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Network structure and governance in sport clusters: a mixed methods analysis

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ABSTRACT

Research question: This study contributes to our understanding of how network structures influence cluster governance and consequently cluster outcomes. We investigate the relational structure of cross-sectoral sport clusters and how these influence network governance.

Research methods: We employed a mixed methods approach, combining qualitative research data and social network analysis (SNA). Forty-nine interviews were conducted with employees from the surfing clusters in Aquitaine (France) and Torquay (Australia). The interview transcripts were subjected to two rounds of coding prior to SNA on an aggregated actor level.

Results and findings: Findings from both show the core is comprised of five actor types, while five other actor types are peripheral. The French case is a Network Administrative Organisation-governed Network while the Australian case is a Leading Group-governed Network.

Implications: This article contributes to knowledge on network governance, more specifically on network governance in sport clusters. We extend existing theory on network governance by suggesting a fourth, intermediate mode of network governance, the leading group-governed network. Furthermore, our research provides insights for sport clusters, an under-researched context in interorganisational sport networks.

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Network governance; interorganisational; sport cluster; mixed methods; network analysis

Introduction

Network structures are ubiquitous in the sport industry (Wäsche & Gerke, 2019). This is unsurprising, given the many inter-sectoral and intra-sectoral networks comprised of for-profit, non-profit, and public sport organisations. Examples include federated networks of sport organisations at national, regional and local levels (Shilbury et al., 2016), professional sport leagues (Dickson et al., 2005), community sport networks (Cousens et al., 2012), sport event networks (Kellett et al., 2008; Naraine et al., 2016; Wäsche, 2020), sport tourism networks (Dickson, 2010; Wäsche & Woll, 2013), elite sport networks (Gerke & Wäsche, 2019; Lucidarme et al., 2018), buyer–

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supplier networks (Gerke et al., 2015), sponsorship networks (Wagner et al., 2017), innovation networks (Gerke, 2016), and entrepreneurial/ start-up networks (Wäsche, Gerke, et al., 2017).

Only a few studies provide a systemic theoretical examination of sport clusters[1], a type of cross-sectoral interorganisational network (e.g. Gerke et al., 2015; Gerke et al., 2020; Shilbury, 2000). Most sport cluster studies have applied the cluster concept descriptively without emphasising the nuances of sport clusters and their governance (e.g. Chetty, 2004; Logue et al., 2014; Stewart et al., 2008). This is despite a growing interest in sport clusters by regional (Cluster Grand Paris Sport, 2021), national (Ministère des Sports, 2019) and international organisations (European Platform for Sport Innovation, 2021). Governance is crucial to cluster success, and more specifically to collective innovation performance (Berthinier-Poncet, 2013), knowledge building (Cassanego Júnior et al., 2019), ethical issues (Gereffi & Lee, 2014), and financial sustainability (De Propris & Wei, 2007).

In clusters, organisations create a network by virtue of their interdependent relationships and behaviours. Individual and collective outcomes are dependent on the quality of network governance. Our research focuses on relationships and interactions as distinct from actor characteristics. In doing so, we take a relational perspective, considering actors' structural embeddedness, and how this embeddedness both facilitates and constrains actor behaviours within the cluster network (Burt, 1982). Hence, by understanding the clusters' network structures, we can better understand how network structures influence cluster governance and consequently cluster outcomes.

Governance of a network refers to the structure, coordination, and management of collaborative activity (Lam, 2014; Raab & Kenis, 2009). Provan and Kenis (2008) used two criteria to underpin three modes of network governance. The two criteria are (1) the extent that network governance is brokered[2] and (2) the extent that brokerage happens through network participants or through external actors (Provan & Kenis, 2008). The three modes of governance are: participant-governed networks, lead organisation-governed networks, and networks governed by a network administrative organisation (NAO; Provan & Kenis, 2008). In this study, we explore these three modes of network governance in sport clusters.

The objective of this research is to explore the network structure and its impact on network governance in cross-sectoral clusters. We address two research questions: (1) how are networks in cross-sectoral industry clusters structured?; and (2) how does network structure influence network governance? This research extends the Provan and Kenis (2008) classification of modes of network governance by introducing a new mode of network governance, the *leading group-governed network*. Furthermore, this research contributes to knowledge on sport clusters as an emerging middle-range theory[3] (Brodie et al., 2011; Gerke et al., 2020).

The following section summarises the literature on network governance, both in sport and in clusters. We present the methods utilised for qualitative data collection, deductive, inductive coding and social network analysis (SNA) (see also supplementary file). The results section provides an overview of findings. We triangulate the findings in the discussion section and close the paper with conclusions on implications, limitations, and suggestions for future studies.

Literature review

Network governance

Networks are 'groups of three or more legally autonomous organisations that work together to achieve […] a collective goal' (Provan & Kenis, 2008, p. 3). Networks are a form of governance in the context of production systems but are also subject to governance because they need a system of decision-making and coordination (De Propris & Wei, 2007; Lam, 2014; Raab & Kenis, 2009) that 'reflect the governance interactions in a network' (Lucidarme et al., 2018, p. 352). The main tenants of network governance are partner selection, task allocation amongst the network partners, network resources and responsibilities, and the coordination, collaboration, and evaluation of network relationships (Sydow & Windeler, 1997).

Provan and Kenis (2008) proposed three basic models, or forms, of network governance (Figure 1). Each model reflects differing levels of brokerage and centrality. The broker spans gaps or so-called 'structural holes' (Burt, 1992) and creates weak ties (i.e. connections between otherwise unconnected groups of actors (Granovetter, 1983). Centrality refers to whether an organisation occupies a central or peripheral position in a network. Centrality is more or less dependent on the number of links it has with other organisations (Provan et al., 2007).

