Service System Network Analysis

Department of Communities Tasmania

Final Report

Joined Up Place Based Project

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Table of Contents

Executive Summary

Network membership in the Huon Valley has grown significantly. Since the Wave 1 survey in 2016, there has been a threefold increase in Huon Valley Service Providers Network numbers invited to participate in the survey. Further, new types of organisations (not just new organisations) are joining the network as well.

Notwithstanding the above**, there is limited quantitative evidence of network growth, and in some circumstances evidence of network decline, resulting in inconclusive findings.** This may be because there was no growth but is more likely due to limitations with adequate survey data available to assess network growth**.** Only 27 organisations participated at both Wave 1 and Wave 2 survey time points, and often the networks changed so much it was not possible to ascertain positive or negative change. Having more robust data across the whole of service provider network, and not just a small subset of respondents, would enable sound quantitative evidence to be presented on the networks.

Existing collaboration, referral, and coordination of services remain highly connected from Wave 1 to Wave 2, with some new types of organisations, suggests network growth. However, these new organisations are yet to fully engage the overall service network. Quantitative indicators suggest a slight decline in the number of network ties and therefore possible overall network decline. Other quantitative indicators suggest more coordinated action among service provider organisations, such that referrals are now taking more direct shortcuts rather than longer referral paths.

Face-to-face networking events are viewed extremely positively by service providers, and make service providers feel valued, allow them to make connections to build their professional networks.

Critical to have formal role supporting the informal network. A regional coordinator is the key to the network by saving service providers time spent doing administration, helping them in sharing information to others, and connecting service providers to one another. Interview data suggests that significant efficiency gains are being made by having a Regional Coordinator of the network. Further, the network helps create a more consistent message among service providers.

Mutual acknowledgement between organisations that mutually affirm they are *easy and reliable collaborators* is a predictor for ongoing collaboration. However, a lack of reciprocation predicts no ongoing collaboration.

Service provider satisfaction was extremely high with Joined Up information events, and also with the development of services documentation, as evidenced by the survey results.

Organisations seen as highly effective at providing services in 2016 **attract other organisations** to collaborate with them in 2018.

Initial **perceived competition between service providers leads to later collaboration** between such organisations. This suggests that the network is making service providers aware of the skills, capabilities and potential to work together and this is resulting in competitive behaviour converting to collaborative behaviour.

Some organisations noted increased competition and were **critical of unknown service providers arriving unannounced and 'intruding' in their local communities** who ask to be connected into their networks without first having established trust and rapport.

Boards and forums appear to be significant sites for the maintenance of collaborative ties between organisations.

Some organisations were critical of the lack of cohesion of services in the Huon Valley, but then were not involved in the Huon Valley Service Providers network.

A placed-based approach that involves communities can **leverage significant in-kind support from local community organisations**, the use of local businesses as venues for Huon Valley Service Provider Networking events, as a case in point.

Recommendations for replicating the Joined Up Place Based approach

If the Tasmanian State Government wishes to replicate the Joined Up Place Based initiative more broadly to other parts of the state, the following are key recommendations to improve the likelihood of success:

- Formal structure in the form of a paid network coordinator (ongoing time and resource allocation) is absolutely necessary to coordinate and leverage existing informal network. As noted strongly in the interviews, the network will not self-sustain without some formal structure.
- Any new network building initiatives need to join existing informal and/or formal networks of local service providers rather than create a new and potentially competing network.
- Choosing the right person for the network coordinator role is essential. It needs to be a local person who is already well connected (i.e., very central) into the local service network, regardless of any formal position they might hold.
- The network coordinator must be someone that is respected, competent and above all trusted. Service providers will accept suggestions from people they trust to make connections with other organisations, resulting in greater network connectivity and coordination.
- Use social network analysis (SNA) before rolling out any new placed based service network initiatives to provide an evidence-base of current networking activity. This use of SNA can help identify potential network coordinators. Follow up with SNA to further analytically assess the network to assess impact of the program will provide a sound, quantitative evidence base of network building, rather than reliance on anecdotes which can be skewed and unreliable.
- Ongoing assessment of the impact and connectedness of service provider networks need to maximise the participation of the network in any network evaluation (e.g., network surveys). As a network is essentially a bird's-eye-view of a service ecosystem, having large amounts of missing data significantly hampers the possibility to see how a network is connected. SNA methods also require a consistent representative for each organisation as it improves data quality and comparability of responses.
- Centralising the collection of network data and embedding it within grant application and award processes will result in less reliance on surveys for network data, which we know from the experience of this research can be problematic to get sufficient people to participate. Additionally, it would be useful to collect network information about organisations through their board and committee memberships, forum attendances, and memberships of various networks.
- Finally, planning network evaluations in conjunction and alongside social network experts, rather than the Department of Communities Tasmania (Communities Tasmania) doing this in isolation, will give the Communities Tasmania better insights on the different possibilities for collecting and analysing data to assess the connectedness of service systems.

Report Structure

This report is divided into 5 key sections:

1. Overview of Joined Up - Place based initiative
2. Importance of networks
3. Social Network Analysis (SNA)
4. Findings for Huon Valley Placed Based Case Study
5. Using SNA to Evaluate Future Place Based Approaches

The (1) Overview of Joined Up – Place based initiative gives background information to the sub-project that was piloted in the Huon Valley throughout 2016-2018. In (2) Importance of networks section we present evidence for the value that networks provide, with specific detail for health services and communities. (3) Social Network Analysis (SNA) is introduced and explained as a set of theories and methods that can be usefully applied to the study of social networks. We argue that this constitutes the most appropriate way to understand networks. In section (4) Findings for Huon Valley Placed Based Case Study, we provide details of our two-wave, 18-month study of service provider networks in the Huon Valley. This includes social network analyses of survey data results as well as interview data. Finally, in (5) Using SNA to Evaluate Future Place Based Approaches we make recommendations about how a broader adoption of SNA as a set of tools to measure impact and connectivity in communities may be best implemented.

1. Overview of Joined Up Place Based Project

The Tasmanian Government is committed to providing a more connected and collaborative human service support system which is person-centred, timely in its interventions, improves the service experience of consumers, increases resilience and self-capacity, and promotes positive health and wellbeing outcomes.

In supporting this commitment, Communities Tasmania is delivering the Joined Up Human Service Project (Joined Up). Joined Up is a reform towards a more collaborative and client focussed human service support system. Joined Up aims to make human services easier for Tasmanians to access; improve engagement with the service and support system; contribute to better client outcomes for people with multiple complex needs; and improve community health and wellbeing through the following five initiatives:

- Person-based;
- Service improvement;
- Privacy and information sharing;
- System improvement; and
- Place-based.

Through the place-based initiative, Joined Up measured, facilitated and re-measured collaborative effort through:

- partnering with Swinburne University of Technology (Swinburne) to measure views on collaboration within the Huon Valley service network by conducting a social network analysis;
- funding activities facilitated by a service network coordinator. These activities were defined by the service network and the first social network analysis, with the aim of improving collaboration and information sharing across the Huon Valley service network. Activities were:
  - Service referral forms
  - Network awareness
  - Flexible partnerships for future service delivery
  - Mobile hot-desk and peer to peer support.

- Swinburne re-measuring the Huon Valley service network through another social network analysis.

Swinburne were enlisted due to their experience in **Social Network Analysis (SNA),** to understand the structure of connections between service providers that contribute to improving service systems. The analysis within the Huon Valley geographic locale examined networks of **collaboration**, **competition,** and **trust** that exist among service providers, and identified how certain patterns and structures in these networks help, or hinder, more effective human service provision. The analysis sought to understand the structure and implications of the connections within these networks. The Swinburne research delivered these insights into the current network structures of the service system in the Huon Valley to the DCT. These findings were provided to a public gathering of the Huon Valley service network, which nominated and volunteered to deliver related activities to improve the overall network. These activities were implemented for 12 months and then the network was re-assessed for network change regarding collaboration, competition and trust. This second and final report covers both Wave 1 of the research, collected in September and October of 2016, and Wave 2, collected in April 2018.

1.1. Background

Through the election policy, *A hand up for vulnerable Tasmanians*, the Tasmanian Government committed to delivering a more joined up service and support system for vulnerable individuals and families, especially those with complex support needs. The aim was to make it easier for people to navigate human services and the broader support system; minimise the amount of information service consumers have to repeat; and work with people with multiple and complex needs on their strengths and goals with the aim of building resilience. This approach is particularly pertinent where clients seeking these services are experiencing challenges such as homelessness, family violence, mental health and drug and alcohol issues. It was noted in the policy that a joined up human service support system is part of a long-term plan to be undertaken in partnership with the community sector. Delivering a more effective and efficient joined up human service support system will involve testing and identifying elements of the system that need to be redesigned, while retaining what is working well.

To this end, this research project aims to understand how health and human services providers working in or across the Huon Valley are connected together through various ties such as collaboration, formal agreement, referrals, and competition for funding. The aim of the project is to understand the current network structures between services to identify what is working well, and what is not from a system-wide perspective. Communities Tasmania sees that collaboration between service providers is key to improving outcomes for the community. To this end, Communities Tasmania is keen to work in a cooperative and collaborative approach with existing service networks. A number of organisations have undertaken a considerable amount of work to improve the Huon Valley community's access to information and services. The array of key activities being provided in the Huon Valley aim, from an operational perspective, to provide shared access and assessment across multiple channels, transfers of care and referrals to the most appropriate health services and support, and improve access to phone and web-based service information.

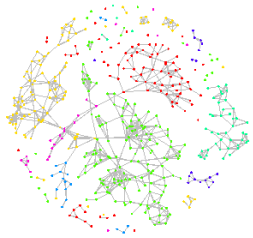
1.2. Huon Valley – Place Based Case Study

Huon Valley based in southwest Tasmania was selected as a case study site for the place-based Initiative. Huon Valley rates 962 on the Australian Bureau of Statistics Socioeconomic Index for Areas, meaning that it sits below the national average, though not significantly so. Notably, before beginning the research there was discussion amongst those in the Huon Valley that this was a highly cohesive community that already had established networks.

In September 2016, a one-off $20,000 grant was provided to Huon Regional Care for the purpose of developing and implementing an action plan to support the Huon Valley Place Based approach. Huon Regional Care assigned their Health and Wellbeing Coordinator to deliver the outputs of the Action Plan and further develop the Huon Valley Service Provider Network.

The grant has been used solely for the purpose of delivering the activities of the action plan. The Health and Wellbeing Coordinator is a pre-existing role and provides formal organisation of the Huon Valley Service Provider Network and disseminates information on health and wellbeing services to the network and the broader community.

2. Importance of Networks



The term network has been increasingly popularised and represents a particular organisational form that is distributed, agile and able to deal with complex human systems in ways that hierarchies are simply unable to accommodate (Powell, 1990). In the 21st century networks have become ever more popular due to development in social media (e.g. Facebook), and globalisation and technological advances are constantly reshaping social connections across the modern world. A variety of forces are at work: expanding trade and migration; the rise of social media; falling community and civic participation (McPherson, Smith-Lovin, & Brashears, 2006; Putnam, 1995). This complex social connectivity shapes both large-scale societal problems, and small-scale individual outcomes. As a result, there is a pressing need for insights and corresponding tools and methods by which to understand the interplay between individuals' behaviour (including health and wellbeing) and social cohesion.

As seen strikingly over the past few years, this interplay between people, organisations, relationships, and communities is poorly understood. Brexit and the US 2016 presidential election have suggested that new forms of social connectivity (e.g. social media) can combine with small-scale campaigns and relatively modest interventions to produce unexpected, large-scale results. Looking in the opposite direction, the history of public health is full of examples of large-scale, resource-intensive interventions that fail to make a corresponding impact on population health, including smoking, obesity, and other health outcomes (Hawe, Shiell, & Riley, 2009). These are all examples of *non-linear* effects. That is, in a richly interconnected world, a small effort does not necessarily produce a small result. Big actions can have little to no effect, while small actions – under the right conditions – can have huge ramifications.

Non-linear effects are just one hallmark of *complex systems* (Sterman, 2006). Here, "complex" means more than just "complicated." In a complex system, different people and organisations ("agents") are constantly interacting, cooperating, and competing with one another, each in accordance with their own set of needs, priorities, and tendencies. Added up together, these patterns build up to form a social system that behaves in special ways that cannot be understood by examining each individual part in isolation. In a phrase, **the whole is more than the sum of its parts**. Other properties of complex systems include the following (Sterman, 2006):

- **Internal dynamics (Self-organisation).** Social systems are not centrally controlled by an all-knowing, all-powerful authority. Instead, agents organise themselves on a small scale according to a loose set of principles or rules. These principles form certain relational patterns

in the system, which can be uncovered using statistical techniques (see below), and may be a target for intervention.

