published in Tourism Management (TM) (314 articles), the highest proportion of articles with authorships that are affiliated with Australian universities (42.98) has been in the Journal of Hospitality and tourism Management (JHTM). Of 21,818 articles published across the 25 journals, 2,409 (or 11.04%) were (co)authored by scholars affiliated with Australian universities and articles affiliated with Australia have increased substantially over the relevant period (Figure 1). The researchers proceeded to assess the polynomial trend line ($R^2 = 0.9617$) using different regression models (linear, exponential, logarithmic, and power law approaches) with dependent variables (published articles) and independent variables (year of publication) to identify the model that best fits the data (Barrios, Borrego, Vilagínés, Ollé, & Somoza, 2008).

[Insert Table 1 & Figure 1 here]

The third step involved undertaking a manual extraction of bibliometric data from the sampled articles, such as the names of all (co)authors, and affiliations. As the last step, the data were organized and cleaned for further analysis. This entailed inputting author names and affiliations manually into an Excel spreadsheet, and checking for misspellings or repetitions within the database. At this stage the appearance of different combinations of names and variable initials was considered (Kumar & Jan, 2013).

Analysis

The data were analyzed with SPSS along with Bibexcel, Pajek, Ucinet6, NetDraw, and VOSviewer network analysis software packages. While SPSS was used to calculate frequencies in the study and to undertake cross-tabulations, Bibexcel was the preferred method to identify co-authorship and to build networks showing collaborations in the article authorship amongst actors. Ucinet 6 was preferred for calculating network attributes and NetDraw for modifying network data from files generated via Bibexcel. Pajek was used to display the applicable network. Heat maps were generated using VOSviewer software (van Eck & Waltman, 2010). The maps utilize “warmer colors and bolded fonts to emphasize concepts that are frequently used, while words that are used only sporadically are shown in colder colors and subdued smaller fonts” (Zupic & Čater, 2015, p. 447).

Finally, time periods were established to examine and display the data for easier visualization and to facilitate an examination of network evolution and any changes in the pattern of collaboration. Following Ramos-Rodríguez and Ruíz-Navarro (2004), six sub-periods were identified in preference to scrutinizing the data annually. The respective periods were: before 1992, 1992–1996, 1997–2001, 2002–2006, 2007–2011, and 2012–2016. This approach was

relatively random and the groupings permitted us to visualize the data better and to identify possible trends and patterns in the literature between 1965 and 2016.

RESULTS

Overview of authorship data

In the case of articles where the relevant author/s qualified as being affiliated with Australian universities, the researchers calculated the number of articles, the number of author appearances, the number of authors, the number of multi-authored articles, the number of authors of multi-authored articles, the results of articles per author and authors per article, and the collaboration index (Table 2). In elucidating how many authors were involved in research teams the researchers based the tallies for the collaboration index on Total Authors of Multi-Authored Articles/Total Multi-Authored Articles (Elango & Rajendran, 2012). The data show an increasing tendency towards collaboration and this is confirmed by the pertinent numbers of author, as is evidenced in Figure 2. It is shown that multi-authored articles have dominated over the past four periods. This figure also shows the rarity of multi-authored articles, including those by four and more contributors.

[Insert Table 2 & Figure 2 here]

The evolution of national and international collaborations was investigated in four categories, including one author from a single institution and country; two or more authors from one institution and one country; two or more authors from at least two different institutions from one country; and two or more authors from two or more institutions and two or more countries as seen Figure 3. The results show that international collaborations have been growing steadily with a remarkable increase over the most recent period (2012-2016).

[Insert Figure 3 here]

Evolution of co-authorship networks

Since authors enter or leave an academic research community via collaboration(s), it may be anticipated that collaboration or co-authorship of networks within this community will be dynamic. Such networks are constantly evolving (Gallardo-Gallardo et al. 2017). Figure 4 presents the period based evolution of co-authorship networks by Australian university tourism researchers. The researchers considered only co-authored articles published between 1976 and 2016 in preparing these networks (1,766 out of 2,409). Figure 4 was generated using the Pajek software package program and presents the evolution of networks at both structural and actor levels. Whilst each circle or node signifies an author, lines or ties represent collaborations or co-authorship in the articles. The existence, strength and structure of ties should be considered when interpreting the networks, rather than the location of any node in the network since the nodes are placed randomly (Gallardo-Gallardo et al. 2017; Hanneman and Riddle, 2005).

As is evidenced in Figure 4, the structures of networks are atomized during the first two periods (before 1992 and 1992-1996). In other words, the structures that applied during these two periods were incipient because they were governed by dyads and triads of co-authors. Multi-authored articles almost tripled in the third period (1997-2001) from 80 to 212 (see Table 2), partly because 14 out of the 25 journals started publishing in or after 1997. The number of authors (N) and subsets or components (C) of networks in this period increased from 132 to 313 and from 40 to 82 respectively. Furthermore, the number of authors in the main or largest component (#MC) more than tripled from 12 to 38. The structure of the network acquired increasing complexity, since the network components became close-knit communities with a growing frequency of collaborations (Gallardo-Gallardo et al. 2017). This trend has continued into the three most recent periods. The main component in 2012-2016 had 548 authors and the

network had 123 components. The structure is more complex than its predecessors (see Figure 4). This evolution shows that the collaborative network generated in articles affiliated with at least one author from Australian universities has been maturing.

[Insert Figure 4 here]

Secondly, the authors sought to identify greater detail across the network at two levels – the macro (as a network) and the micro (as an actor in the network) to acquire an enhanced understanding of the evolution. At the macro level, “density of network” was considered as an indicator of cohesion. To calculate this indicator, the authors considered means of the ratio of the number of ties to the maximum possible numbers of ties. These ranged from 0 to 1 and showed a level of connection amongst authors. Higher levels mean more interactions with other authors (Koseoglu, 2016). The network density for each period, calculated via Ucinet 6, is presented in Table 3. While the earlier density was 4.8%, it was 0.3% during the last period (2012-2016). As is evident from these numbers, the density decreased from the first to the last period. However, this does not mean a decreasing tendency for collaboration, since network density is inversely related to network size. As can be seen from other indicators in Figure 4 (Number of authors, Ties, Components, and Number of authors in the main component) and visualization of networks, network sizes have been increasing. This is the reason for the decreasing level of density (Gallardo-Gallardo et al. 2017).

An author’s degree centrality was considered to assess the evolution of the network at micro or actor level. This indicator shows the importance of authors by identifying an author’s number of collaborations in the network. The arithmetic summa of the arches is calculated, either coming to or going from each author (Gallardo-Gallardo et al. 2017). We used Ucinet 6 to examine authors’ degrees in the network. Table 3 lists top central authors by period based on the

degree of centrality. There were several authors in the network in the first two periods; however, the degrees increase in subsequent periods, as well as the number of central authors.