Network governance may be highly decentralised, which implies that most or all network members participate relatively equally. This type of governance is called *participant-governed networks* or *shared participant governance*. In this mode of governance, all network members engage in decision-making and coordination even if to a varying extent. Shared participant governance can be achieved formally (i.e. regular meetings) or informally (i.e. uncoordinated collaboration efforts). Whilst often burdensome and time consuming for network members, shared participant governance is a means of

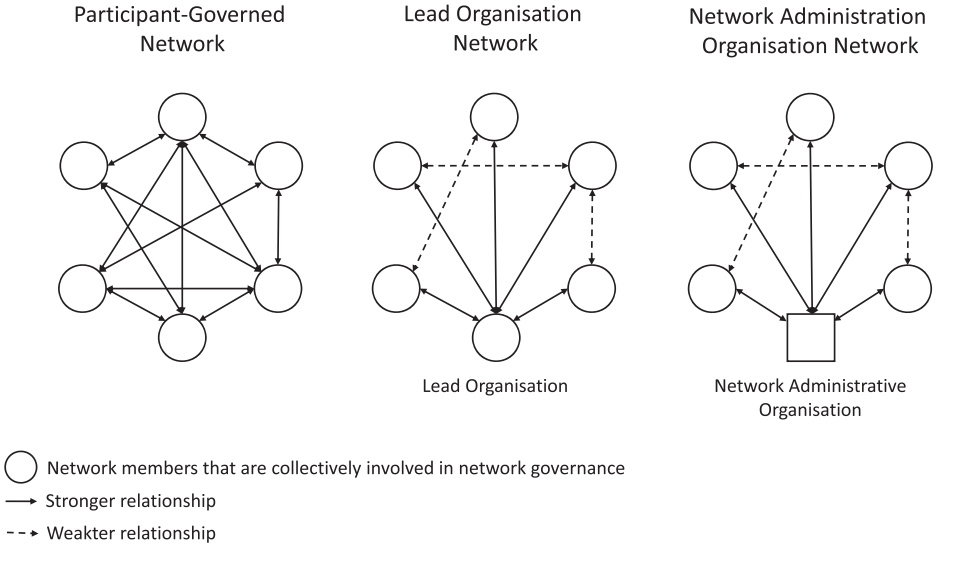

Figure 1. Modes of governance according to Kenis and Provan (2009).

enhancing network capacity and achieving network goals. This mode of network governance prevails in smaller, multi-firm alliances and partnerships, and also in public sector networks (e.g. health and human services). Decisions at the network level are taken collectively and power distribution is consequently more or less symmetrical, despite variations in organisational size, resources, and performance (Provan & Kenis, 2008).

The shared participant governance approach often leads to inefficiencies. Therefore, networks might centralise decision-making by delegating governance responsibilities to a single network member. This scenario is known as *lead organisation governance*. Lead organisation-governed networks occur typically in vertical buyer-supplier relationships, most likely when the supply chain is dominated by one large and powerful firm. Lead organisation-governed networks also occur in horizontal multilateral networks when one organisation has sufficient resources and legitimacy to take the lead role, or in community health networks where there is a pivotal organisation (e.g. hospital in health network). The lead organisation makes all major network-level decisions and coordinates network-level issues autonomously, hence power distribution is asymmetric (Provan & Kenis, 2008).

A third form of network governance occurs when a separate administrative entity is established to govern a network's activities. This model is called an NAO-governed network (Provan & Kenis, 2008). In this network governance mode, network members interact but strategic network decisions and coordination tasks are mandated to the NAO. An NAO might only consist of one person as a coordinator (e.g. cluster manager) or consist of a larger office of people with different specific tasks and a board structure (Provan & Kenis, 2008).

Calls for more research on network governance coincide with the increasing organisation of economic activity (e.g. consortia, joint ventures, clusters, marketing channels) but also public administration in networks (Heide, 1994; Kapucu et al., 2017; Mathews, 1994; Provan & Kenis, 2008). This applies to the sport sector that is increasingly cross-sectoral and networked (Babiak et al., 2018).

Network governance research in Sport Management

Literature on network governance in sport builds on the framework by Provan and Kenis (2008). We illustrated this with selected examples below.

Naraine et al. (2016) detected participant-governed networks in small sport event networks, while networks governed by a lead organisation were more likely to feature in larger networks. However, Wäsche (2020) found a lead organisation governance structure within a small-scale sport event. In this example, a local sports club coordinated all major network activities and decisions.

Lucidarme et al. (2018) found that lead organisation governance in an elite sport network is most effective when the lead organisation's power and resource domination are accepted by the other network members. In the case of a municipal youth sport non-profit network, Jones et al. (2017) identified a lack of network-level governance and consequently a loss of network efficiency and effectiveness. They suggested the use of a third-party intermediary organisation to broker governance-related tasks. This

broker could be a member of the network (i.e. lead organisation), or a separate organisation specifically created for this purpose (i.e. NAO).

Typical NAO-governed sport networks are leagues and other federated networks of professional sport (Dickson et al., 2005; Dickson et al., 2010). Parent et al. (2017) identify an NAO-governed network in the context of hosting the Olympic Games. The structure of the NAO in this example is more akin to a shared governance structure given the member representation on the NAO board.

While sport management scholars have built on Provan and Kenis' (2008) framework for network governance, the interpretation of the different network governance modes in different sport context remains ambiguous and requires further research.

Cluster governance

Clusters consist of networks of formally affiliated or informally connected organisations that have related production activities. (Porter, 1998; Sugden et al., 2006). Clusters are replete with interdependencies, complementarities, and conflicts. Cluster governance is therefore central to the realisation of expected positive outcomes (e.g. interaction, cooperation, exchange of information, collective efficiency and effectiveness, innovative learning) (Cassanego Júnior et al., 2019; Sugden et al., 2006; Wei et al., 2016).

Cluster governance incorporates the relationships between actors within a cluster, but also outside the cluster and addresses the questions of collaboration and decision-making. Cluster governance combines market imperatives guided through price mechanisms and systems and community rules that reflect mutual adaptation and interdependencies. Consequently, long-term relationships and trust are important non-market governance mechanisms (Gerke et al., 2018; Sugden et al., 2006).