- **Systems within systems.** Complex systems themselves composed of smaller complex subsystems. Humans join together to form various organisations, which together make up sectors (health care), which fit into the larger national societies, and international economic systems.
- **Side-effects and trade-offs.** Every action has the potential to alter the social environment, giving rise to new events and new conditions that influence future decisions and action. Even if an intervention's intended goals are realised, unintended side effects can arise.
- **Adaptive (or maladaptive) learning over time.** The behaviour of individuals changes over time. This can be through gradual learning and change, or, alternatively, radical transformation. However, learning and change is not always for the best. It may be aimed at maximising individual short-term gains at the expense of long-term functioning.

Systems thinking highlights the importance of social relationships and interactions among people and organisations (Hawe et al., 2009). Here, successful action and intervention is about understanding relationships and linkages that cut across traditional institutional boundaries to form new alliances and structures that meet constantly changing social, personal, and economic needs.
Thinking about a community as complex systems defies rigid standardisation, and relatively new research methods are needed to understand the individual agent as dynamically adapting to and reshaping the social and economic world around them. Social network analysis (SNA) is well-suited to address this view of the world and how it works.

In complex systems, people and groups have many overlapping and competing goals.

- **Joint goals.** *Example:* a school working with social workers to look after students' wellbeing.
- **Complementary goals.** *Example:* mental health practitioners meeting up, each to ask advice.
- **Competitive goals.** *Example:* two organisations bidding for the same funding.
- **Conflicting goals:** *Example:* a patient asking many questions from a doctor who is eager to see the next patient and stay on schedule.

Within a complex system, these goals combine and interact in an *emergent* way, meaning the whole is different than the sum of its parts.

2.1. Networks are important to health and human services

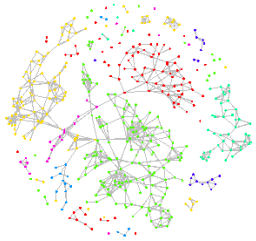
As applied to the health and human services, complex systems thinking has been applied to primary care, hospitals, and schools, and beyond, each composed of practitioners (e.g. nurses, teachers), recipients (e.g. students, patients), the interactions among these agents, combined with various resources and external pressures. A complex systems approach to public health interventions compels us to consider the side effects of intervening, and to be aware of how components of the intervention interact with one another, and how this may be different in different contexts. As mentioned, the history of public health is rife with both big failures and surprisingly simple successes (Hawe et al., 2009). Conversely, relatively simple steps (e.g. smoking bans, vaccination drives) have led to huge public health gains.

There is considerable interest in networks and how relational patterns affect health issues, including processes of social support, social selection, and social influence and information diffusion (Valente, 2010). In the health and human services field, social networks have been used to refer to:

- Personal social relationships that members of the general population have, which affect their health (Bryant et al., 2017; Christakis & Fowler, 2007)
- Patient care networks (Lomi & Pallotti, 2012)
- Health professional networks (Cunningham et al., 2012)
- Online social network platforms (Maher et al., 2014)

This report examines networks between service provider organisations operating within and across the Huon Valley. The focus is on the ways in which these service provider organisations collectively coordinate (or compete), trust, refer and interact in other ways to provide services into Huon Valley communities. Before we present results for this, we introduce Social Network Analysis (SNA) as a theoretical and methodological approach to examining and evaluating social networks such as these networks between service providers in the Huon Valley.

3. Social network analysis (SNA)



Social network analysis is a general approach to analysing social systems of interconnected social entities. **Social network analysis** focuses on the "relationships among social entities, and on the patterns and implications of these relationships" (Wasserman & Faust, 1994, p. 3). A network consists of a set of relations (or arcs) amongst a set of actors (or nodes). More detail is found in Figure 1.

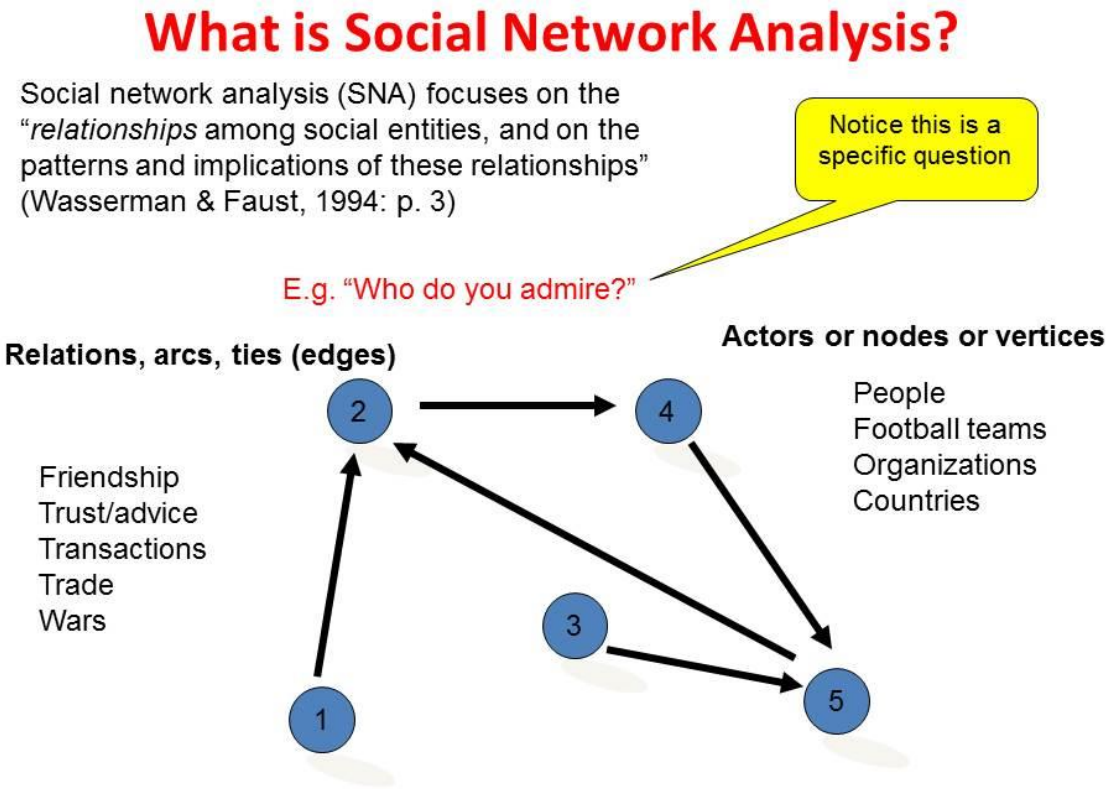


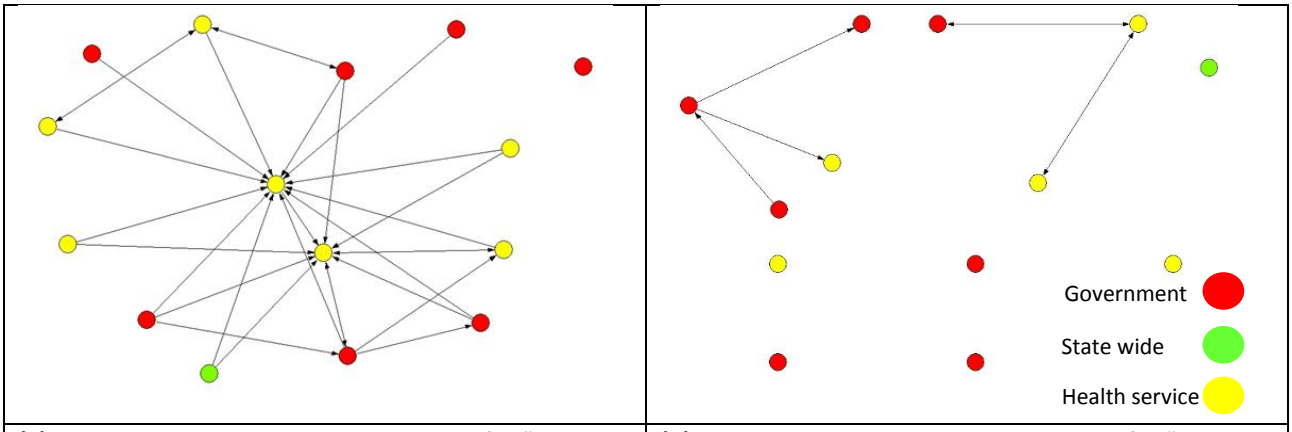
Figure 1: What is social network analysis (SNA)?

While there are many different types of SNA, what brings this field together is a common focus on individual social entities – be they human individuals, organisations, countries, and so forth – and particularly the *relationships* that connect them (see Figure 1). These relationships can be defined in numerous ways and may refer to various outwardly observable exchanges and interactions (e.g. referrals, coordination of services), subjective feelings (e.g. trust, liking, disliking), events (e.g. collaboration on a project), and so on. See Robins (Robins, 2015) and Borgatti et al (2009) for overviews of SNA.

The direction of network ties are important in a network, such that the arrows may reflect the direction of flow (e.g. knowledge, advice) or investment of emotion or value in (e.g. friendship, trust). Notably, most network visualisations (or maps, or graphs) put the most connected nodes (i.e. dots representing organisations) in the centre of the network visualisation. Hence, we call these more connected nodes (or organisations) the *central* nodes in the network.

3.1. Network visualisation

The visualisation of networks is perhaps the most appealing aspect of social network analysis. Network visualisations (or graphs, or maps) can quickly and clearly demonstrate a range of complex information in pictorial form.



(a) Example Network by Organisation type for "Who do you go to for important information and advice?" with two key nodes

(b) Example Network by Organisation type for "Who do you go to for important information and advice?" (with key nodes removed)

Figure 2: Illustrative example of how a network (seen in panel a) can be significantly impacted by the removal of just a few nodes (seen in panel b) from the network

In the above illustrative example of Figure 2, "who people go to for important information and advice" is strongly centred on two individuals or nodes, which are both health service workers. This network is highly efficient as there are two key people to go to gain advice, which is likely to make such advice consistent. Interestingly, it seems without these two key people there is little or no advice occurring between others in the network.

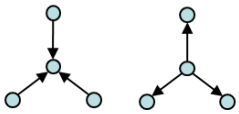
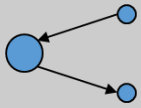
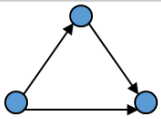
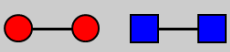
3.2. Evaluating networks and assumptions about network growth

One assumption underpinning the Huon Valley service network is that if there is an increase in the number of network connections over time, then this is evidence of network

growth. This is a reasonable and fair assumption. More connections mean more connectivity among the network – we say that the network density has increased.

However, there are other ways in which we can think about evaluating networks. Networks may be denser and more *organised* in various ways. We can observe many different types of substructures within a network to see how it organises itself. These substructures represent different and important social processes that shape the network. Table 1 presents some social processes and their corresponding network patterns. So, not only do we want to see an increase in the number of network ties, but we also want to see increases in the number of network patterns below, such as reciprocal ties (which demonstrate mutual agreement or collaboration), and particularly for closure (the making of triangles) which are a strong indication of group formation and coordinated effort. So while the number of ties indicates network growth, there are a number of things beyond simple increases in the number of ties which speak to the idea of increased network coordination and effectiveness.

Table 1: Social process and network patterns

Self-organizing principles	Description	Corresponding network pattern
Reciprocity	Tendency to exchange like for like. ("You scratch my back, I'll scratch yours")	
Centralization	Tendency for there to be a few highly popular agents (hubs) in a network, and many less-popular agents. (Popularity)	
Brokerage	Tendency for intermediaries (gatekeepers) to form between unconnected individuals.	
Closure	Tendency for relationships to "clump" together into relatively dense clusters ("A friend of yours is a friend of mine.")	
Homophily	Attraction to similar individuals ("Birds of a feather flock together.")	

3.3. SNA is a useful tool for understanding complex systems

Networks are useful for measuring and recording complex systems for the following reasons:

- Networks represent opportunities (and limits) for collaboration, influence, and innovation.