[Insert Table 3 here]

Social structure of co-authorship networks

The authors next addressed the issue of influential actors as authors, institutions, and countries in the network. This was generated for the overall period (1976-2016) in order to assess the social structure of the community. Figure 5 presents the components of the overall network. Author publications represent the size of nodes with bigger circles or nodes meaning higher author publications. The thickness of ties or lines shows the strength of the collaborations. The graph indicates that while several authors have higher degrees or ties, many have lower degrees. This shows the unevenness of degree distribution in the network (Gallardo-Gallardo et al. 2017).

[Insert Figure 5 here]

To identify the importance of authors across the complete network, two indicators were considered: degree centrality and betweenness centrality. The meaning of degree level was explained in the previous analysis. Betweenness centrality explains the extent to which a particular point lies “between” the various other points in a network. A high score reflects a hierarchical network structure, in which a single or a small number of nodes in the network tends to be more central than other nodes. Authors with a high degree or betweenness are usually key researchers in the network (Gallardo-Gallardo et al. 2017)

[Insert table 4 here]

Lastly, the structure of the main component of the complete network was examined. Figure 6 presents a heat map of the main component network that has been visualized via VOSviewer. The main component has 1,364 authors and there are 5,896 ties amongst these

authors. Vosviewer generated 75 clusters. In the map there is a big component (the red part) that includes key researchers. There are also a few small components (light red or yellow) that show potential opportunities for the network to mature.

[Insert figure 6 here]

Overall network based on institutional collaborations: To acquire a better understanding of the collaborations, we investigated how inter-institutional collaborations generated the social structure of the network. To conduct these analyses we counted internal collaborations as a single collaboration and did not consider collaborations WITHIN a university. While the size of nodes representing institutions was the output institutional publications, the thickness of ties or lines shows the strength of the collaboration amongst actors. There are 539 institutions in the network (Figure 7) with 2,594 ties and six components. There is a low density of the networks (0.8%) since many institutions have lower degrees. This shows that although Australian universities have strong ties with the well-known universities, the collaboration level with other less prominent institutions is rare.

[Insert Figure 7 here]

Table 5 presents key universities in the network based on degree centrality and betweenness centrality of the network. Two universities that are located outside Australia, namely The Hong Kong Polytechnic University and University of Surrey, occupy critical positions in the network.

[Insert table 5 here]

Figure 8 shows the heat map including institutions in the main component of the network that has 529 institutions. Victoria University, Griffith University, and The University of Queensland each occupy a strong position in the network. In addition to these three, there is a

significant component that includes a few Australian universities along with The Hong Kong Polytechnic University.

[Insert figure 8 here]

Overall network based on country collaborations: To investigate collaborations between countries, we focused on visualizing the whole network and two of the indicators that were explained previously, namely degree centrality and betweenness centrality. To conduct these analyses, we counted internal collaborations amongst countries as a single collaboration. While the size of nodes representing countries was the number of publications from that source, the thickness of ties or lines shows the strength of the collaborations amongst actors. Additionally, the colors in Figure 9 identify clusters generated via VOSviewer. Authors affiliated with Australian universities have collaborated with counterparts from 60 countries. There were 376 ties in these collaborations with a density of 7.5%. There are 35 clusters in the network. As a supplement to this graph, the degree and betweenness values presented in Table 6 confirm that western developed countries occupy a critical collaborative position in relationship to Australia within the network. Collaborations between Australian institutions and counterparts in developing or underdeveloped countries are rare.

[Insert Figure 9 and Table 6 here]

DISCUSSION AND CONCLUDING REMARKS

To advance scholarly understanding of the creation and dissemination of tourism knowledge it is important to produce evidence about how institutions and individuals engage with the wider knowledge domain. Tourism is an interesting subject for such an investigation since it is global in reach and draws upon a multiplicity of disciplines. Its main period of expansion to date has also coincided with the establishment of the world wide web, the expansion of university

education and research and the increasing globalization of the tourism phenomenon itself. Whilst hotel schools in Europe and North America date back to the nineteenth century and early twentieth century respectively, ie prior to mass tourism, Australia has grown almost exclusively through the mass tourism era. Considering Australia's relatively small population (25 million – equivalent to the Netherlands or Taiwan), it has been a disproportionate contributor to tourism scholarship. Through the relatively short history of its involvement, Australia has contributed substantially to publications in the top journals. It has also demonstrated evidence of high quality, as evidenced by the scale of collaborations and networks which has served to deepen the scholarly outputs. Whilst it has been outside the scope of the present investigation to explore institutional and departmental rankings, some tentative findings about institutional collaborations are evident. As a former British colony, Australia has retained connections with other jurisdictions that form part of the British Commonwealth. The main international collaborations with Australian tourism academics have been associated with the University of Surrey (UK) and The Hong Kong Polytechnic University (in the former British colony of Hong Kong).

The impact of institutional impacts on research networks and productivity has also been outside the immediate scope of this paper. Do tourism researchers who are employed at more research oriented Universities generate bigger outputs? As University rating agencies such as QS and CWUR have started to move beyond institution- (University) wide rankings to discipline specific assessments, there is an increasing prospect of examining various measures of cross institutional collaboration, including at individual researcher level. The resultant data could potentially inform tourism departments about their role within the wider institutional context and vice versa for university leaders who seek a better understanding of the role of tourism scholarship.

Whilst the focus of this study on Australia is noted as a limitation, the fact that this country generates more than a tenth of all global tourism journal outputs suggests that it may be represent important collaborative and networking phenomena. It is also acknowledged that the study has not used the full range of available analytical techniques. The coverage has nevertheless been extensive and is a reminder of the increasing availability of visual representations for the mapping of scholarly networks, backed by solid analysis. It is anticipated that future researchers will be able to consider the findings of the current investigation and make extended use of the relevant techniques that have been deployed to compare developments in tourism research in different locations.

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Table 1. The sample of journals

Selected Journals	Earliest issue	Latest issue	# of articles	# of articles in the sample	% of articles affiliated by Australia
Anatolia: An International Journal of Tourism and Hospitality Research (Anatolia)	1997- v8(3)	2016-v27(4)	427	29	6.79
Asia Pacific Journal of Tourism Research (APJTR)	1996-v1(1)	2016-v21(12)	650	98	15.08
Annals of Tourism Research (ATR)	1973-v1(1)	2016-6-v61	2297	288	12.54
Cornell Hospitality Quarterly (CHQ)	1960-v1(1)	2016-v57(4)	2430	26	1.07
Current Issues in Tourism (CIT)	1998-v1(1)	2016-v19(14)	666	130	19.52
International Journal of Contemporary Hospitality Management (IJCHM)	1989-v1(1)	2016-v28(12)	1199	54	4.50
International Journal of Culture, Tourism and Hospitality Research (IJCTHR)	2007-v1(1)	2016-v10(4)	265	35	13.21
International Journal of Hospitality Management (IJHM)	1997-v1(1)	2016-v59	1710	136	7.95
International Journal of Hospitality and Tourism Administration (IJHTA)	1997-v1(1)	2016-v17(4)	345	23	6.67
International Journal of Tourism Research (IJTR)	1999-v1(1)	2016-v18(6)	714	108	15.13
Journal of Destination Marketing & Management (JDMM)	2013-v1(1)	2016-v5(4)	124	14	11.29
Journal of Hospitality Marketing & Management (JHMM)	1992-v1(1)	2016-v25(8)	667	52	7.80
Journal of Hospitality and Tourism Management (JHTM)	2006-v13(1)	2016-v29	228	98	42.98
Journal of Hospitality and Tourism Research (JHTR)	1976-v1(1)	2016-v40(6)	920	56	6.09
Journal of Sustainable Tourism (JST)	1993-v1(1)	2016-v24(12)	879	218	24.80