Previous literature on cluster governance differentiates *hierarchic* governance forms from *heterarchic* or *self-governed networks*. In hierarchic governance, one single actor or a few powerful actors impose their decision on other network members in the cluster. Hence, it resembles a lead organisation-governed network or, if there is a separate entity, an NAO-governed network. In contrast, heterarchic networks are more democratic insofar as more members are involved and power relationships are more symmetrical (De Propris & Wei, 2007; Sugden et al., 2006; Wei et al., 2016). Heterarchic cluster governance has features common with the shared network governance mode (Provan and Kenis (2008). Jessop (1998) considers the anarchy of exchange or market self-regulation through the 'invisible hand' as another network governance mode (Williamson, 1975).

While some approaches to network governance focus on private actors within a production system, other approaches include the public sector with its institutions and agencies (Jessop, 1998), as well as social and environmental non-profit and non-governmental organisations (Gereffi & Lee, 2014). This leads to a confluence of private, social, and public governance in a new form of synergistic governance involving private, public, and societal actors (Gereffi & Lee, 2014).

A cross-sectoral approach to network governance in sport is important because the sector consists of commercial, public and non-profit organisations (Babiak & Thibault, 2009; Gerke et al., 2018). A better understanding of network governance in sport clusters is necessary to maximise interaction, cooperation, exchange of information, collective efficiency and effectiveness, and innovative learning.

Methods

In this study we adopt a multiple case study following a replication logic (Yin, 2018). Our aim is to compare two probably different cases that we select for theoretical replication. Hence we expect different results for foreseeable reasons (Yin, 2018). We collected qualitative data through interviews that we first analysed through thematic analysis and then converted into quantitative, relational data for subsequent SNA (Mckether et al., 2009; Wäsche, Dickson, et al., 2017). The conversion design is an approach that is commonly used in social network mixed methods. Integrating qualitative and quantitative strategies aims at improving the quality of data and enhancing explanatory power (Hollenstein, 2014).

SNA is suitable for analysing complex relationships among people, groups and communities. The content of those ties structures their relationships. Hence, we used the content of relationships as described by interviewees, to determine the network structure through SNA (Sallent et al., 2011). For the data analysis, we employed an inductive approach to identify relationships and connections between network actors (Parent et al., 2017). Interviews are a powerful tool to collect network data because they allow researchers to engage with the interviewee and probe responses (Jones et al., 2017). We followed Parent et al. (2017) and their use of the free-recall approach within the semi-structured interviews to underpin the SNA (Prell, 2012).

Case selection

This study investigates two surfing clusters in Australia and France. These countries provide favourable conditions for the development of sport clusters in surfing because they have world class conditions for surfing and well-developed and geographically concentrated surf industry organisations (Gerke, 2016; Logue et al., 2014; Stewart et al., 2008). One surfing cluster is in the Southwest of France (i.e. Aquitaine region) and has a dedicated cluster network organisation (EuroSIMA, 2018). The French surfing cluster generates €1.7 billion turnover annually, comprises more than 400 organisations of which 180 are formally federated in a cluster network organisation, and employs approximately 4000 people (EuroSIMA, 2018). The Australian surfing cluster is based in Torquay (i.e. southwest of Melbourne). This cluster has no formalised network organisation, but according to estimations from interviewees, the cluster comprises approximately 200 companies generating €0.4 billion whilst employing about 1000 people.

Data collection

We conducted semi-structured interviews (n = 49) with representatives from 21 organisations in each cluster. For some of the larger organisations, we interviewed more than one representative. Using the typology of ten different types of organisations (i.e. boardsport brand (BB), equipment specialist (ES), accessories/clothing (AC), services/consulting (SC), media/communications (MC), board designer/shaper (DS), professional sport organisation (PS), amateur sport organisation (ASO), education/research institute (ER), and governing body (GB)) typical found in surfing clusters (Gerke et al., 2015), the lead

researcher interviewed at least one organisation per category per case (except an MC firm in the Australian cluster). Table 1 summarises the interview participants.

We used a cluster manager (France) and the head for tourism and economic development within the local council (Australia) as intermediaries to recruit interview participants. The participants were either directors (if smaller companies) or managers from marketing or research and development (R&D) departments (if larger corporates). The interviewee needed to be involved in interorganisational linkages (i.e. exchanging resources with members from other organisations). The interviews covered three parts. Part one focused on understanding the organisation and the participant's role within it (e.g. Can you introduce yourself and tell me about your position in the organisation?). Part two explored the cluster environment and the organisation's position therein (e.g. What are the particular characteristics of the surfing cluster here?). Part three examined interorganisational relationships and networks (e.g. To whom and what kind of relationships do you have with other organisations within the surfing cluster?). Approximately 80% of the semi-structured interviews were conducted in person, with the remainder conducted through telephone or video conference calls. Interviews in the French surfing cluster averaged 41 min and in the Australian cluster 45 min. Interviews were recorded and transcribed by the lead researcher. Interview transcripts were shared with interviewees for adjustments and approval.

Data analysis

We used NVivo v.10 to aid with the qualitative data analysis. A total of 637 pages of interview transcripts were inductively screened for any words indicating a relationship. Our focus was on cooperative ties including information exchange, shared marketing activities, and collaborative R&D. Examples indicating such a relationship are mobility of staff, ownership links, collaboration, co-sponsorship, knowledge transfer, joint problems, coopetition, similar interests, partnership, subcontracting, etc. The results of this initial coding round were a list of quotation extracts that indicated specific interorganisational linkages between specific actor types for each case.

To allow generalisation and comparison among the two investigated clusters, organisations of the same type were collapsed into aggregated actor types. Aggregates provide more reliable data than individuals' data in SNA (Prell, 2012). This procedure is

Table 1. Number of interviews per type of cluster organisation and case.