- Networks represent the history of the system, up to its current state.
- Networks are multilevel. They can represent two or more systems side by side, and how changes in one system can affect the other.
- Networks are measurable, can be analysed statistically, and are open to simulation.

3.3.1. Network structure (network self-organisation)

The usual approach in health research is to select or randomly *sample* individuals and scrutinise their health, behaviour, and attitudes using various statistical techniques (Figure 3.A). However, focusing just on the individual robs the analysis of a lot of contextual information. More information about the social context can be collected by focusing on the social relationships that a person has with others (Figure 3.B). This research generally focuses on the size of one's personal network (i.e. the number of connections) and its composition (e.g. the proportion of male friends to female friends). A more informative approach is to consider how people's personal networks knit and interlock together into a whole network. Extended network sampling (Figure 3.C) and whole-network approaches (Figure 3.D) allow us to more adequately capture network connectivity across an entire social system. These last two approaches allow us to consider a range of additional internal dynamics, referred to as self-organisation principles, which are described in Table 1.

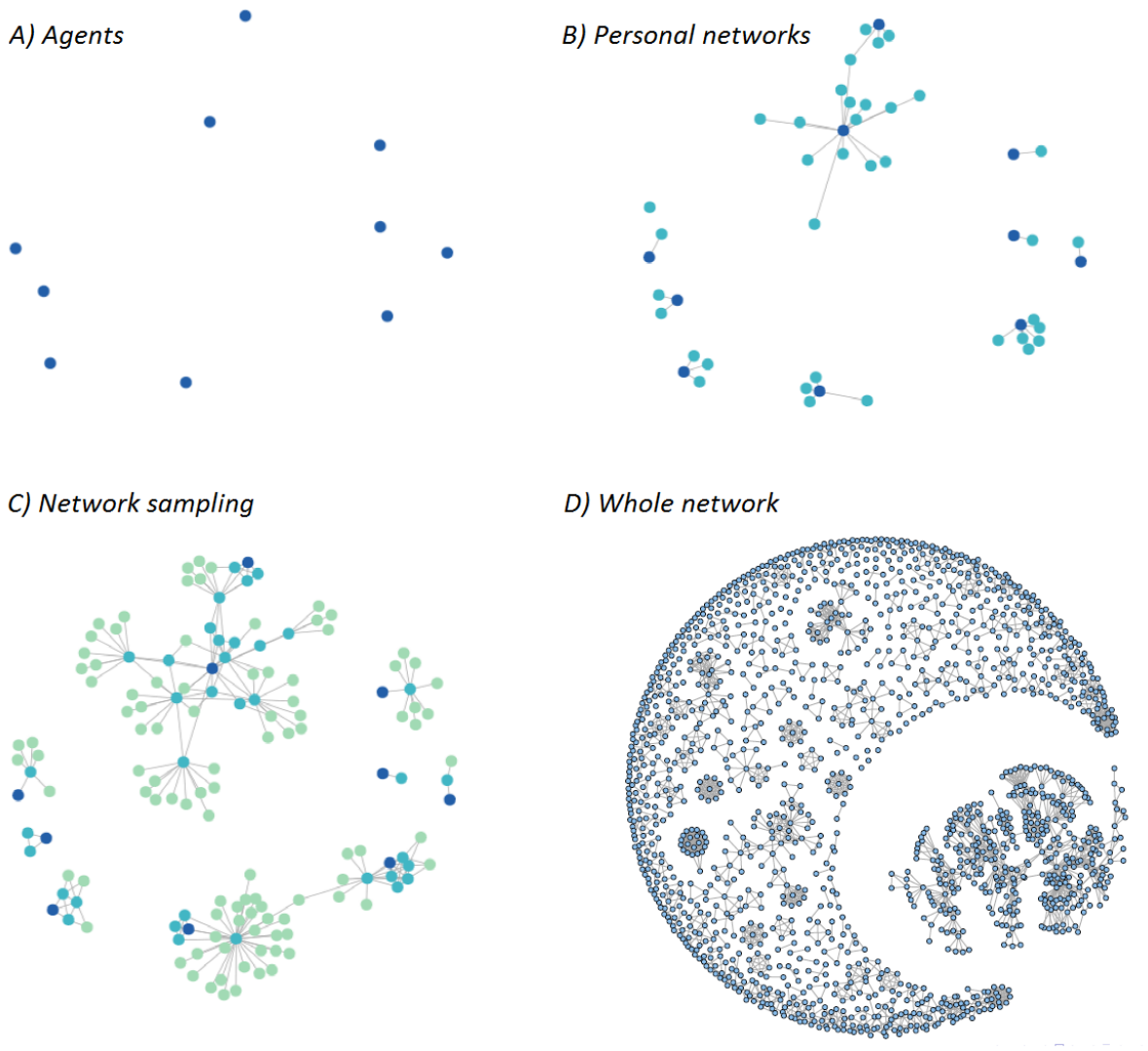


Figure 3. Data collection approaches. Panels B, C, and D are social network approaches of increasing informativeness

3.4. Diffusion of health and innovation

A whole-network approach is particularly informative, partly because it allows researchers to trace transmission and diffusion across a network. In health research, networks have often been used to trace the spread of disease and negative mental health between connected individuals. Examples include:

- Transmission of Hepatitis across a network of needle-drug users
- Spread of HIV among sexual partners
- Spread of depression across friendships within a disaster-affected community.

However, this transmission process is not limited to disease. It can refer to the diffusion of beneficial resources, such as various kinds of knowledge. This could include, for example:

- The development of a useful new way of doing things
- A creative solution to a common problem
- Awareness of what a particular organisation has to offer
- The use of a new technology.

How knowledge and information spread across a network might tell us a lot about how people and organisations learn and adapt to new challenges. For example, organisations without many connections might be slow to hear about new requirements for the National Disability Insurance Scheme, and thus struggle to implement the necessary changes. On the other hand, an organisation with many connections (to the right organisations) might be quicker to hear about a useful new technology that saves time and money, freeing up staff to work on other priorities.

An example of how we might track the spread of institutional knowledge can be seen in Figure 4. This network shows labour mobility within one small part of the Hobart-Huon health and human service sector.

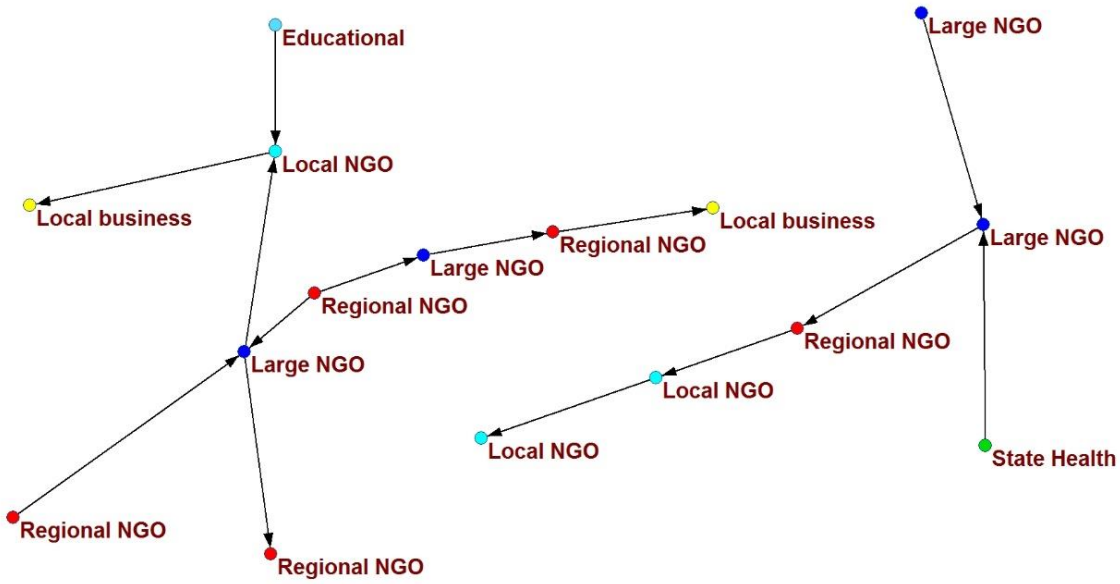


Figure 4: Labour mobility among Huon Valley service provider organisations

This network shows the movement of people (survey respondents) from one organisation to another over time, as employment changes (names of organisations have been redacted for confidentiality). System-level change can be seen in the movement of key social actors from one position in the system to another. With this movement comes changes in their relationships with other actors and agencies. Relational data collected over time are necessary to capture this

movement (Hawe, Schiell, & Riley, 2008). In community-based interventions to improve the performance of coordinated support, for example, we might wish to see back-and-forth labour movement among social work, and specialist organisations. Alternatively, difficulties might be identified early if we see frequent staff turnover, and the exodus of experienced individuals from a particular sector, signalling losses in institutional knowledge.

Labour mobility is an important issue though it was not the focus on the current research so we have not gone in-depth on this issue. At either extreme, labour mobility may be problematic. Too much churn and people are not sufficiently knowledgeable about their work because they are constantly changing positions. Too little churn impedes new ways of thinking associated with the experience that new staff bring into a workplace. The right amount of churn can bring knowledge that joins up the system.

3.4.1. Networks and geography

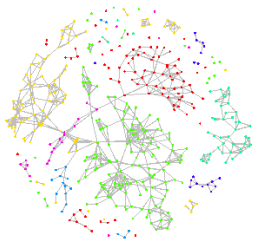
The importance of geography to social networks cannot be understated and makes a network approach to understanding the Joined Up place-based approach particularly appropriate. It is well established that ties in social networks are more likely to be formed between individuals that are in some way similar, and it is more likely for ties to be formed between individuals who are geographically nearby (McPherson, Smith-Lovin, & Cook, 2001; Preciado, Snijders, Burk, Stattin, & Kerr, 2012). Similarly, in economics it has long been established that the volume of commodity flows can often be modelled as being inversely proportional to (a power of) the geographical distance between trading entities (Isard, 1954). As a concrete example, consider patients being transferred between hospitals (Caimo, Pallotti, & Lomi, 2017; Iwashyna, Christie, Moody, Kahn, & Asch, 2009; Lomi & Pallotti, 2012). Patient transfers are expected to be more likely between hospitals that are closer to each other, and if we do not control for this in a statistical model, we are liable to reach incorrect conclusions.

It is also a frequent characteristic of networks that they contain "clusters" or "communities", in which there are more connections within a community than between communities (Fortunato, 2010; Fortunato & Hric, 2016). In networks which are embedded in space, it is likely to be the case that these communities are induced partly or largely by spatial proximity. In order to detect communities formed due to other factors, we need to factor out the effect of space (Expert, Evans, Blondel, & Lambiotte, 2011).

3.5. Network statistics and statistical models

While simply inspecting pictures and visualisations of these networks can be informative in its own right, these networks often hold repeated patterns that are difficult to see with the naked eye. To aid the process of recognising prominent patterns within the service network, a special statistical technique known as *exponential random graph modelling* (ERGM) can be used (Lusher, Koskinen, & Robins, 2013). This model allows us to consider processes of relationship formation within the network. This approach uncovers whether certain patterns appear more frequently than simply by change, indicating a positive tendency towards that type of relationship, or, conversely, whether certain network ties appear less frequently than by chance alone, indicating a negative tendency away from that type of relational pattern. A further network analysis method used here is Logistic Regression Quadratic Assignment Procedure (LR-QAP). This works similar to ERGM in identifying networks structures of interest (Krackardt, 1987; Krackhardt, 1988).

4. Findings: Huon Valley Joined Up Project



The following represents the overall findings for the Service System Network Analysis of the Huon Valley Joined Up Place Based Project, including findings from Wave 1 (2016) and Wave 2 (2018). We present findings for the network survey, followed by the interview data. However, we begin with the initial research questions for this project and provide some details of the Huon Valley Service Providers network.

To summarise the findings, there is inconclusive quantitative evidence that the networks in the Huon Valley have *grown* over time. We have some data that suggests network growth and other data that contradicts this, and some data that is not clear. Sticking to this evidence base provided by the network survey, we cannot definitively say that the network has grown over time even though there are some positive indicators. However, we do have conclusive evidence that the network has *changed* over time. For example, we see that from Wave 1 to Wave 2, perceived competition between organisations at Wave 1 have a tendency for these organisations to collaborate at Wave 2. Further, where both organisations agree at Wave 1 that collaboration with the other organisation is easy and reliable, such collaborations continue on at Wave 2, but not so when only one organisation views the other organisation as easy and reliable.