Journal of Travel and Tourism Marketing (JTTM)	1992-v1(1)	2016-v33(9)	1598	137	8.57
Journal of Travel Research (JTR)	1968-v7(1)	2016-v55(8)	1053	177	16.81
Journal of Vacation Marketing (JVM)	1994-v1(1)	2016-v22(4)	591	134	22.67
Scandinavian Journal of Hospitality and Tourism (SJHT)	2001-v1(1)	2016-v16(4)	315	11	3.49
Tourism Economics (TE)	1995-v1(1)	2016-v22(6)	979	112	11.44
Tourism Geographies (TG)	1999-v1(1)	2016-v18(5)	453	55	12.14
Tourism Hospitality Research (THR)	1999-v1(2)	2016-v16(4)	338	39	11.54
Tourism Management (TM)	1999-v3(1)	2016-v57	2463	314	12.75
Tourism Management Perspectives (TMP)	2012-v1	2016-v20	269	29	10.78
Tourist Studies (TS)	2001-v1(1)	2016-v16(4)	238	36	15.13
Total	-	-	21818	2409	11.04

Table 2. Data related to authorship by sub-period

Periods	Before 1992	1992- 1996	1997- 2001	2002- 2006	2007- 2011	2012- 2016	Total
# Articles	61	161	342	403	613	829	2409
# of author appearances	80	267	631	761	1410	2184	5333
# of unique authors	53	161	359	439	745	1038	2059
Articles per author	1.15	0.99	0.95	0.92	0.82	0.80	1.17
Authors per article	0.87	1.01	1.05	1.09	1.22	1.25	0.86
# Multi-authored articles	18	80	212	255	488	713	1766
# Authors of multi- authored articles	28	132	313	373	732	1033	1992
Collaboration Index	1.56	1.66	1.48	1.46	1.50	1.45	1.13

Table 3. Density of the network and top authors based on degree centrality by period

Author	Degree	Author	Degree	Author	Degree
Before 1992 (Density= 4.8%)		1992-1996 (Density= 1.4%)		1997-2001 (Density= 0.7%)	
Philip L. Pearce	4	Philip L. Pearce	10	Chris Ryan	10
John J. Pigram	2	Alastair M. Morrison	6	Bill Faulkner	10
Clem A. Tisdell	2	Joseph T. O’Leary	6	Brian M. Edward King	9
Connie Mok	2	J.S. Perry Hobson	6	Larry Michael Dwyer	8
Brian Slater	2	Gianna M. Moscardo	5	Lindsay W. Turner	7
Vivien Cheung	2	Colin Michael Hall	5	Philip L. Pearce	7
				Robin N. Shaw	7
				Johannes Bauer	7
				Bruce R. Prideaux	7
2002-2006 (Density= 0.6%)		2007-2011 (Density= 0.4%)		2012-2016 (Density= 0.3%)	
Brian M. Edward King	19	Bruce R. Prideaux	20	Noel Scott	40
Bruce R. Prideaux	18	Sara Dolnicar	19	Songshan (Sam) Huang	32
Larry Michael Dwyer	8	Larry Michael Dwyer	18	Larry Michael Dwyer	27
Lindsay W. Turner	8	Gayle R. Jennings	18	Brent W. Ritchie	26
Arch G. Woodside	7	Brent W. Ritchie	18	Sara Dolnicar	25
Chris Guilding	7	Noel Scott	18	Brian M. Edward King	23
Jan Warnken	7	Brian M. Edward King	13	Lisa M. Ruhanen	22
Jamie Murphy	7	Beverley A. Sparks	13	Richard N.S. Robinson	21
		Betty Weiler	11	Peiyi Ding	20
		Deborah J. Edwards	11	Philip L. Pearce	19
		Timothy Jeonglyeol Lee	11	Terry Delacy	19
		Jeremy Buultjens	11	Bruce R. Prideaux	19
		Wade L. Hadwen	11	Susanne Becken	19
		Rob Law	10	Rob Law	17

Geoffrey I. Crouch	10	Stephen Leslie Wearing	17
Susan A. Moore	10		

Table 4. Top authors in the overall co-authorship network by degree and betweenness

Author	Degree	Author	Betweenness
Noel Scott	56	Bruce R. Prideaux	174016
Brian M. Edward King	55	Brent W. Ritchie	128794
Bruce R. Prideaux	52	Brian M. Edward King	128358
Philip L. Pearce	46	Noel Scott	114966
Brent W. Ritchie	45	Larry Michael Dwyer	111223
Larry Michael Dwyer	44	Betty Weiler	96169
Sara Dolnicar	42	Lisa M. Ruhanen	69235
Songshan (Sam) Huang	35	Sara Dolnicar	63841
Beverley A. Sparks	28	Philip L. Pearce	58810
Terry Delacy	27	Beverley A. Sparks	54213
Richard N.S. Robinson	27	Songshan (Sam) Huang	53279
Peiyi Ding	25	Judith Mair	46256
Betty Weiler	24	Richard N.S. Robinson	45354
Rob Law	23	Pierre J. Benckendorff	43380
Lisa M. Ruhanen	23	Tien Duc Pham	43357
Stephen Leslie Wearing	22	Rob Law	42283
Natalie Stoeckl	21	Bill Faulkner	37072
Susan A. Moore	21	Dean Bradley Carson	36834
Timothy Jeonglyeol Lee	21	Paul Anthony-Whitelaw	35127
Ralf Buckley	21	Simon Darcy	35047
David Bruce Weaver	20	Susan A. Moore	35037
David J. Solnet	20	Geoffrey I. Crouch	33956
Dianne Dredge	20	Roy Ballantyne	33795
Gayle R. Jennings	20	Jennifer H. Laing	33527
Pierre J. Benckendorff	20	Alexandra Coghlan	33507

Table 5. Top institutions in the overall co-authorship network by degree and betweenness