	Aquitaine	Torquay
Boardsport brand (BB)	6	3
Equipment specialist (ES)	2	2
Accessories/clothing firm (AC)	3	2
Board designer/shaper (DS)	1	1
Media/communication (MC)	1	0
Services/consulting (SC)	4	4
Education/research institute (ER)	1	3
Governing body (GB)	4	8
Amateur sport organisation (AO)	1	1
Professional sport organisation (PS)	1	1
Total	24	25

consistent with the advice of Scott (2013, p. 50) who suggests that 'Agents can then be grouped into sets of agents with commonly occurring combinations of attributes, and these sets can be arranged into a sets-by-sets tables that show the frequency of relations between members of various categories.' The aggregated approach also coincides with Barney and Felin's (2013) call to establish micro–macro links. To illustrate, six BB were interviewed in the French surfing cluster. Then, the information on interorganisational linkages provided by each of them was combined into one category: interorganisational linkages of BBs, i.e. the aggregated actor.

The extracted quotations reduced the relevant data significantly and were the basis for the second phase of coding. We analysed each dyadic relationship to understand the type of resource or knowledge exchange. We summarised and listed the types of interorganisational relationships per possible dyad. Each possible dyad between two of the ten cluster organisation types indicates a coding theme (e.g. BB-ES, BB-ER). Identical relationships that appeared several times were listed only once because we were interested in relationship types, not relationship numbers. We summarised the possible dyads in a table. For example, the relationship between a BB and an ES was coded as BB-ES. Refer to Tables 1 and 2 in the supplemental files for the complete second round coding scheme and for an example of second-round coded content.

The pre-coded data were then revisited and synthesised quantitatively into a table. We coded weaker ties as relationships indicating one or two identified forms of link. We coded stronger ties as relationships with more than two identified forms of link. No tie relationships reflected no evidence of a cooperative relationship. Each form of cooperation was indicated by a different source. This simplified perception of the interconnections between the members of the sport cluster provided the basis for SNA. The terms 'weaker ties' and 'stronger ties' were used to avoid confusion with the concept of weak ties, i.e. connection between two otherwise unconnected subgroups (Granovetter, 1973, 1983).

For the SNA, data matrices were symmetrised and dichotomised to calculate various network parameters. To identify central and peripheral actors we calculated degree and betweenness centrality values. To explore and compare the structure of both networks in their entirety, we calculated different cohesion parameters (i.e. size, number of ties, density, average degree, degree range, centralisation, components, h-index, global

Table 2. Network position of organisation type (degree and betweenness centralities, normalised values in brackets).

	French surfing cluster		Australian surfing cluster	
Type of organisation	Degree	Betweenness	Degree	Betweenness
Boardsport brand (BB)	8 (0.889)	5.500 (0.153)	8 (0.889)	6.667 (0.185)
Equipment specialist (EC)	7 (0.778)	3.500 (0.097)	7 (0.778)	3.333 (0.093)
Accessories/clothing firm (AC)	7 (0.778)	3.500 (0.097)	5 (0.556)	1.167 (0.032)
Services/consulting firm (SC)	6 (0.667)	0.500 (0.014)	4 (0.444)	0.333 (0.009)
Media/communications firm (MC)	4 (0.444)	0.000 (0.000)	0 (0.000)	0.000 (0.000)
Board designer/shaper (DS)	4 (0.444)	0.000 (0.000)	5 (0.556)	1.167 (0.032)
Professional sport organisation (PS)	2 (0.222)	0.000 (0.000)	3 (0.333)	0.000 (0.000)
Amateur sport organisation (AO)	2 (0.222)	0.000 (0.000)	3 (0.333)	0.000 (0.000)
Education/research institute (ER)	6 (0.667)	0.500 (0.014)	4 (0.444)	0.333 (0.009)
Governing body (GB)	8 (0.889)	5.500 (0.153)	5 (0.556)	1.000 (0.028)

clustering coefficient). Finally, we correlated both network matrices using the Quadratic Assignment Procedure (QAP) to test for structural similarity.

Results

Our qualitative results provide evidence of different forms of cooperative relationships within the cluster network. First, we present examples from the qualitative analysis to illustrate stronger ties (i.e. thick black lines in Figures 2 and 3). Then, we present network visualisations and network parameters indicating cluster-specific network characteristics.

Interorganisational relationships within surfing cluster networks

In this section, we explain the nature of relationships in the stronger-tie dyads (i.e. thick black lines in Figures 2 and 3). We summarise the types of relationships across cases and provide examples of the most common ties. See also Table 3 in the supplementary files for quotations.