We now present the details of these analyses and data findings.

4.1. Key research questions

To guide the analyses, a set of key research questions were formulated to assess general themes of networked collaboration within the system. They are as follows:

- What is the nature of collaboration and trust within the service system?
- What is the nature of reputation within the service system? In particular, what types of organisations are regarded as effective? What types of organisations are regarded as having the "community's best interest at heart"?
- What drives consensus and agreement within the service system?
- How has the network changed?

4.2. Huon Valley Service Providers network

The Huon Valley Service Providers network started in the Huon Valley in June 2015. Attendee numbers at network meetings from this time to March 2018 are listed below. Notably, July 2017 and March 2018 were two key networking events with increased attendees.

Network Meeting	Attendance
Jun 15	15
Aug 15	20
Oct 15	12
Dec 15	29
Feb-16	16
Apr-16	29
Jun-16	24
Aug-16	33
Oct-16	16
Feb-17	15
Apr-17	24
Jul-17	71
Sep-17	33
Nov-17	23
Mar-18	87

4.3. Data collection

4.3.1. Survey development

Prior to the development of the survey, the Swinburne research team, in conjunction with the Joined Up team from DCT, met informally with over twenty local and State agencies, both in Hobart and in the Huon Valley, over the course of four days (June and July, 2016). Through these meetings, the research team heard service providers' own descriptions of key issues and challenges facing service provision in the Huon Valley, providing several themes to address in pursuit of the research aims. Of particular focus was how service providers view relationships among organisations, including both functional relationships (clients, referrals, coordinated and integrated service delivery) as well as more subjective links, including relationships of trust and mistrust. A further theme to emerge was that of the reputational links among the service providers. Subsequently, these themes were integrated into a social network questionnaire, which is summarised below at 4.3.2.

In March 2018, interviews were conducted with various service providers in the Huon Valley regarding their insights into the success of the place-based activities. Those insights are included in the findings of this final report.

Finally, in April 2018, a second wave network survey was conducted. This network survey importantly includes people from 2016 (76 respondents) and 2018 (91 respondents). Further, this 2018 survey also includes new people and organisations to the network. We note that participation may have been reduced due to formatting issues with the Wave 2 email invitation, which presented correctly on most email servers and didn't on some email servers. This may have resulted in some survey invitations being treated as spam. Correspondence was made to rectify this issue, but we are not sure if this negatively impacted upon survey completion.

4.3.2. Survey content

Network questions

Respondents were asked to report on the following relationships, as they existed between their own organisation and others within the Huon Valley service system.

- **Referral pathways** between organisations
- **Trust** between organisations
- Regular **coordination** of integrated care
- Easy and reliable **collaboration**
- Which organisations have the **"community's best interest"** at heart?
- Which organisations are **effective**?
- Which organisations have been **difficult to work with**?
- Which organisations are your primary **competitors?**
- Which organisations are overly concerned with their own **status** or reputation?
- Which organisations are concerned with protecting "**turf**"?
- Which **events** do you attend?
- What **boards** are you on and **forums** do you attend?

Other survey content

Respondents were also asked to report on the following personal views and details, as well as organisational details.

- Basic respondent demographics

- General details on the size, composition, and function of the organisation
- Organisation's mission and performance
- Respondent's views on the performance and culture of the Huon Valley service system.
- Open-ended responses on related topics
- Re-contact information

4.3.3. Participants

Research participants were identified by an extensive canvassing of the Huon Valley service system, conducted by the Joined Up team. As part of this process, for the Wave 2 network survey some 568 individuals from public and private agencies, offices, and organisations were identified as generally involved in service provision within the Huon Valley. We compare this to Wave 1 where there were 185 such individuals. This is also a 307% increase in individual participants signed up on the email list for the Huon Valley Service Provider Network, which is a substantial increase and an indicator of the growth of this network. However, when we examine the number of people who actually participated in the survey, we see an increase in participation from Wave 1 (76 to 91 people from Wave 1 to Wave 2) and a negligible increase in representation (57 to 58 organisations from Wave 1 to Wave 2). See Table 2 below for details.

Wherever possible, the Joined Up team collated names and contact information of several people at each organisation, such that executive, middle management, and front-line workers were all approached for recruitment into the study. By prior agreement with the Joined Up team, individual agencies will not be named in any report, or in any other format provided by the research team to DCT. Instead, to make the data useful for following actions, organisations were grouped according to the following categories, as agreed to through discussion between the Swinburne research team and the DCT Joined Up team. Not offering survey participants the opportunity to self-select to receive confidential results that identifies their own organisation in views of network analysis may diminish the relevance of results. If Communities Tasmania were to pursue future analysis, it should further investigate when and how confidential results could be provided.

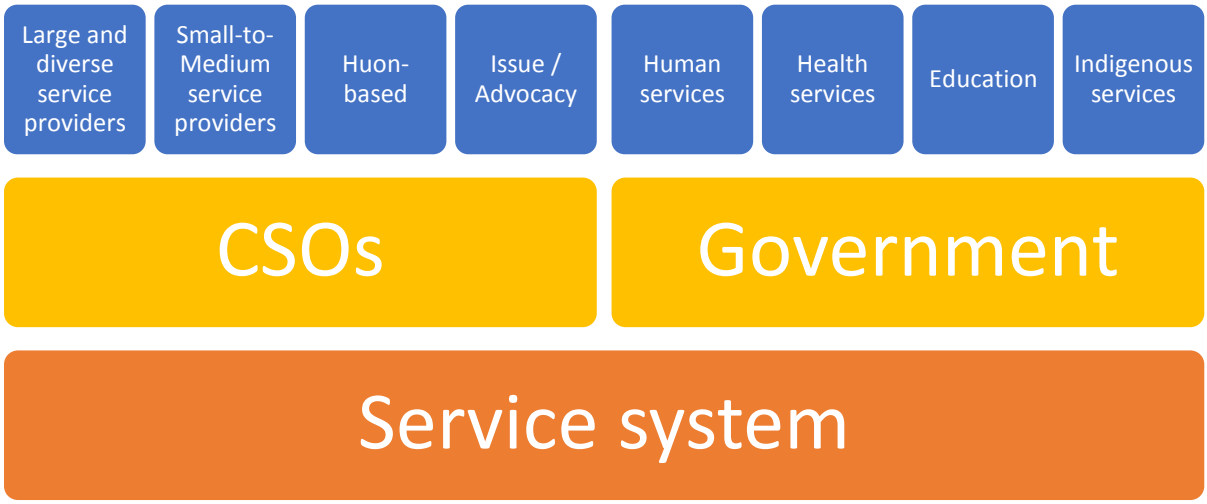
4.3.4. Categories of organisations

Community service organisations (CSOs)

- Large and diverse service providers
  - > 50 FTE
  - Hobart-based
  - Provide a range of direct services
  - Service areas are state-wide and/or Tasmanian subdivision
- Small-to-medium service providers
  - < 50 FTE
  - Hobart-based
  - Provide direct services
- Huon-based service providers
  - Located in the Huon Valley
  - Vary in size
- Issue/advocacy organisations
  - Organisations whose primary mission is related to a specific health issue, health phenomenon, or a particular population group (other than indigenous – see below).
    - Includes peak bodies
  - Provide little to no direct services (possible exceptions include information/referral services and support groups)
  - Vary in size

Government entities

- Health services
  - The medical profession, broadly construed
  - Health centres & associated professions (e.g. social workers)
  - Includes Tasmanian Health Services
- Human services
  - State, federal, local government
  - Emergency response (not including hospitals)
  - Includes Department of Health and Human Services (as structured at the time of the survey)
- Indigenous services
  - Primary mission: Serving the Indigenous population
- Education
  - Schools
  - Learning and information centres
  - Other education services



4.3.5. Participants by category in Wave 1 (2016) and Wave 2 (2018)

Table 2: Counts of participating people and organisations for Wave 1 and 2 surveys

	Wave 1		Wave 2	
	2016		2018	
Organisation Name	**# Respondents**	**# Organisations**	**# Respondents**	**# Organisations**
Human services	7	4	10	7
Health services	8	2	4	1
Indigenous services	4	3	4	2
Education	9	6	5	3
Large and diverse CSOs	13	9	17	7
Small-Medium CSOs	15	14	19	15
Huon CSOs	8	8	8	4
Issue and Advocacy CSOs	12	11	8	5
Local businesses	-	-	5	4
Local voluntary groups	-	-	4	3
Local private health	-	-	4	4
Alternative therapies	-	-	3	4
TOTAL	76	57	91	58

We note that at Wave 2 (2018) there are four new and different types of organisations, which indicates an increased diversity in organisations involved. In particular, we notice that these are all *local* organisations.

4.4. Network growth

The first evidence we looked at regarding network growth was whether there was an increase in the number of ties in each of the networks. Table 3 below shows this for the overall networks for Wave 1 (n=57) and Wave 2 (n=58), as well the matched 27 organisations that participated in both phases. It is assumed that if there was new and / or ongoing effort to improve the strength of the network between SNA1 and SNA2, then we may expect a resulting increase in the ties between networks across these time-points. What we find is that this is not the case.

Table 3: Number of ties in network

Network attribute	All organisations at Wave 1 (n=57) and Wave 2 (n=58)		Intersection of organisations across both waves (n=27)	
	Wave 1	Wave 2	Wave 1	Wave 2
Easy collaborator	133	91	43	54
Coordination	108	53	52	29
Referrals	226	138	85	76
Trust	136	67	46	35
Effective	63	59	27	30
Community's Best Interest at Heart	117	85	50	41
Competitor	30	24	13	18
Difficult	50	28	25	13
Empire building	26	18	8	9
Protects Own Turf	20	13	5	5
Total	909	576	354	310

Looking at all organisations, there appears to be a marked reduction in the number of ties from Wave 1 to Wave 2 (909 ties falling to 576), which is not what we might have expected for particular networks. Given the previous assumption, for networks defined by *positive* attributes, ranging in order from 'easy collaborator' through to 'community's best interest at heart', we would expect an increase in ties. We did not find an increase in the number of ties for *all* organisations for any of the positive network attributes. For the intersection of organisations that participated in both surveys (n=27), we do find some increases in positive network ties (easy

collaborator, effective) but also reductions (coordination, referrals, trust, community's best interest at heart).

For those networks defined by *negative* attributes, such as 'competitor' through to 'protects own turf', we would hope that they decrease in the number of negative ties, reflective of there being less issues between organisations. We do find this for the all organisations data, which constitutes organisations that participated either in Wave 1 and/or Wave 2. However, when looking at the 27 organisations that participated across both Waves, we find that while difficult ties go down, competitors and empire builders actually increase.

Additionally, while there were 27 organisations that participated in Waves 1 and 2, only 20 people were consistent in their participation from Waves 1 and 2. This means that the respondents for some organisations were different for Wave 1 and Wave 2. Having consistent informants/representatives of an organisation is preferred, but of course people move on from organisations. Nonetheless, it would be better to have the same people respond to the SNA survey over time as the method analyses the strengths between organisations based on the views and opinions of their representatives.

4.5. Network visualisations (maps)

This section provides a visual overview of the network data collected among participating organisations. Organisations are depicted in terms of the categories described on pages 9-10, as indicated by the different coloured nodes (i.e., dots) in the visualisation. We present Wave 1 (n=57 organisations) and Wave 2 (n=58 organisations) network diagrams for some networks of interest. The direction of the arrows in the network diagrams is important, and reflects one organisation selecting another organisation. For instance, in a referral network the arrow points from the organisation that is referring, towards the organisation to which a client is being referred.

NB: We do not present all network diagrams because the patterns are mostly the same. What we find is that there is inconclusive evidence of network growth in the Huon Valley. We present selected examples below that illustrate the general findings we have.

4.5.1. Missing data

Importantly, we note that we include only those organisations in these network diagrams that actually completed the network survey. This is the standard practice for normal surveys, where you only have your data recorded if you participated. In network surveys though, it is possible that one organisation (A) nominates another organisation (B), even though (B) did not participate in the survey. While it can be informative to include those nominated like organisation (B) who did not participate, it can also be misleading, in that we may wonder why an organisation has not reciprocated its collaboration ties.

So, in the network analyses presented here, we *exclude* organisations that did not participate and treat them as missing data. Clearly, it would be best to have every organisation participate, and thus have a full and complete view of the overall eco-system of service providers in and across the Huon Valley. We had about 240 distinct organisations listed for Wave 2, and we had 58 organisations participate, so roughly one quarter of the organisations are reflected in the network diagrams.