Institution	Degree	Institution	Betweenness
The University of Queensland	128	The University of Queensland	38629.8
Griffith University	120	Griffith University	37320.9
Victoria University	64	Victoria University	16856.8
Southern Cross University	63	Southern Cross University	16389.1
James Cook University	61	James Cook University	15103.5
The Hong Kong Polytechnic University	49	University of South Australia	12451.0
University of South Australia	49	The Hong Kong Polytechnic University	10658.8
The University of New South Wales	46	Monash University	10425.2
Monash University	45	The University of New South Wales	8867.4
La Trobe University	43	University of Technology Sydney	8741.8
University of Technology Sydney	42	La Trobe University	8136.0
Curtin University	37	The University of Western Australia	8107.0
University of Wollongong	34	Curtin University	8041.6
The University of Western	30	University of Wollongong	7986.6
The University of Surrey	27	Edith Cowan University	5435.6
Murdoch University	26	Queensland University of Technology	4975.6
Edith Cowan University	26	Murdoch University	4548.2
University of Canberra	26	University of Canberra	4157.7
Swinburne University of Technology	23	CSIRO	3185.8
The University of Newcastle	21	The University of Newcastle	2967.1
Western Sydney University	20	Swinburne University of Technology	2865.8
Deakin University	18	The University of Surrey	2859.3
RMIT University	18	Australian National University	2686.7
Queensland University of Technology	17	Deakin University	2646.9
University of Otago	15	Western Sydney University	2422.8

Table 6. Top countries in the overall co-authorship network by degree and betweenness

Country	Degree	Country	Betweenness
Australia	60	Australia	1523.05
USA	22	USA	84.233
UK	16	UK	34.517
Hong Kong	11	Hong Kong	11.917
Norway	10	Norway	7.617
New Zealand	9	China	5.000
Canada	9	Canada	4.733
China	7	New Zealand	4.650
France	7	France	4.533
Sweden	6	Sweden	2.033
South Korea	5	Japan	1.750
Malaysia	5	Malaysia	1.533
Switzerland	5	Switzerland	1.333
Japan	5	Portugal	1.200
Italy	5	Slovenia	1.000
Portugal	5	Austria	0.833
Taiwan	4	South Korea	0.583
Austria	4	Italy	0.417
Slovenia	4	Germany	0.333
Lebanon	4	The Netherlands	0.333
Mexico	4	United Arab Emirates	0.200
Chile	4	Lebanon	0.200
Thailand	3	Fiji	0
Germany	3	Taiwan	0
Macau	3	Macau	0
Fiji	3	Denmark	0
The Netherlands	3	Thailand	0
Denmark	3	Greece	0
United Arab Emirates	3	Singapore	0
Iran	3	Mauritius	0
Greece	2	Iran	0
Mauritius	2	Spain	0
Spain	2	Sri Lanka	0
South Africa	2	South Africa	0
Serbia	2	Serbia	0
Egypt	2	Botswana	0
India	2	Indonesia	0
Finland	2	Bangladesh	0
Albania	2	Turkey	0

Iceland	2	Egypt	0
Sri Lanka	1	Ireland	0
Singapore	1	India	0
Botswana	1	Malta	0
Indonesia	1	Saudi Arabia	0
Bangladesh	1	Nepal	0
Turkey	1	Mexico	0
Ireland	1	Finland	0
Malta	1	Belgium	0
Saudi Arabia	1	Bhutan	0
Nepal	1	Belize	0
Belgium	1	Albania	0
Bhutan	1	Croatia	0
Belize	1	Czech	0
Croatia	1	Chile	0
Czech	1	Cambodia	0
Cambodia	1	Papua New Guinea	0
Papua New Guinea	1	Iceland	0
Ecuador	1	Ecuador	0
West Africa	1	West Africa	0
Brazil	1	Brazil	0
Lithuania	1	Lithuania	0