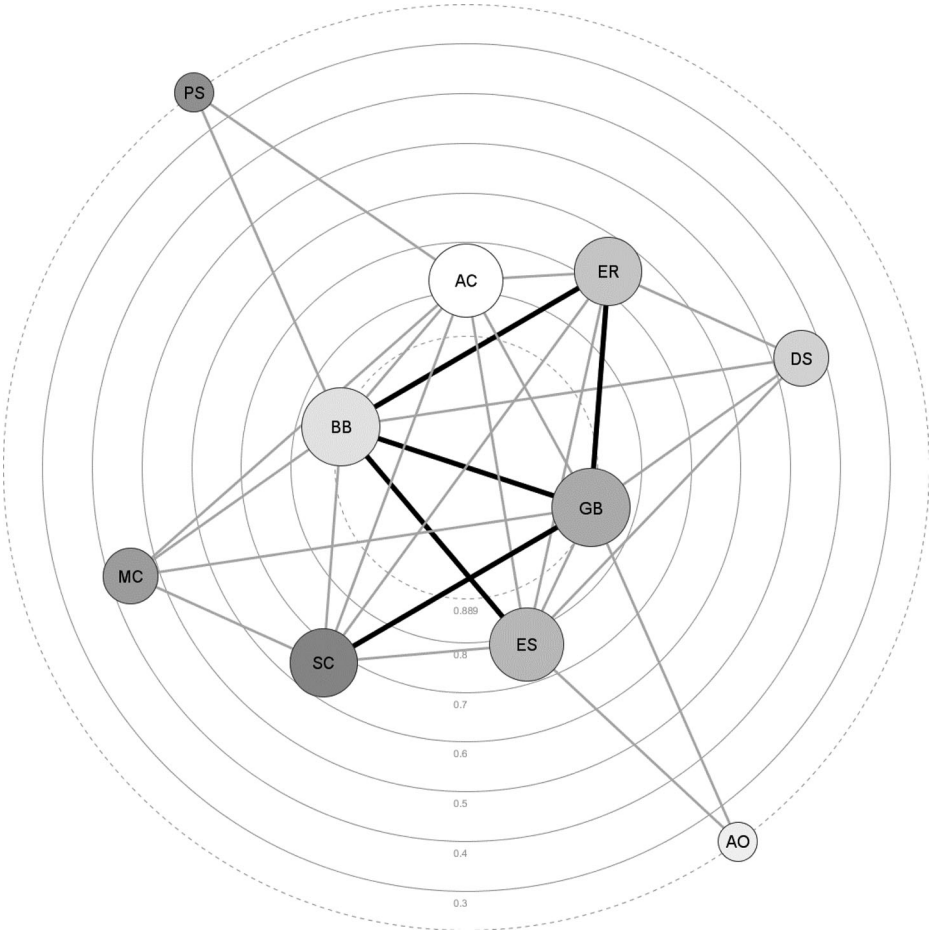

Figure 2. Network of cooperation in the French surfing cluster.

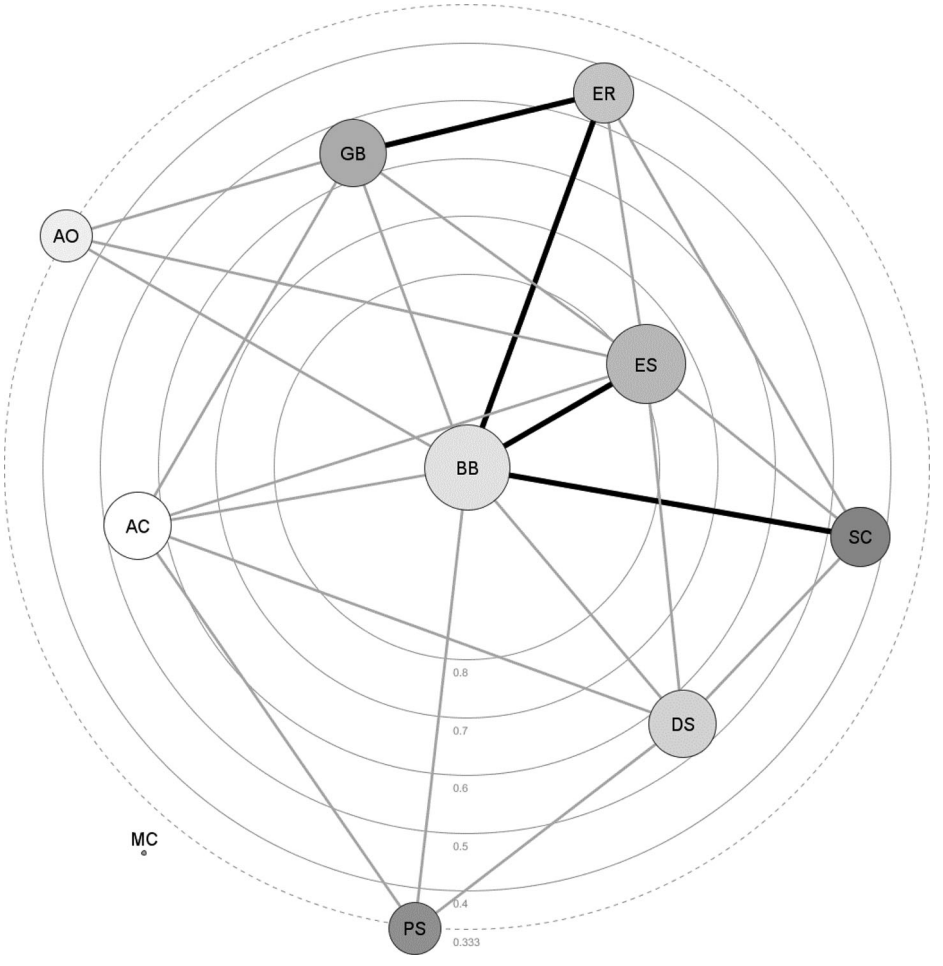

Figure 3. Network of cooperation in the Australian surfing cluster.

BB-ES (stronger tie in both cases)

A stronger tie exists between BB and ES. BB and ES referred to each other as their suppliers or sub-contractors. In some instances where the BB owned their retail shops, they

Table 3. Network cohesion of clusters and correlation.

Parameters	French surfing cluster	Australian surfing cluster
Size	10	10
Ties (stronger)	27 (5)	22 (4)
Density [n.s.]	0.600	0.489
AvgDegree [n.s.]	5.4	4.4
Degree range	2–8	0–8
Centralisation	0.361	0.500
Components	1	2
H-Index	6	5
Global clustering coefficient	0.901	0.794
QAP correlation	0.436*	

*$p < .05$.

sold ES products. In other instances, ES only sold particular services or products to BB, for example, repair services or manufacturing of prototypes.

Beyond these transactional relationships, some ES mentioned social relations (e.g. friendships, family relations) and informal communication. A GB representative in France explained how joint surf sessions enable employees from different cluster organisations to socialise but also discuss business issues. This type of relationship is captured in the category 'social relationships'.

Another connection between BB and ES but also amongst BB is mutual ownership. For example, one of the co-founders of Rip Curl also founded Quiksilver. Billabong belonged to Rip Curl until 2000. Most of the BB either had subsidiaries, managed other BB, or belonged to a corporate group federating several BB. For example, Quiksilver and Billabong belong to the global asset management firm Oaktree Capital Management. At the same time, Quiksilver has the skateboarding brand DC Shoes as a subsidiary and manages Roxy, a female-focussed surf brand (Quiksilver, 2018). This structural interrelatedness also facilitated knowledge transfer at a top management level.

Furthermore, there was high staff mobility between BB and ES but also amongst BB. The high staff mobility facilitated knowledge transfer. The aforementioned ties were summarised under 'staff and ownership relations'.