As such, while we interpret the data the best we can, we need to be cautious about the information we do not have about this network. It is more likely that those that participated in the network survey were actually more connected than those who did not do the survey, but we cannot be entirely sure. Nonetheless, this is the data we have, and we make the best interpretations we can from it.

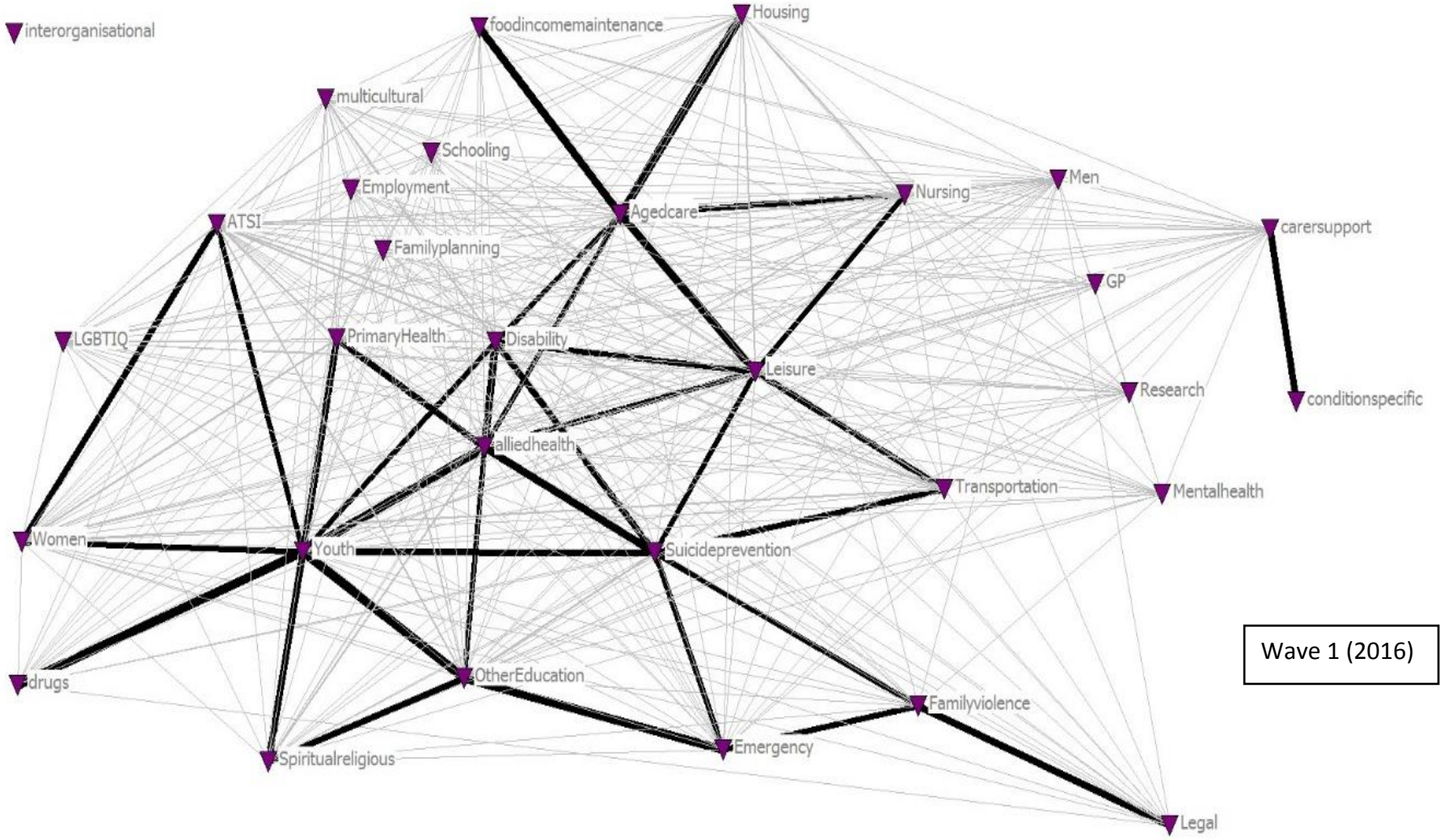
4.5.2. Services provided by organisations

First up, we present networks of services provided by organisations. These networks show connections from organisations to services only (not direct connections between organisations, or direct connections between services). What can be seen from network visualisations of the *services provided* is that at both Waves 1 and 2 there is substantial interconnectivity between the services, and the organisations providing them. We do not see isolated clusters or organisations only providing one service and being disconnected from the other services. We also see that there are multiple organisations for each service.

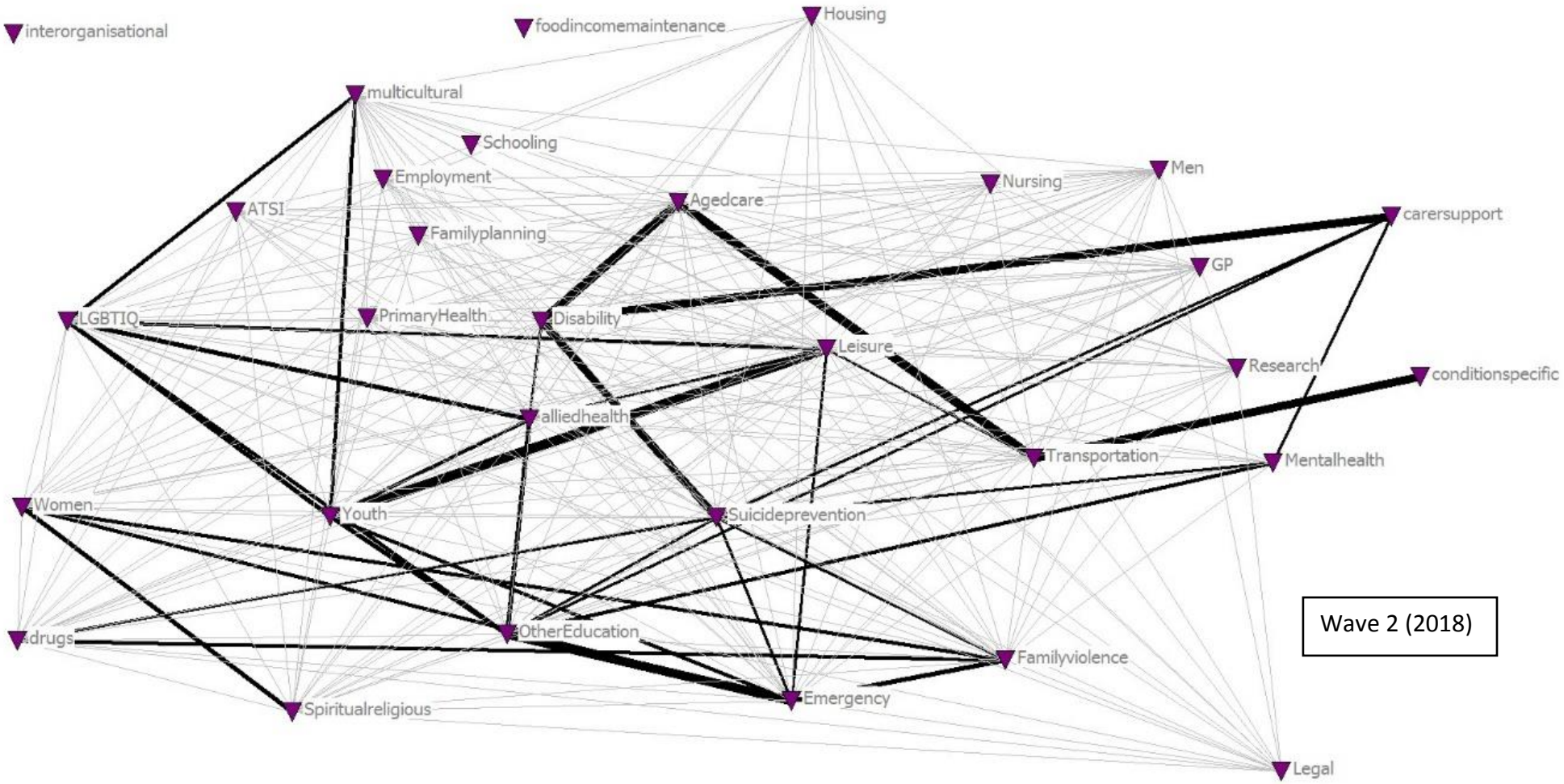
In order to get a better picture of the change in service areas co-provided by the same organisations, we represented organisations as social ties that directly link together any service

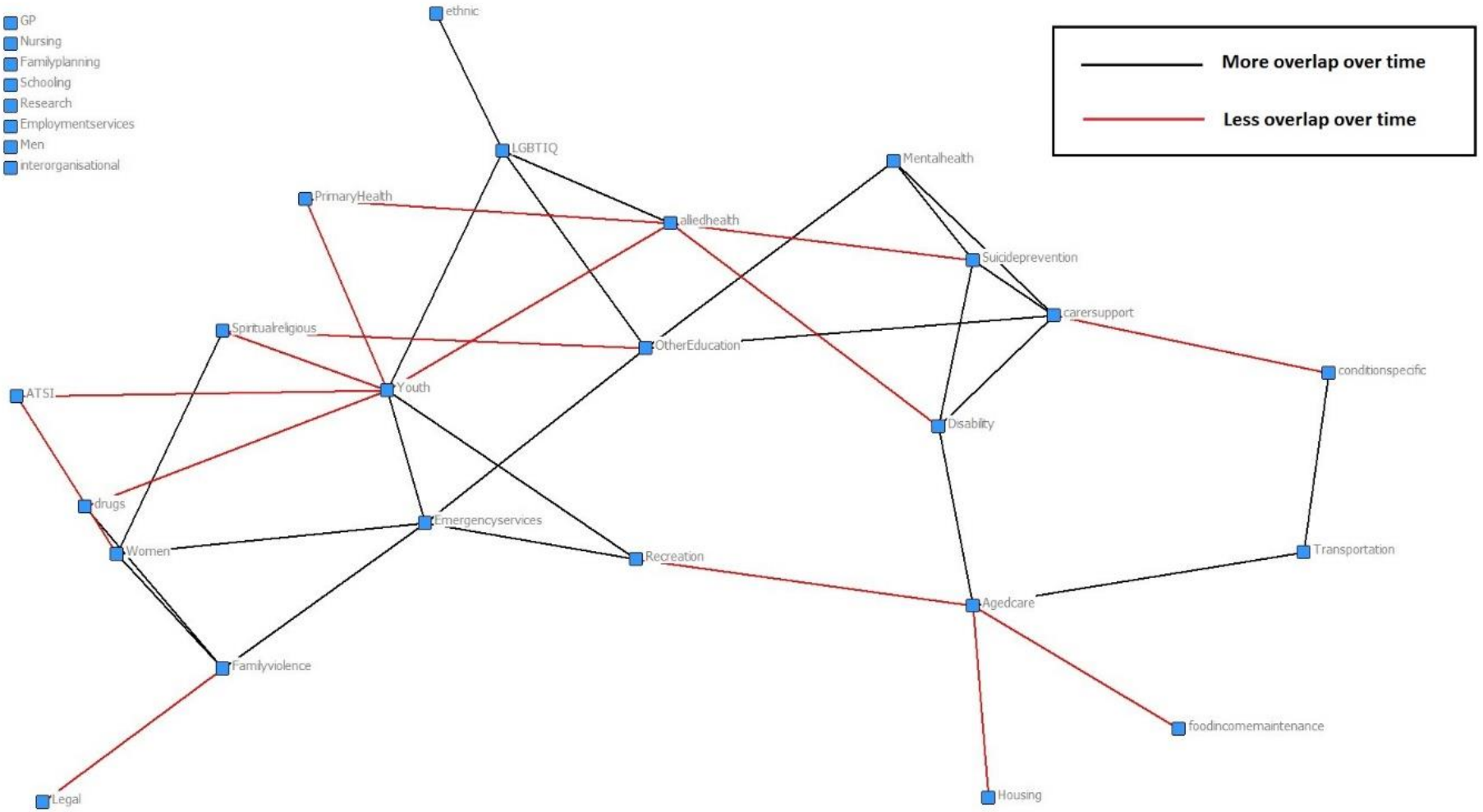
areas in which at least one organisation served both areas. We then looked at both time points and compared the two networks. As can be seen, while some service areas got “closer” together in terms of the number of organisations, other service areas moved apart.