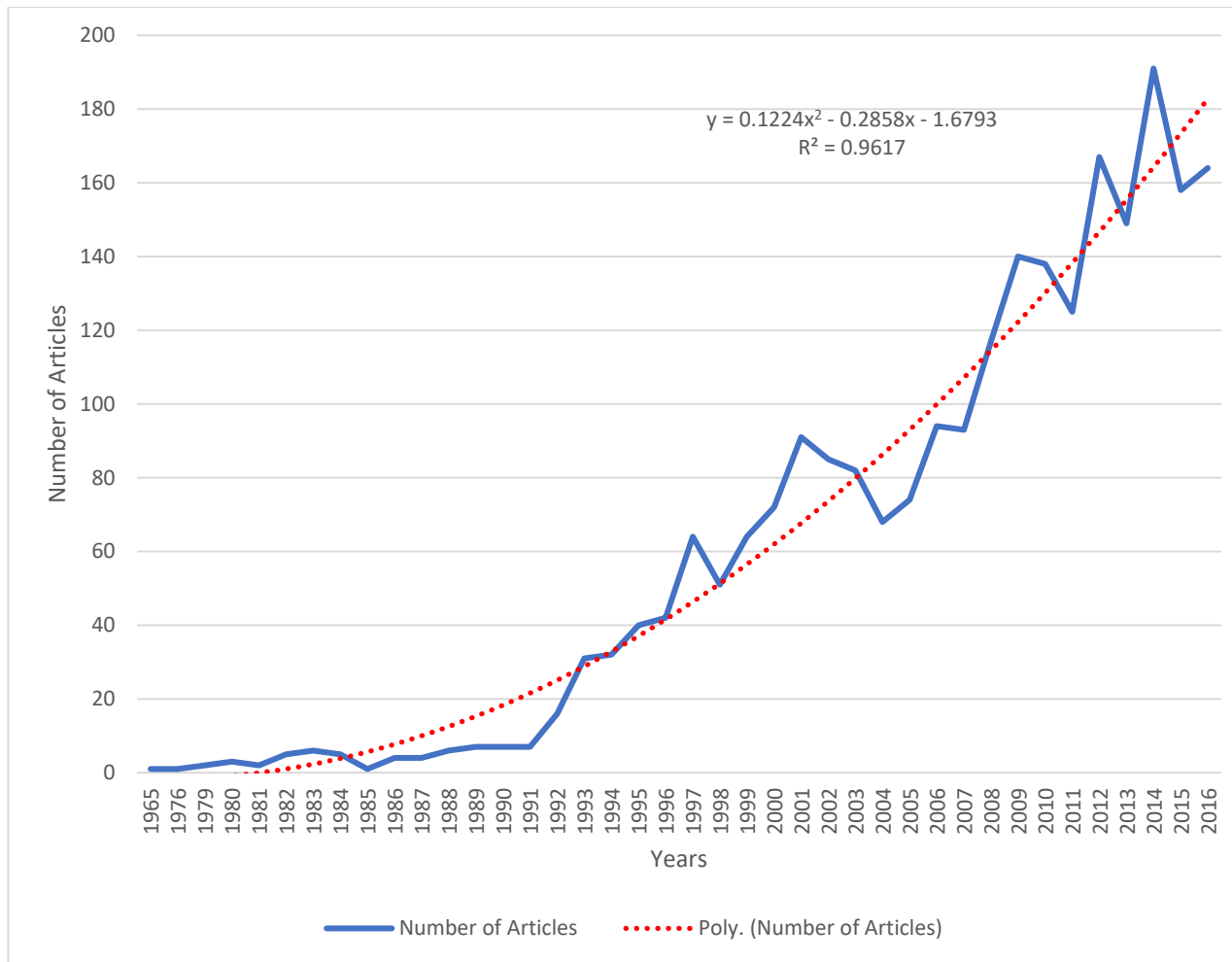


Figure 1. Distribution of articles by Australian Universities

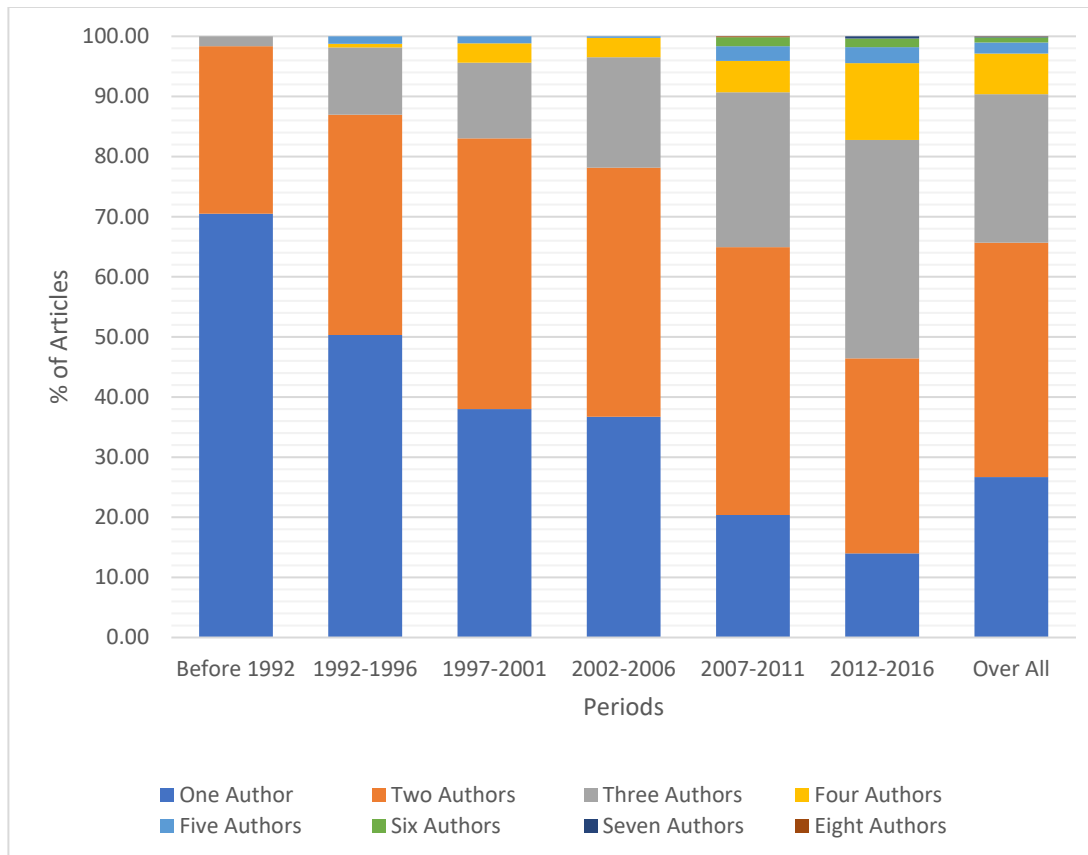


Figure 2. Authorships by period

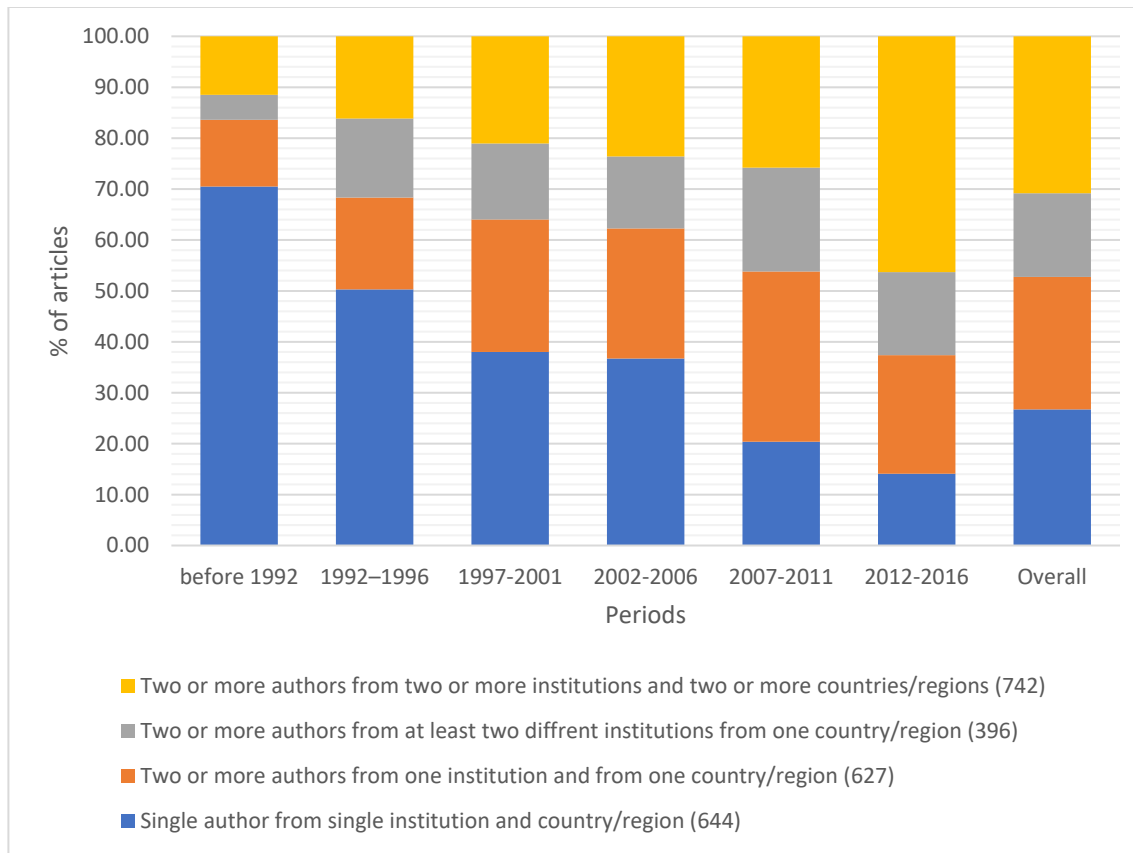
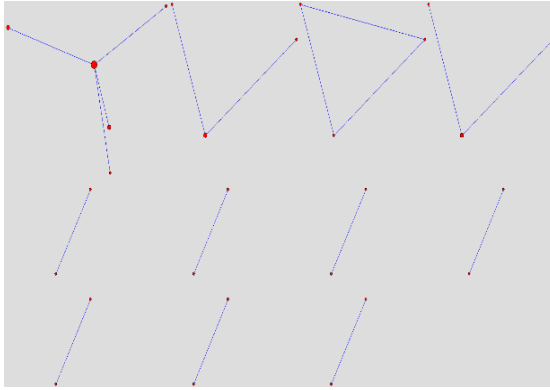
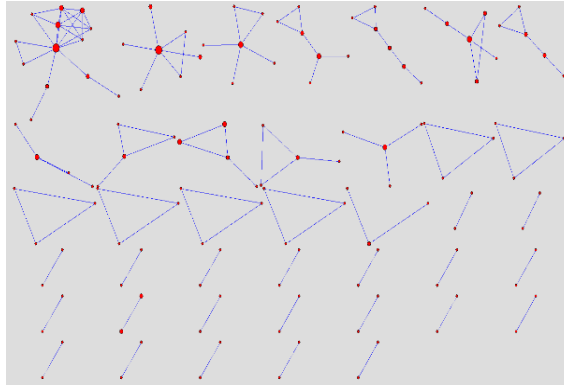