BB-ER (stronger tie in both cases)

Interviewees indicated stronger ties between BB and ER. A BB indicated collaborative links to ER for R&D projects of new or improved product material, design or technology. Sometimes these collaborations experienced difficulties due to diverging objectives and agendas. Other cooperative activities included university-based creativity sessions, as well as supporting postgraduate theses, projects and internships. This form of tie was summarised under 'collaboration in research and development'.

ER-GB (stronger tie in both cases)

Interviewees indicated stronger ties between ER and GBs. In the French cluster, ER systematically investigated and promoted opportunities for collaboration between ERs and surfing-related organisations. Some universities were also members or partners of the formal cluster network organisation. Collective innovation projects organised through GBs created 'the possibility to develop much bigger innovation projects' as a GB representative from the French cluster explained. In the Australian cluster, there were links between ER and many GB types, including national sport organisations, and the tourism office within the regional council. However, contrary to the French cluster, the GBs were not a facilitator of collaborative R&D between the surf industry and ER.

BB-SC (stronger tie in Australian case and weaker tie in French case)

In the Australian cluster, the link between BB and service/consulting firms (SC) was a stronger tie while in the French surfing cluster it was only a weaker tie. There were linkages between BB and SC specialised in the surfing industry. SC referred to a variety of actors offering specialised services in the surfing industry such as distribution, retailing, surf lessons, surf event organisation, engineering, and other services. One of the Australian BB cited retailers as 'the number one' SC connection. Retailers served not only as sales outlet but also as important source of customer feedback. Another important

type of SC were surf school instructors given their ability to test materials and products and provide feedback. There were also specialised surf industry consultants working on broad (e.g. firm strategy) or more specific issues (e.g. sustainability). These ties were summarised in the theme 'market interdependencies and support'.

BB-GB (stronger tie in French case and weaker tie in Australian case)

The stronger tie to GB indicated by French BB is related particularly to the cluster network organisation and the involved public authorities. As fee-paying members of the cluster network organisation, the BB considered the cluster network organisation as a GB. The cluster network organisation was an intermediary, providing links to other firms in the industry, public authorities and research organisations. In the Australian case, there was little evidence for links between BB and GB. For example, BB and local authorities interacted when organising surf competitions. The relationship category 'political lobbying and subsidies' contains quotations reflecting these connections.

SC-GB (stronger tie in French case and no tie in Australian case)

In the French case were stronger ties between SC and GB. The membership of surf specific SC in the cluster network organisation explains this link. This connection provides the SC with access to other GB (e.g. public authorities, national sport organisations).

Quotations illustrating these ties are provided in Table 3 in the supplementary files.

Social Network Analysis of sport Cluster Networks

This section presents the SNA of the two clusters. The SNA is based on the ten-actor typology of cluster members. Figure 2 illustrates the social network in the French surfing cluster and Figure 3 illustrates the Australian surfing cluster. The size of the actors indicates actor centrality based on degree. Thick, black links indicate stronger ties and thin, grey links indicate weaker ties. Utilising a centrality layout, the figures display networks with central actors positioned in the centre of the layout and less central actors in peripheral positions.

Both network visualisations illustrate the central role of BB. In both cases, BB is the central, most popular actors having ties to eight out of nine possible actors in the network with a standardised degree centrality value of 0.889 (see Table 2). In the French case, there is a second type of cluster organisation that is as well connected as the BB: the GBs. The second most central actors are ES and AC with a degree of 0.778. PS and AO are only weakly linked (0.222). In the Australian surfing cluster, it is also the ES that has the second highest number of ties (0.778). Interestingly, GB is less central than in the French case (0.556). ES and AC are also less central compared to the French network. PS and AO are also peripheral.

In summary, the Australian network is characterised by less equally distributed relations. The Australian cluster is more centralised around the BB and the ES (see Table 3). The concentration of cooperative relations around two actor types leads to a higher degree of information control by these two actor types. The GB has a low degree of information as indicated by the betweenness scores. In contrast, the cooperative

relations within the French cluster are more equally distributed, resulting in a more equally distributed flow of information among the core actors, especially the GBs.

Cohesion parameters (Table 3) further indicate that the French network is structurally more developed. The French network has more ties (stronger and weaker) and is denser, resulting in a higher average degree (while the differences are not significant). The smaller range of degree and centralisation score shows that cooperative relations are more equally distributed in the French network. Furthermore, it consists of only one component and has a higher h-index (indicating that there are six actors with at least six degrees in the French network). The clustering coefficients indicate higher transitivity in the French network resulting in more triplets of cooperation (closed triangles).

While there are differences, the network visualisation revealed structural similarities. In both networks, the same five actors are connected through stronger ties and therefore, form a subgroup in the centre of the cluster network: BB, GBs, ER, ES, and SC firms. These actors form the cores of the networks in both clusters. There are also five categories of actors that have only weaker or no ties with other cluster organisations: designers/shapers, AC firms, media/communication firms, AO, and PS. These actors are peripheral to the clusters. The similar structural set-up of both networks is also indicated by a moderate and significant correlation ($r_p = 0.436$, $p = 0.018$). The results show that the networks – although different – have a similar underlying structure.

In total, the French network is more cohesive, relations are more equally distributed and more transitive. However, the structures of both networks are correlated moderately and are to some extent similar.

The SNA results allow us to make some initial interpretation with regards to Provan and Kenis (2008) typology of modes of governance. To extend our understanding, we further scrutinised the network governance in the two clusters triangulating the SNA results with our initial qualitative data analysis. Combined SNA and qualitative results indicate an NAO in the French surfing cluster. With regard to the Australian surfing cluster, the interviews revealed that a group of local retailers and manufacturers attempted to establish an NAO. The quotes (see Table 3 in supplementary files) regarding the theme *Network governance* highlight the absence of an NAO for the Torquay surfing cluster and the challenges with creating one, given the entrenched nature of the informal and or unstructured approach to network governance.