Some caution should be exercised in interpreting the specificity of these changes, given differences in the two samples over time. However, these changes demonstrate the flexible and adapting nature of the service system. The key questions become: Do changes in the system reflect adaptive long-term learning on a system-wide scale? Or do they reflect short-term gains that leave problematic gaps in the system?



Wave 1 and Wave 2 – Services co-provision. Service areas that are co-provided (in the Huon Valley) by the same organisation. Line thickness represents the number of organisations covering both service types.


interorganisational
foodincomemaintenance
Housing
multicultural
Schooling
Employment
Nursing
Men
ATSI
Agedcare
carersupport
Familyplanning
GP
LGBTIQ
PrimaryHealth
Disability
Leisure
Research
conditionspecific
alliedhealth
Transportation
Mentalhealth
Women
Youth
Suicideprevention
drugs
OtherEducation
Familyviolence
Emergency
Spiritualreligious
Legal
Wave 2 (2018)

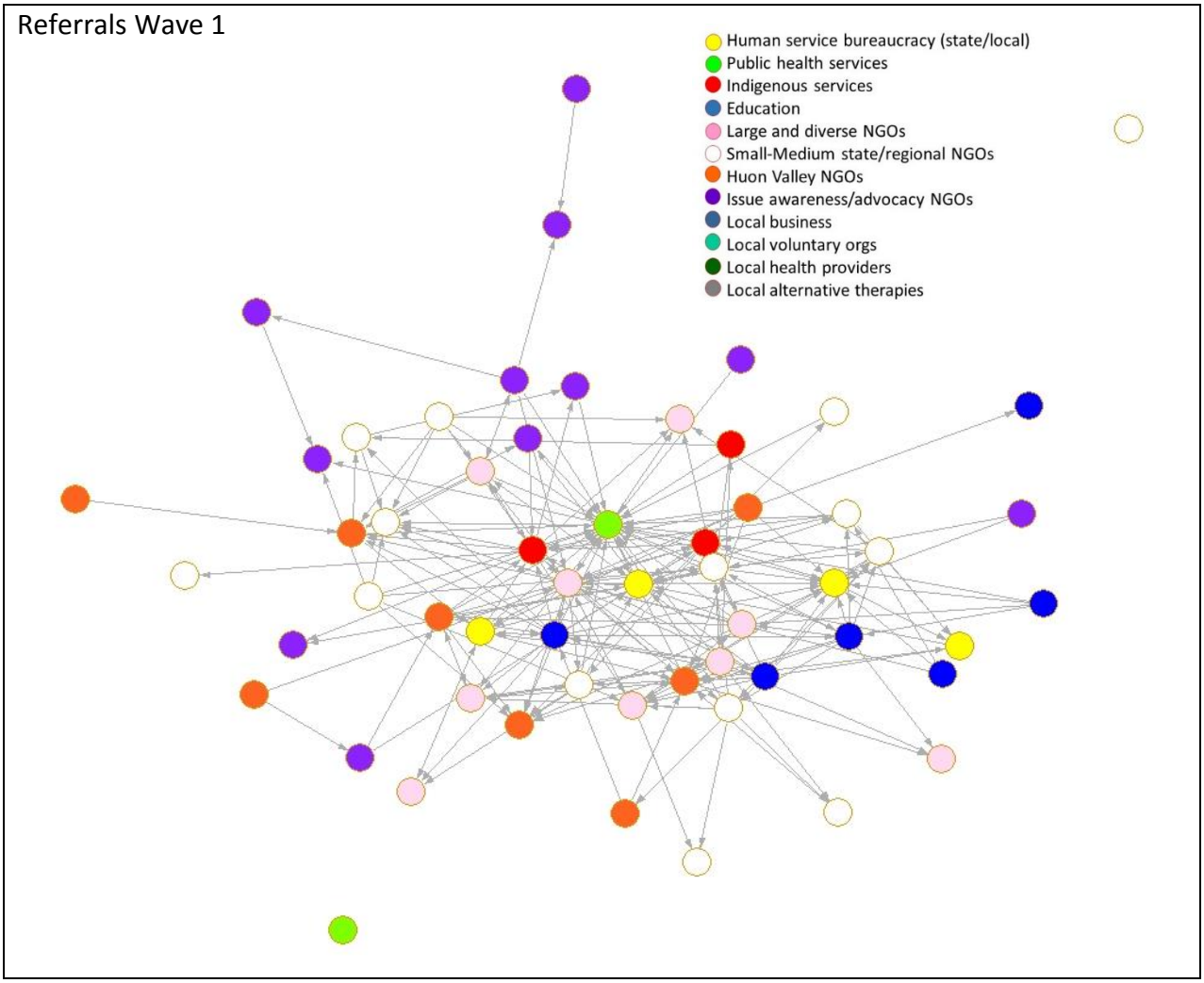


Wave 1 versus Wave 2 – Differences in service co-provision over time. Black lines mean that more organisations cover both service areas at time 2, compared to time 1. Red lines mean that fewer organisations cover both service areas at time 2, compared to time 1.

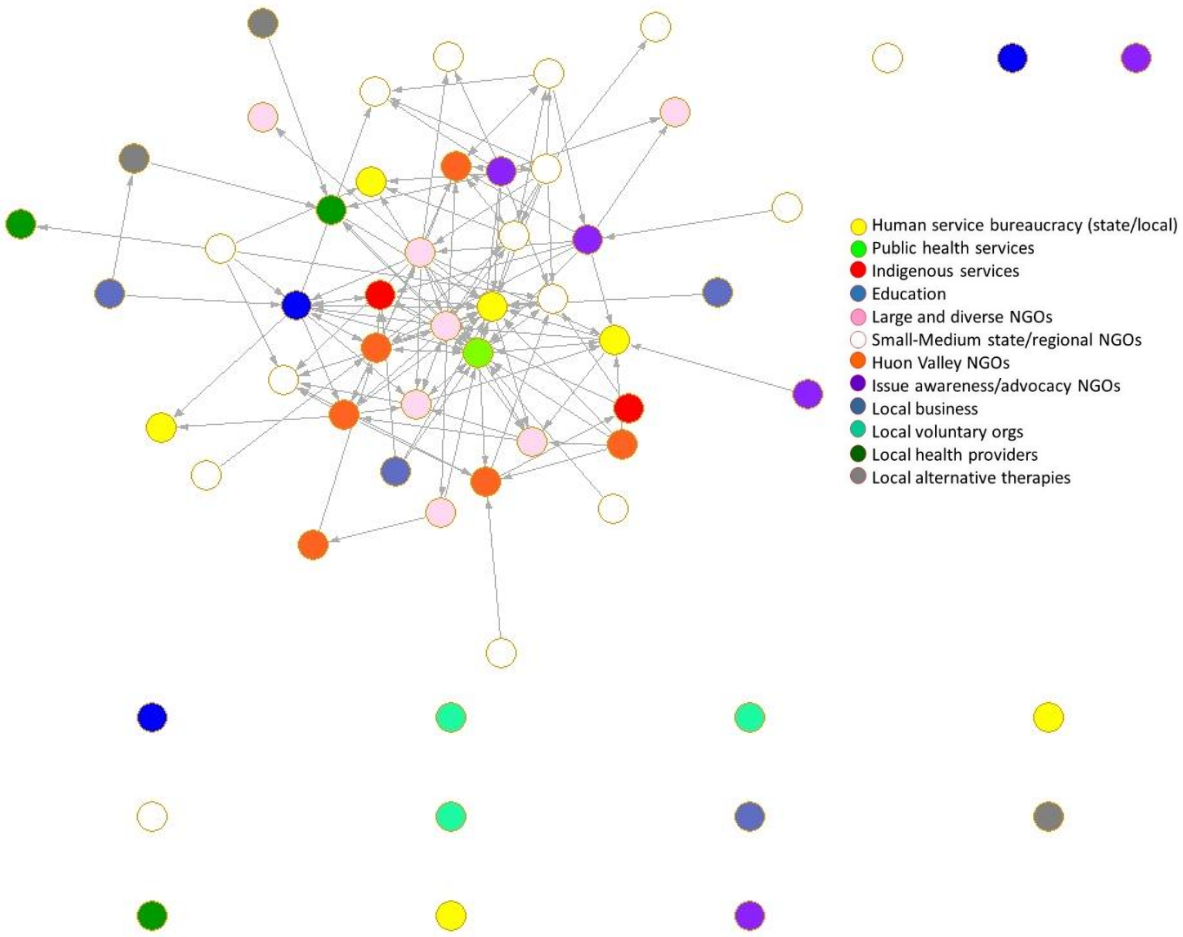
4.5.3. Referral network

This referral network in Wave 1 is a network of organisations and which organisations they refer clients to, with the arrow pointing towards the organisation that is the recipient of the referral. The visualisation (below) clearly illustrates the general pattern of findings we have for most of the networks in the study. The referral network in Wave 1 appears quite cohesive with only two organisations in the top and centre that are not connected into the main hub. In Wave 1, the referral network has Public Health Services, Human Service Bureaucracy and Large and Diverse NGOs appearing as key, very central and highly selected nodes at Wave 1. The referral network is highly connected, which means that there is evidence that organisations are referring clients on to multiple other organisations. This reflects some level of knowledge of the services offered by other organisation. There are however two isolated nodes which indicate that these organisations do not refer clients to other organisations in this network diagram, and that other organisations in this network diagram do not refer to them. To be clear, for the two isolated nodes, there are actually two possibilities to explain their lack of connections to others. First, such isolated organisations may have made outbound connections to organisations that did not participate in the survey, and thus were excluded from the network diagram (as previously noted, all network diagrams only include those organisations that participated in the network survey). Second, these two isolated organisations may not have made any out-bound connections to any organisation.

Referrals Wave 1



Referrals Wave 2



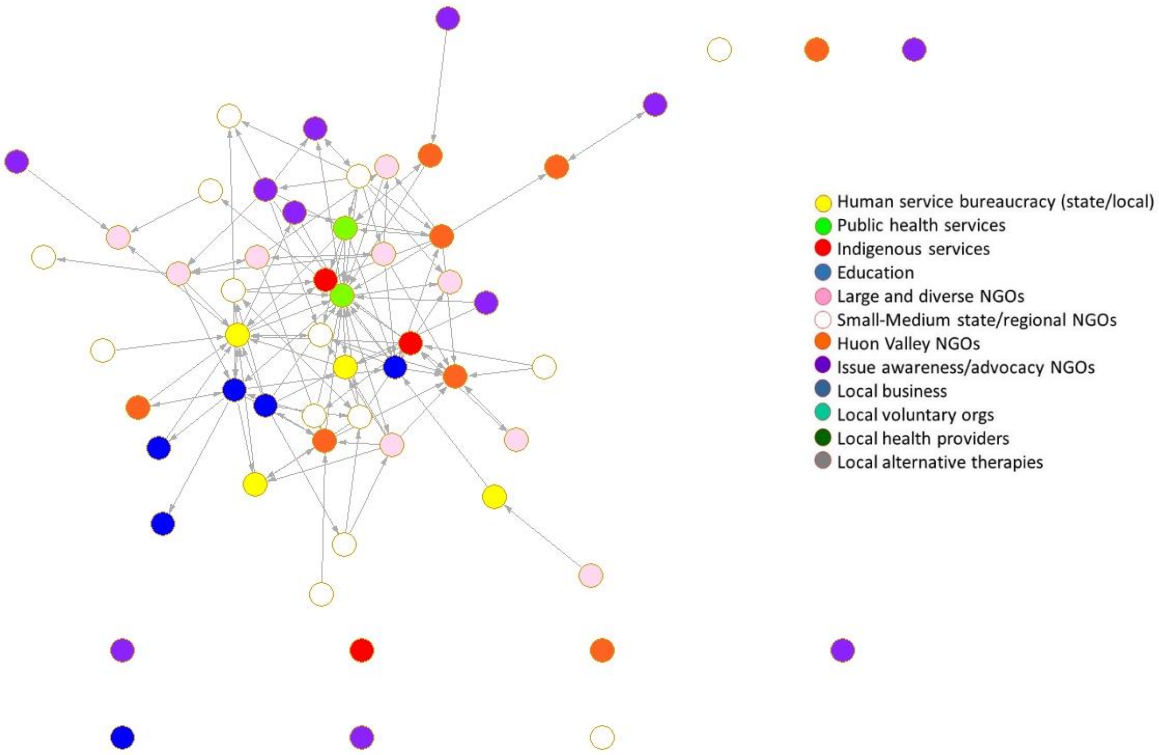
In Wave 2, the referral network has Public Health Services, Human Service Bureaucracy and Large and Diverse NGOs still appear as key and very central and highly selected nodes at Wave 1. However, we also have a range of disconnected nodes from the network. These to some degree represent the *new nodes* in the network – the addition of *local* organisations, but not in all cases. As noted, it is possible that some of these isolated nodes are connected up in referrals to other organisations that did not participate in the network survey (and as noted above, organisations that did not participate in the survey were excluded from the analyses). Overall, the referral network is very well connected, though the isolated nodes to some degree represent the fact that new organisations have joined the network and may be yet to connect.