Figure 3. National and international collaborations

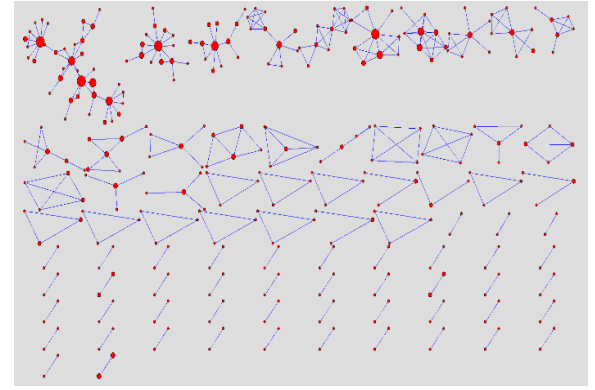
Before 1992 (N= 28; T= 36; C= 11, #MC= 5)



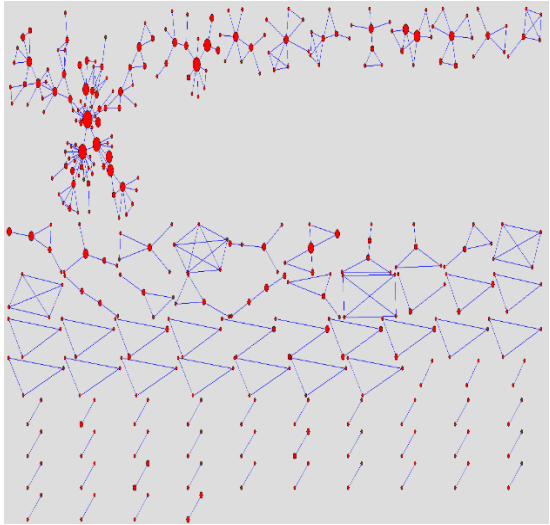
1992-1996 (N= 132; T= 254; C= 40, #MC= 12)



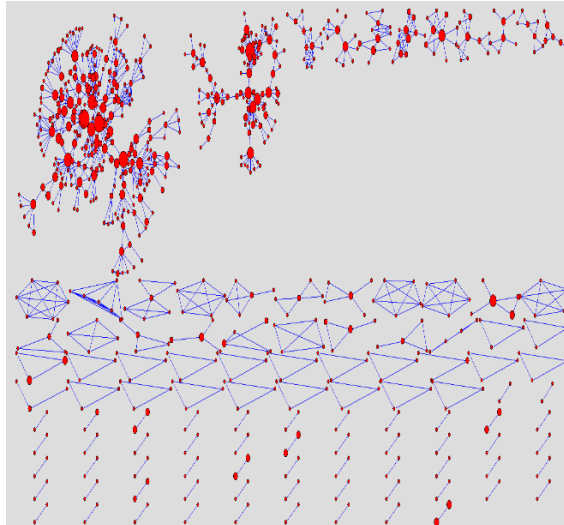
1997-2001 (N= 313; T= 682; C= 82, #MC= 38)



2002-2006 (N= 373; T= 798; D= 0.6%; C= 84, #MC= 92)



2007-2011 (N= 732; T= 2222; D= 0.4%; C= 108, #MC= 271)



2012-2016 (N= 1033; T= 3728; D= 0.3%; C= 123, #MC= 548)

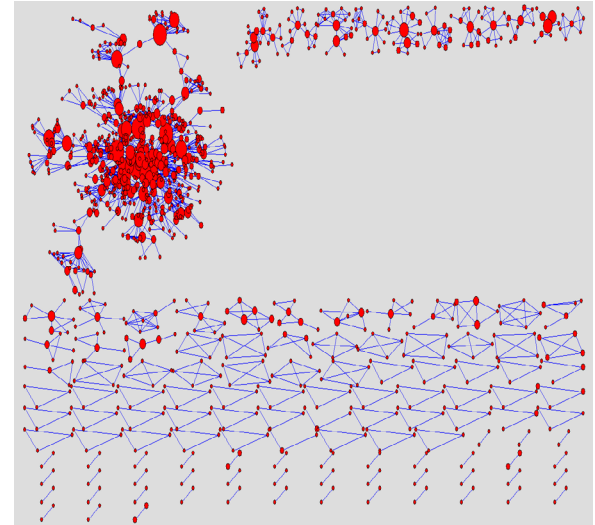


Figure 4. Evolution of co-authorship network by period

Note: Author Number (N); Ties (T); Number of components (C), and Number of authors in the main or largest component (#MC)