Discussion

Research using the network perspective and SNA methods is growing due to the increasing interconnectedness of actors and their actions (Scott, 2013; Wäsche, Dickson, et al., 2017). The interconnectedness of social and economic actors (Granovetter, 1985) leads to the accumulation of dyadic relationships that develop into both informal and formal networks (Gerke et al., 2018). Networks require coordination to be effective and efficient (Provan & Kenis, 2008). The body of knowledge on network governance in clusters is still emerging (O'Toole & Laurence, 2015; Provan et al., 2007). Therefore, we asked (1) how are networks in cross-sectoral industry clusters structured? and (2) how does network structure influence network governance?

To address our first question, we identified the central and the peripheral actors in the cluster and the nature of their connections. Moreover, we analysed the overall structure

of the clusters showing both similarities and differences. While the French cluster is more cohesive and less centralised than the Australian cluster, both clusters reveal similar actor positions. We found that in both clusters, five actor types with stronger ties form the core network in the cluster. The five leading actor types are BB, ES, GBs, ER, and SC. In the following paragraphs, we discuss the role of the focal actors in those interdependencies and the impact on network governance.

The role of leading actors for network governance

BB and ES are the most central actors in both clusters. BB design, manufacture, and/or sell core equipment used for surfing and other boardsports like skating or snowboarding. BB usually has a large product range including AC and fashion products, but their core product is technical equipment. They have links to all other actor types in the network, except one in both cases (AO in the French cluster and MC in the Australian cluster). Those connections exist through various interdependencies: staff exchange and ownership relations, market interdependencies and mutual support, collaboration for R&D, social relationships, political lobbying, and subsidies (see Table 3 in supplementary files). This resonates with Sugden et al. (2006) who considered cluster governance as a combination of market-driven and community rules. BB plays an important role in the coordination of those interdependent activities and hence, are also actors of governance in the network of the cluster (Jessop, 1998). This supports the argument that larger firms that control supply chains play a dominant role in the governance of clusters (Gereffi & Lee, 2014). ES design, produce, and/or market essential technical products (e.g, surf pads, fins or wax) for any boardsport activities. ES is well integrated in the cluster network, but is without a dominant role in the network and therefore less influential on network governance. In the following paragraph, we outline examples of interaction and interdependencies that allow us to draw conclusions on the role of BBs and ES for network governance (Jessop, 1998; Sugden et al., 2006).

The exchange of qualified staff creates interdependencies because knowledge and resources crucial to maintain a competitive advantage may migrate over to a direct competitor (Logue et al., 2014). Ownership relations are formal interdependencies with concrete governance implications through mutual shareholding and membership in GBs of BB (e.g. the executive or supervisory board of a company). Informal information exchanges between staff from different BB might have an impact on the BB competitive advantage in the market (Gerke, 2016). Our data indicate that a market-leading BB is beneficial for the other BB with regards to extra-cluster competition (e.g. other fashion brands using the surfing image). R&D collaboration between BB dealt only with non-strategical issues (e.g. recycling, packaging) but not with strategically important R&D issues (e.g. new product development) and was coordinated by the cluster GB in the French case. Interdependencies occur also due to the retail system in the surf industry where sometimes one BB is the owner of a retailer network and other BB and also ES are dependent on them to distribute their products. BB executes governance through continuous interaction with other actor types in the surfing cluster (e.g. ES, SC) (Sugden et al., 2006). Just as Krätke (2002) concluded, it is the larger firms – BB here – that have a high level of centrality and hence, a leading and coordinating role in network governance.

BB collaborates with ER for R&D projects, a finding consistent with previous literature (Sandberg et al., 2015). These organisations exchange resources like time, knowledge,

access to laboratories, and ideas. Interdependencies develop once projects start since the mutual implications of both parties are crucial to the finalisation and success of the projects. A BB might depend on a research institute for the development of new material or design confided to them. Vice versa the research institute might receive funding from the BB directly or the industry collaboration with the BB might allow them to justify the research project and access external funding. Successful R&D partnerships between BB and ER might develop a dominating position because other network members might not have the capacity to establish such a partnership. This case represents a crucial dyad with regard to beneficial network effects, such as access to know-how and speed with regard to developments and innovation based on trustful relations and minimised transaction costs (Powell, 1990). Other cluster organisations might depend on the success of this dyad to obtain solutions for similar problems. They might adopt the solutions after their introduction to the market or join the R&D project team. In some cases, there is also an organisation from the public sector involved. In this case, the triple helix model (i.e. the collaboration of academics, companies, and governmental organisations) is evident (Etzkowitz, 2012).

BB has relationships with ES and SC. In both cases, interdependencies consist of supplier/ subcontractor-buyer relationships. Mutual interdependency exists because suppliers and sub-contractors need the orders of the BB for their economic survival while BB often depends on the specialised products and services provided by the ES and SC.

The role of GBs for network governance

GBs have strong relationships with BB and ES. In the Australian case, local and regional public authorities, the national surfing organisation, the tourism development organisation, and a sport technology industry network all indicated information exchange and collaboration. In the French case, representatives from regional councils, a chamber of commerce, the agglomeration organisation of several communities, and the cluster network organisation indicated interdependencies due to information exchange and shared projects. GB represents the public sector in the cluster. They were involved in network governance mainly through political lobbying and the control of subsidies. Network governance was formalised in the French cluster where public and private actors decided jointly to create a new entity to serve as GB of the cluster (NAO) (Provan & Kenis, 2008). In the Australian case, network governance was informal and also the involvement of public actors remained informal.

BB showed a strong link with these GBs. For example, in the French cluster, BB had a strong presence in the governing board of the cluster NAO. A BB CEO was even president of the cluster NAO. Also, with regards to ER, GB has coordinating roles and execute power through the (non)diffusion of information about potential collaboration possibilities with cluster organisations.