So, the evidence here for the referral network is mixed. It appears that there are *less* connections at Wave 2 compared Wave 1, but the number of new types of organisations has increased at Wave 2, suggesting the Joined Up networks are diversifying. However, based on the metric of 'more ties is better and represents growth', this referral network has less ties over time (as shown in Table 3, Wave 1 = 85, Wave 2 = 76). There is *not* a quantitative increase in the number of referral ties over time. If we couple this finding with the fact that we estimate only 20% of organisations participated, it is indeed possible that the referral network has grown but simply that we do not have the data to support this. Most of the networks follow this pattern of appearing less connected at Wave 2, even though we have other evidence (like the number of participants on an email list, interview data, increased diversity of organisations) suggesting there is growth. But on the simple assumption that growth is 'increasing numbers of ties' we do not have evidence to support network growth, and by contrast, using this metric we appear to see network decline.

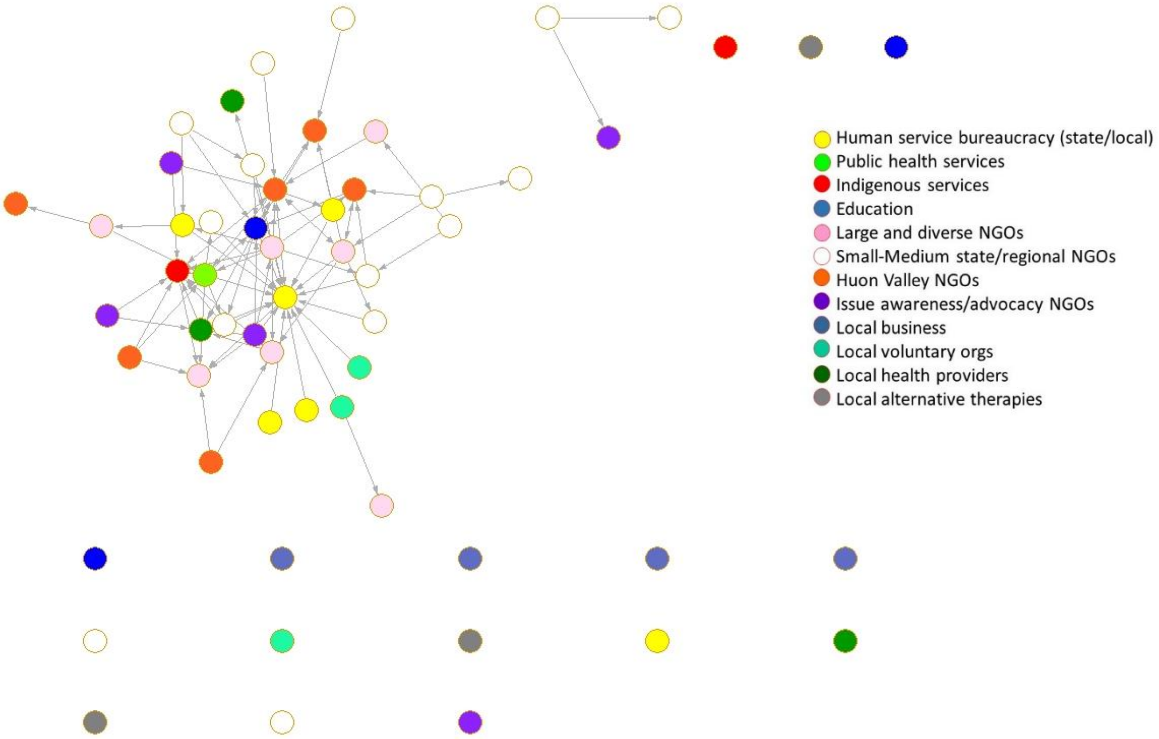
4.5.4. Collaboration network

Looking at the collaboration network below we see a similar story to the referral network. In Wave 1, the collaboration network is very well connected, with only a few isolated organisations. Again, Public Health Services and Human Service Bureaucracy appear as key players in this network. At Wave 2, the collaboration network is still very well connected, and Human Service Bureaucracy is a key hub in the network. There is not too much change between Wave 1 and 2 here. There is still quite a considerable amount of collaboration occurring. However, there are less collaborative ties at Wave 2 (91) compared with Wave 1 (133) which indicates that the network has not grown. A number of the isolated nodes are newcomers to the collaboration network and represent new types of organisations (e.g. local businesses) that were not in Wave 1.

Collaboration Wave 1



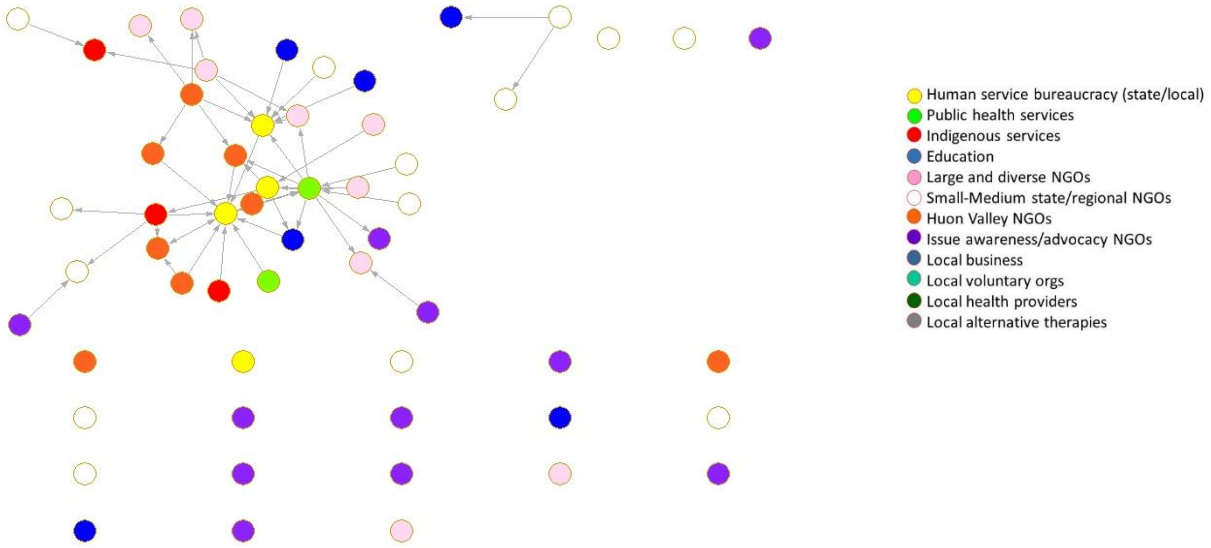
Collaboration Wave 2



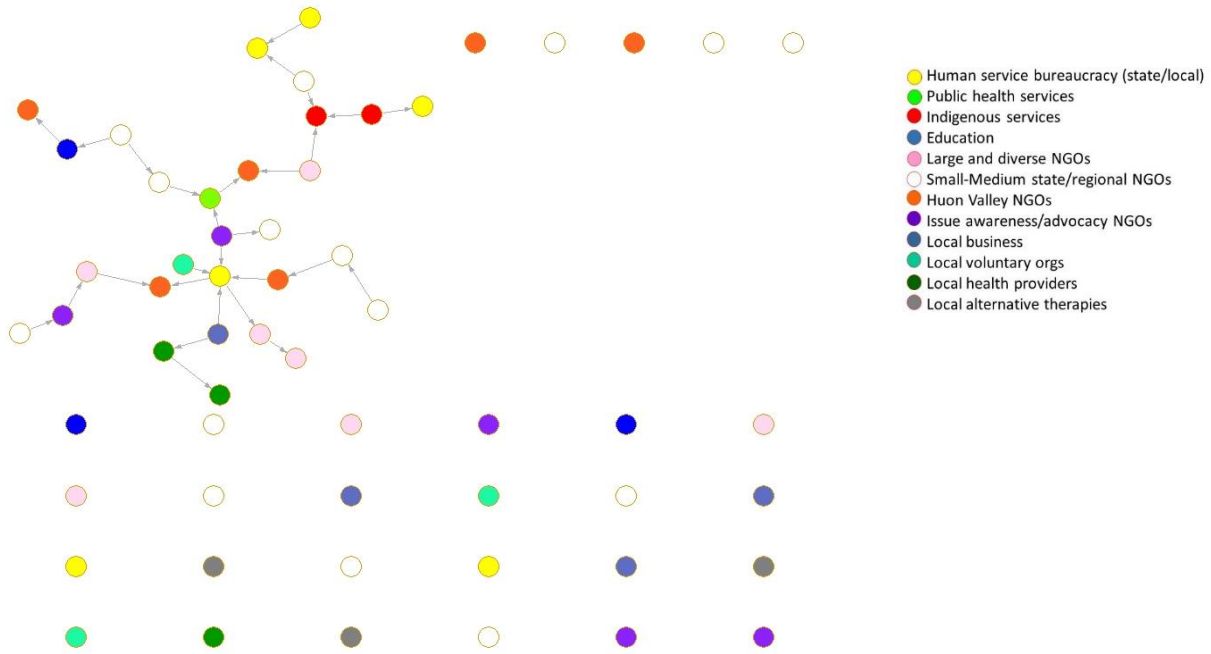
4.5.5. Difficult ties network

The difficult ties network represents the selection of organisations that other organisations find difficult to work with. Arrows point towards organisations that are deemed difficult to work with. As in seen in Wave 1, government human service bureaucracies are very central organisations within the network in 2016, indicating that many organisations find them difficult to work with. In comparison to Wave 1, the Wave 2 difficult network has less ties (see Table 3 – Wave 1 = 50, Wave 2 = 28). Further, government human service bureaucracies are not as central in the Wave 2 network, though one entity still remains highly selected. This decrease in the number of difficult ties is a positive for the network. Less ties here are a positive for this network type.

Difficult Wave 1



Difficult Wave 2



As noted, we do not present all network images here because the story is much the same and can be derived quite plainly from Table 3 which shows increases and decreases for various networks over time. Across all networks there appears to be less ties in Wave 2, which does not support the idea of network growth for the positive networks, but in fact for the negative networks is a positive sign that difficulties and differences are reduced over time.

4.6. Network change from 2016 - 2018

In this section, we explain the types of patterning we see in the network, with respect to a comparison of networks in Wave 1 and Wave 2, using LR-QAP (Krackardt, 1987; Krackhardt, 1988).

The analysis so far uses a statistical regression model to find the important predictors of collaboration ties, as observed at time 2. In the below LR-QAP analysis, we test how collaboration ties at time 1 (and several network positions within the collaboration network) influence subsequent collaboration at time 2. We also test the influence of several other types of network ties and evaluations on collaboration. Table 4 presents the results of this analysis.

Table 4. LRQAP. Dependent variable: Collaboration tie at Time 2

		Coefficient	Odds Ratio	T	Significance
	Intercept	-3.19	0.04	-15.67	
(a)	Easy and reliable collaboration - nominating the same network partner at T1	-0.56	0.57	-0.96	*ns (p* < .10)
(b)	Easy and reliable collaboration – nomination by the same network partner at T1 (reciprocity)	0.96	2.60	2.01	*
(c)	Easy and reliable collaboration (T1) X clustering	-0.16	0.85	-0.34	ns
(d)	Easy and reliable collaboration (T1) X popularity	0.12	1.13	1.82	ns
(e)	Coordinates services with (T1)	1.06	2.87	2.19	*
(f)	Competes with (T1)	2.13	8.41	3.18	**
(g)	Finds effective (T1)	1.16	3.19	2.09	*
(h)	Difficult interactions (T1)	0.85	2.33	1.52	*ns (p* < .10)

***probability of less than 0.01 or 99% confidence; * probability of less than 0.05 or 95% confidence; ns* - not statistically significant

As shown in Table 4, simply having a one-way tie of "easy and reliable" collaboration (a) does not predict collaboration at time 2. As seen in (a), nominating others marginally predicts the *absence* of collaboration at time 2 (though this effect falls just short of statistical significance). This likely indicates that when one side of the collaboration does not view another as "easy and reliable," there is no particular staying power. By contrast, when one's network partners view a collaboration as "easy and reliable" as in (b), collaboration is much likelier to continue into the future. While this finding regarding reciprocity (mutuality) of collaboration is not surprising, the negative impact of having non-reciprocal, non-mutual collaborations at time 1 is stark.
It suggests, for instance, that organisations that do not establish mutually-affirmed collaboration relationships will experience more turnover in the partnerships over time.