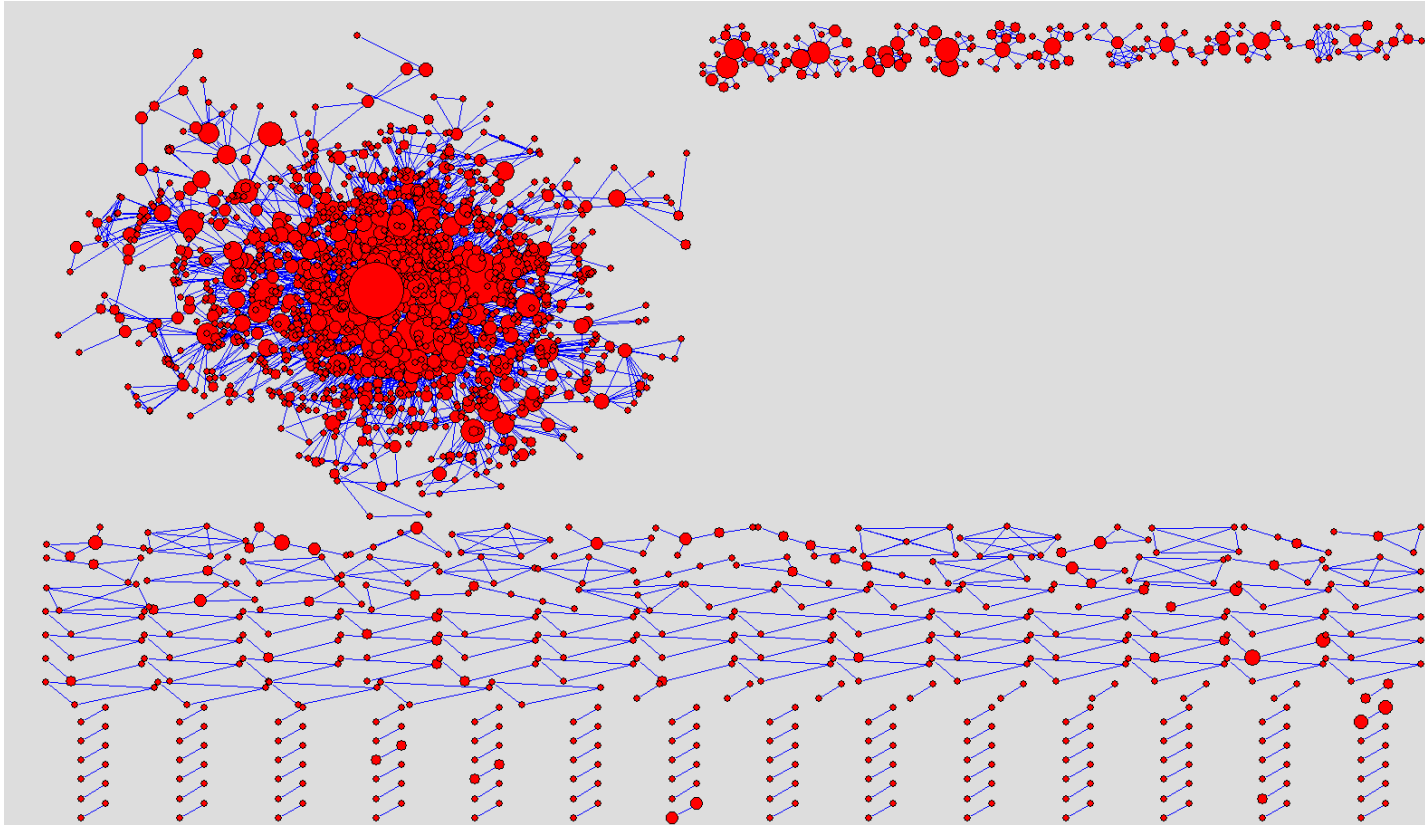


Figure 5. Overall network based on author collaboration (1976-2016)

Number of author: 1992; Ties: 7214; Density: 0.2%; Component: 197; Author number in the main component: 1364

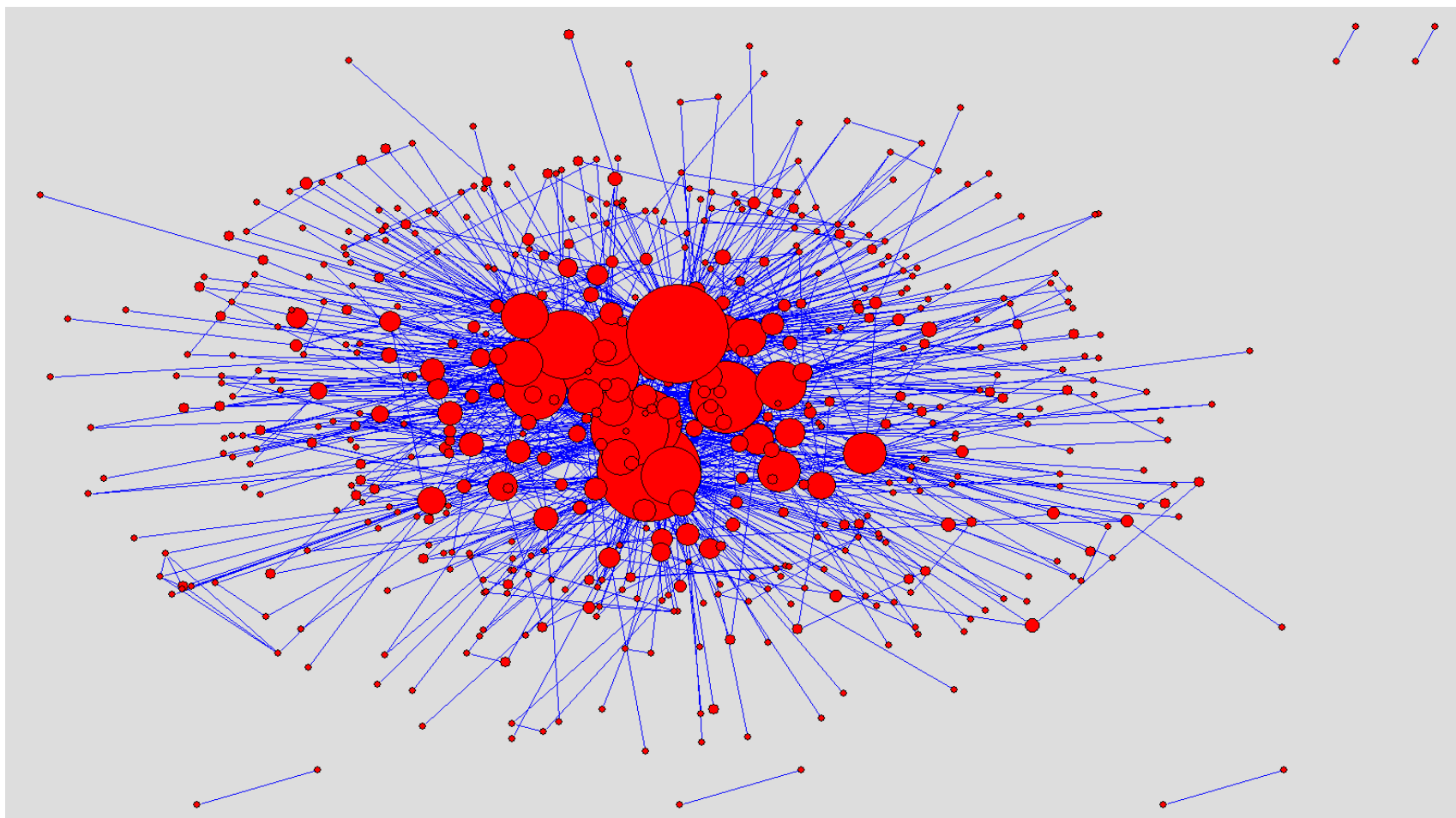


Figure 7. Visualization of the main component of the overall network based on institutional collaborations (1976-2016)