Network structure and its role for network governance

Drawing on the typology of Provan and Kenis (2008) to interpret our results, there is clear evidence of a purposefully created NAO in the French cluster. This might be one reason for the more advanced network development of the French cluster compared

to the Australian cluster. In the Australian case, the mode of governance is not straightforward. There are signs for a shared governance/ participant-led governance, but considering a large number of cluster organisations (about 200) it is unlikely that all cluster organisations are involved in network governance. While there is no single organisation of the network that takes the lead, there is evidence that a group of large and powerful cluster organisations, from the core of the network, are highly influential within the network. We therefore suggest another type of network governance mode: '*leading group-governance*'. This form of network governance adds to previous analyses of network governance in general (Provan & Kenis, 2008) and in the sport context (Jones et al., 2017; Naraine et al., 2016; Sallent et al., 2011).

The leading group-governed network is a hybrid mode of governance, combining elements of brokerage and hierarchy. In terms of brokerage, it is positioned in-between fully brokered network governance modes (i.e. lead organisation-governed networks or NAO-governed networks) and non-brokered network governance modes (i.e. shared governance mode). A group of network members can be more influential than others in the network (Naraine et al., 2016; Parent et al., 2017), which enables them to occupy a dominant decision-making and coordinating role within the network (Wäsche & Gerke, 2019). As such, the leading group can be considered a network within the network, where the leading group network possesses shared governance mode characteristics. In terms of hierarchy this governance structure is at the intermediate level. Decisions are made by some network members but not all as in the shared governance model. Depending on the level of cohesiveness (i.e. density of links within a network and its sub groups) and centrality (i.e. number of links per actor) the leading group might receive a higher level of acceptance than a single lead organisation, which promises effective network governance (Lucidarme et al., 2018). Multiple organisations might be able to capture the different objectives and needs of network members more efficiently than a single lead organisation. On the downside, this could lead to deficient information flow and 'cliques' within the network with diverging objectives (Wasserman & Faust, 1994). The solution could be to pursue greater cohesiveness (i.e. close and dense linkages in the networks) within the network and its subgroups and consensus amongst those members that are part of the leading group and those that are not.

Conclusion

Our research investigates the network structure of two surf industry clusters in different locations, Australia and France, that provide favourable conditions for the development of such a cluster. Our findings show similarities and differences in the network structure of these clusters and its impact on network governance. Both clusters dispose of a group of five actor types that build the core network being strongly connected while the other five cluster actor types are peripheral being weakly connected. The five actor types that form the core network are BB, ES, GBs, ER, and SC firms. The most central actor types in both cases are BB, ES, and GBs. These actor types have most interactions and hence, interdependencies with each other and with other cluster actor types. Therefore, they have a leading role in the coordination and governance of the cluster. In the French case private and public actors decided to create a formalised GB, hence, we can speak of an NAO-governed network. In the Australian case, we find a new mode of network

governance that we called a leading group-governed network. A group of major companies, notably BB and ES, dominate the coordination and governance of the network in the Australian cluster. The respect of informal rules, norms and legitimacy determine the network success and effectiveness in this case. While in the French case informal rules might also play a role, the cluster GB (NAO) has set up official procedures and processes (e.g. joint R&D projects to obtain public funding, joint HR platform for talent management and scouting) which guarantee a certain level of network benefits and effectiveness in the cluster. Our theoretical contribution is the proposition of a fourth mode of network governance that we label the leading group-governed network. This adds to the modes of network governance proposed by Provan and Kenis (2008).

Our study helps cluster members, whether private, public or non-profit organisation, to optimise network governance structures and processes by purposefully establishing or facilitating cooperative interorganisational relationships. This might enhance cluster outcomes through maximised network benefits and effectiveness. The results provide insights for both existing but also new emerging clusters' members, managers and policy makers. For example, clusters without the means to establish an NAO but that do not want a fully shared governance or that one of their members as a lead organisation governs the cluster can opt for a leading group network governance model. This mode of governance might combine the advantages of more hierarchical modes and highly brokered modes of governance (i.e. resource efficiency, fast decision-making processes) with the advantages of less hierarchical and less brokered governance modes (i.e. adherence and support of network members to network levels decision and initiative; commitment and engagement in collective actions). The information provided in this research can be used to revise, modify or reinvent the network governance in a cluster according to the structure, culture, and identity of both the cluster and its member organisations.

One of the limitations of this research is that the context of the two clusters varies. This poses limitations of comparability with regards to the socio-cultural and policy context of each case. We were unable to account for the cultural differences (see Figure 1 in supplementary file). Furthermore, we did not account for differences in public policies, both sport-related and those not. On a positive note, the cultural and policy differences did enable richer results in the sense of theoretical replication (Yin, 2018). Future research should take socio-cultural and policy-related differences more specifically into account in the collection and analysis of network data. Furthermore, supplemental national-level data on culture and policies should also be considered in the analysis of governance structures of sport clusters in future research.

In our analysis, we utilised aggregated actor types, combining empirical data from different sources but the same actor types. This is a novel approach that ensures reliability, allows comparisons among different clusters and generalisations and, hence, provides potential for theorising from social network data. Future research should build on our method of working with aggregated actor types in different social network settings instead of focusing on single actors. The analysis of aggregated actor social networks allows the modelling of network governance linking macro and micro levels. Moreover, combining qualitative and quantitative methods allows gaining a deeper understanding and explanatory power of the relation between structural network characteristics and network governance in sport clusters.

Overall, this analysis shows that network governance varies in cross-sectoral industry clusters and that subgroups and specific positions and roles of actors need to be considered to analyse network structure and its impact on governance in this multi-actor and multi-dimensional context. The result of this research is a fourth, intermediate type of network governance and more theoretical knowledge around the efficient and effective functioning of sport clusters.

Notes

1. Sport clusters are 'geographical concentrations of interconnected organisations that provide different products or services related to a sport, professional and amateur sport entities, sport-related education/ research institutes and governing bodies that exert control or influence over these organisations' (Gerke et al., 2020, p. 201)
2. Brokerage in Social Network Analysis refers to a mechanism 'whereby actors connect different components of the network' that would be otherwise disconnected (i.e., structural holes) (Burt, 1992)
3. Middle-range theories bridge the gap between general theory and empirical findings as they have a lower level of abstraction than general theories (Brodie et al., 2011, p. 76)

Disclosure statement

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