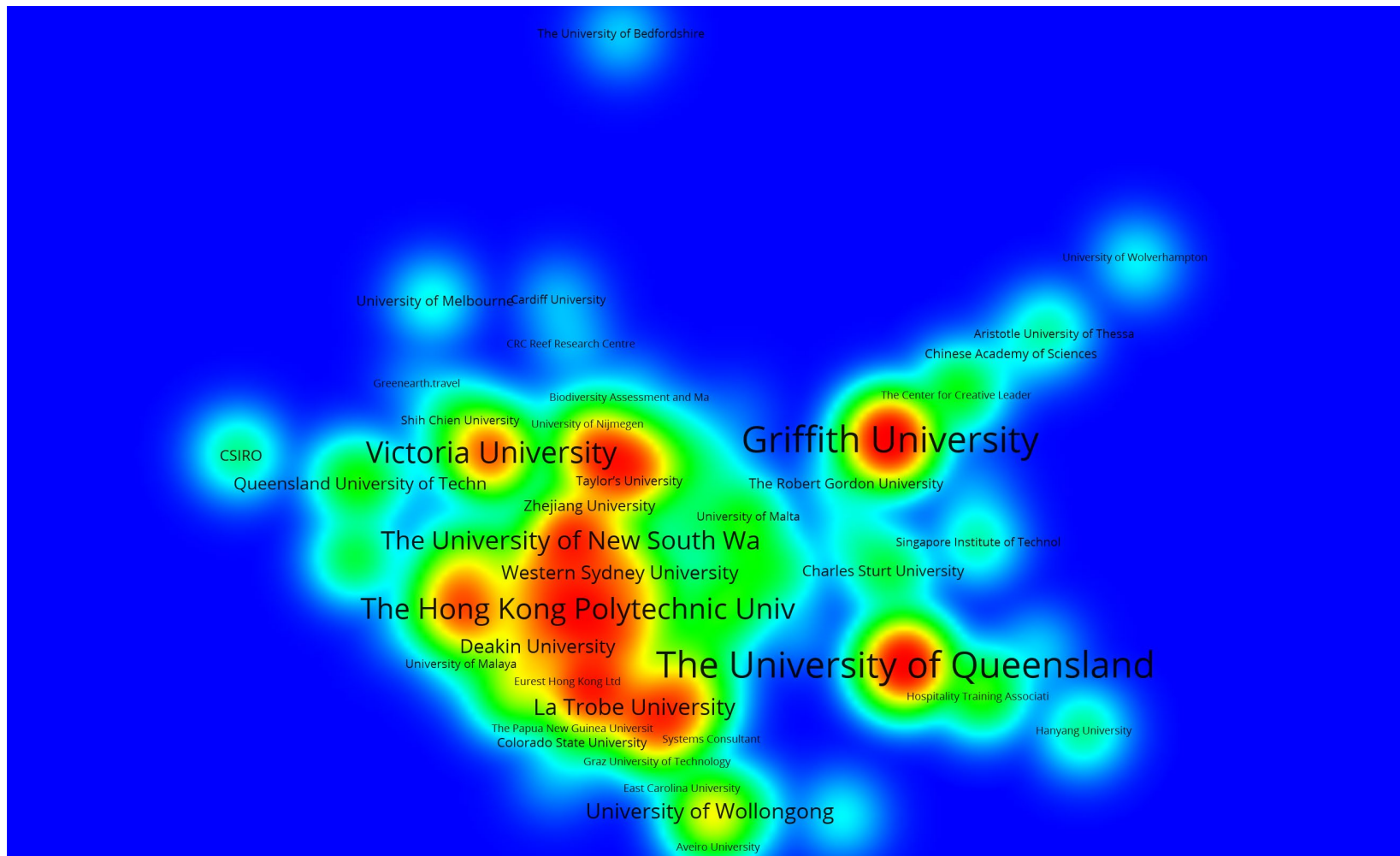


Figure 8. Visualization of main component of the overall network based on the institutional collaboration (1976-2016)

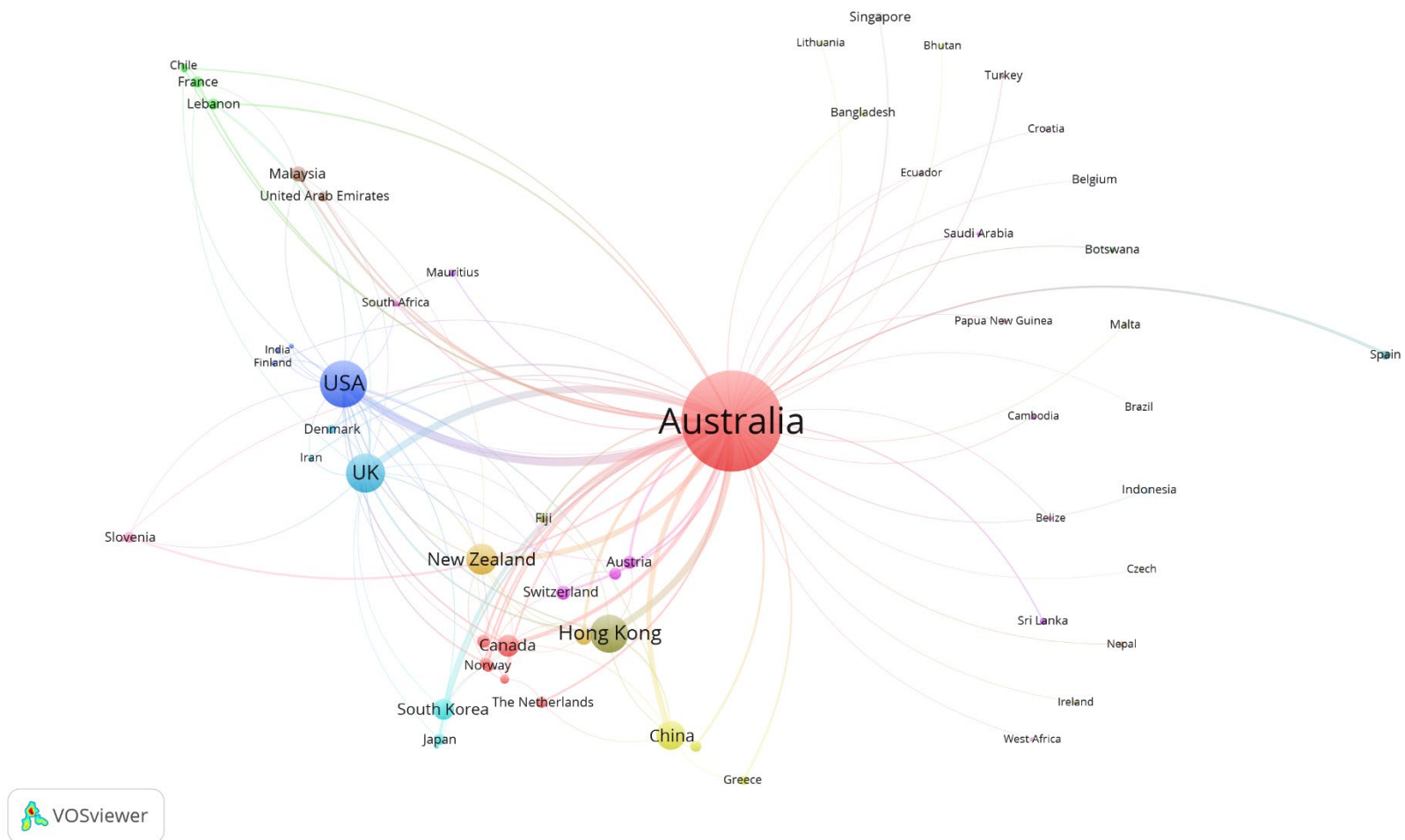


Figure 9. Visualization of main component of the overall network based on country collaborations (1976-2016)