Notably, there was no evidence for other common network processes. As seen in (c), there was no evidence for triadic closure or clustering among organisations, in which one starts collaborating with one's partners' partners (i.e., a friend of a friend is a friend). Also, there was no evidence that very popular collaboration partners at time 1 collect disproportionately more collaboration at time 2.

In addition to past collaboration, we see some other predictors of subsequent collaboration:

- As expected, coordinating services at Time 1 fosters collaboration at time 2 (effect (e)). The intensive exchange and investment of time and effort implied by coordination should lead to continued collaboration.
- Perceived Competition at Time 1 fosters collaboration at time 2. Speculatively, this could be interpreted in several ways, including and not limited to:
    - First, competition may breed a wider awareness of what one organisation can do, and what they want to do.
    - Second, successfully competing for funding means that one is actually participating in the provision of a given service. As the organisation moves from bidding into implementation, they may begin to collaborate with their past competitors who very well may be operating in the same service area already. As a result, the competitors may therefore begin to interact and collaborate within their shared area.
- Deeming an organisation to be a highly effective (g) at providing services is likewise an attractor. This demonstrates the impact that valuing what an organisation offers has on subsequent collaboration.
- It is notable that having difficult interactions with a network partner at Time 1 did not forestall collaboration at time 2. In fact, it verges on being a statistically significant positive predictor of collaboration. Difficult collaborations are not to be avoided. It may signify a high level of investment of time and effort, during which two organisations become more familiar with each other's staff, capabilities and resources, and direction. This inter-firm familiarity could facilitate subsequent collaboration.

4.7. Longitudinal statistical network analysis

A more sophisticated longitudinal statistical network analysis is possible using the RSiena software (Ripley, Snijders, Boda, Vörös, & Preciado, 2018). We attempted such longitudinal statistical network analysis on the 27 organisations that appeared at both Waves 1 and 2. However, for many of the networks there was too much difference between the data in both waves and as such analyses were not possible. That is, the ties between certain organisations present at Wave 1 were almost totally different to those present at Wave 2, and this creates modelling issues which cannot be resolved when there is too much difference between time points. That said, some comparisons between Waves 1 and 2 were possible, and these are presented below.

For the **referral network**, longitudinal analysis in RSiena showed the following results:

Effects	Parameter	Std Err	Significance
ArcA	-3.788	0.057	*
ReciprocityA	0.068	1.12	
In2StarA	0.089	0.021	*
Out2StarA	0.136	0.02	*
TwoPathA	0.03	0.016	
Transitive-TriadA	0.346	0.058	*
Cyclic-TriadA	-0.341	0.1	*

** significant at 95% confidence*

The **referral network** shows positive in-star and out-star effects, which says that there are referral hubs – both outgoing and incoming. Further, the positive transitive triad effect is a positive thing, meaning that referrals are skipping over intermediaries, indicating less shuffling from one service provider to another. That is, if organisation A was referring someone to organisation B, and organisation B then referring to organisation C, we now see an effect for organisation A to refer directly to organisation C. Finally, there is a negative cyclic-triad effect – indicating a lack of circular triangle pathways between organisations, which is a good thing because it means that people aren't being referred back to where they started.

The **effectiveness network** results are presented below.

Effects	Parameter	Stderr	Significance
ArcA	-3.706	0.039	*
In2StarA	0.116	0.166	
Out2StarA	0.312	0.069	*
TwoPathA	-0.363	0.103	*
Transitive-TriadA	0.700	0.340	*

** significant at 95% confidence*

The positive out-star effect indicates that some organisations appreciate a lot of organisations around them. The positive transitive-triad effect indicates that there are small clusters of organisations who appreciate one another.

What these analyses provide is an insight into the reasons *why* organisations are connected to other organisations, not just *if* they are connected. However, as noted, due to limitations with the data we are not able to provide such details for all organisations. The evidence for the referral network is very positive however, and suggests that organisations are making referral shortcuts that are creating efficiencies for the network. This is a very positive thing for the Joined Up network and constitutes positive quantitative evidence for the network.

4.7.1. Interlock of organisations and forums

Systems within systems can be seen within *board and forum interlock*. Interlock refers to when two organisations who participate in the same board or forum. These forums are any setting where representatives of organisations come together to deliberate, make decisions, or share information. This could include peak bodies, advisory boards, or professional "networks". In Figure 5 below, we see the collaboration network from Wave 2 (blue circles and black lines). Added to this is their co-membership in various boards and forums (red squares and grey lines).

When modelled statistically using MPNet (Wang, Robins, Pattison, & Koskinen, 2018 - see Table 5), we see that *forums matter for collaboration*. More collaboration happens inside these forums than outside. In particular, very active organisations (who have many collaboration partners) tend to participate in more forums. Also, collaboration is more likely to happen between organisations who participate in the *same* forums together. While not a causal model, these results could suggest that forums are important sites for establishing and/or maintaining collaboration.

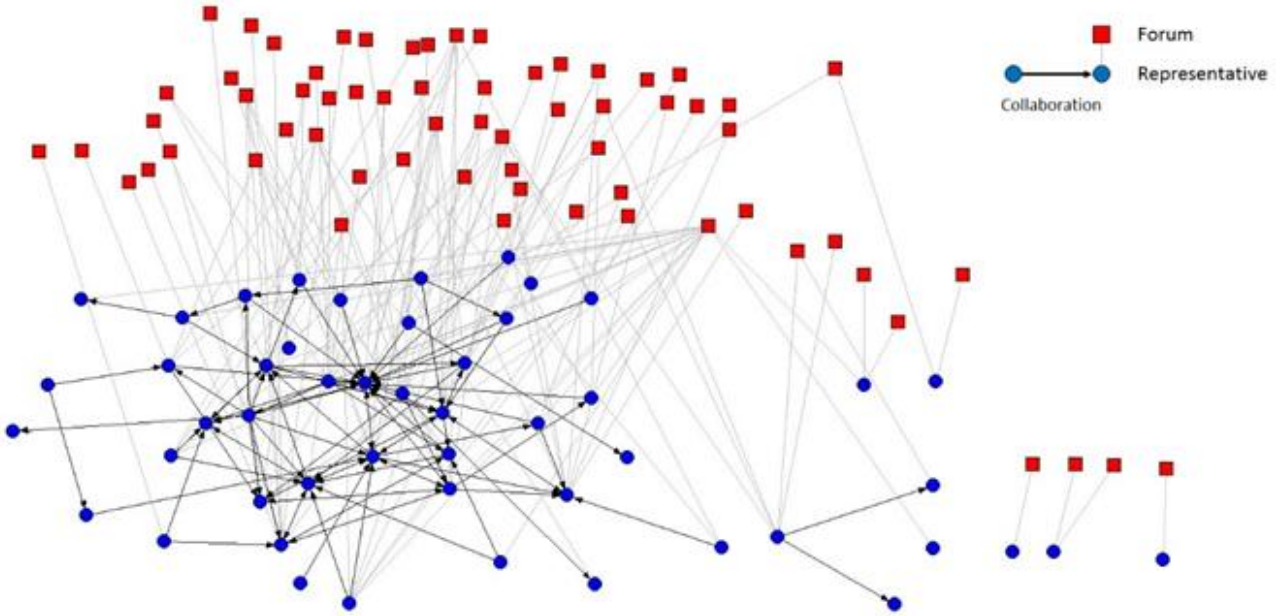


Figure 5: Board and forum interlock network

Table 5. ERGM model for Collaboration (Wave 2), with forum participation

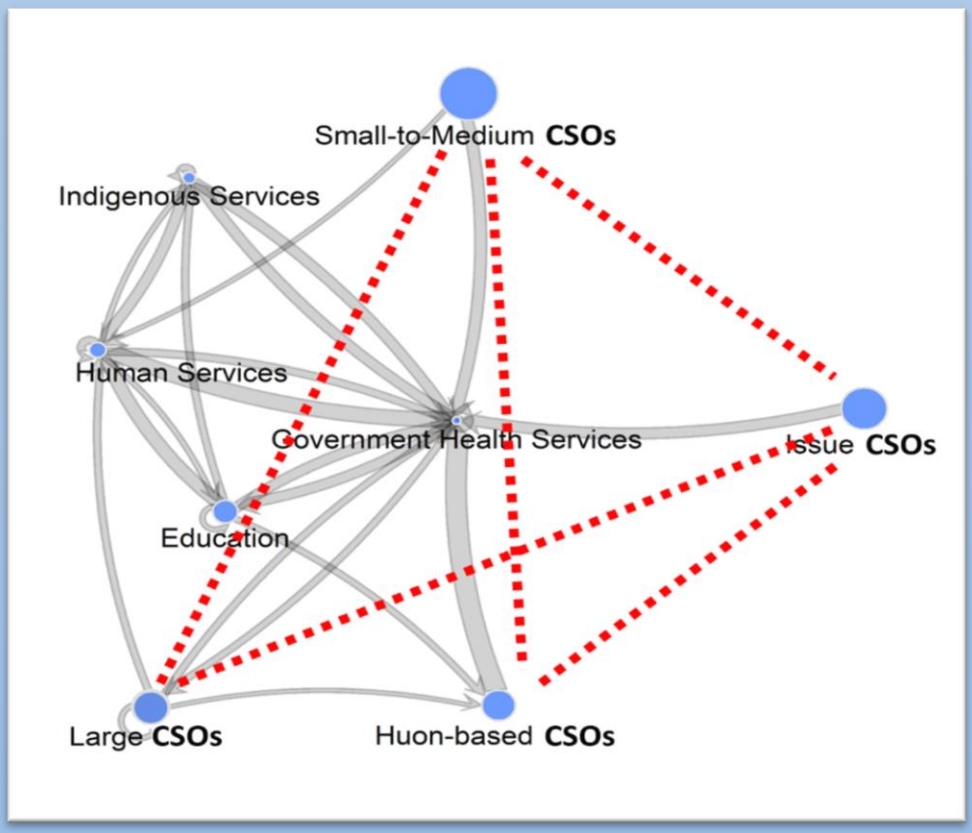
	Model without forums			Model with forums		
Internal dynamics	Parameter	Std Err		Parameter	Std Err	
Reciprocity	1.16	.62		1.03	.96	
Popularity	1.07	.27	*	1.07	.28	*
Activity	0.67	.32	*	0.32	.38	
Clustering (closure)	-0.10	.60		-0.14	.58	
Popularity X forum participation				0.001	.04	
Activity X forum participation				0.18	.07	*
Participate in same forum				0.55	.23	*

* significant effect (Wald > 2)

4.8. Overall network patterns between organisations

In this section, instead of looking at connections between individual organisations, we examine overall connections between different types of organisations, which produces what are called *shrink* networks. Due to having only one government health service at Time 2, it was only possible to conduct this analysis on Wave 1 (2016) data.

Figure 6.
Shrink network of collaboration ties, by organisational category



A *shrink network* is a network visualisation technique in which each node (blue-filled circle) represents a category of organisations (see pages 10-11). Here, the grey lines represent the overall amount of connections between organisations from those two categories. Thicker (grey) lines means that type of connection is relatively more common. If there is no (grey) line, it means that links between those two categories occur at a lower rate than ties in the network, overall.
In this visualisation, we have added red dotted lines to highlight **gaps** in the network.

For Wave 1, an overall picture of the collaboration network is given in Figure 6. The grey lines refer to the connections between those two types of organisations. The red, dotted lines indicate a relative *lack of* ties between those two types of organisations. As shown, government health services and government human services are thoroughly connected to all other parts of the network; this is especially the case for health services, who are an important intermediary in the network. However, two categories of organisations: small-to-medium CSOs, and Issue-and-advocacy CSOs, are particularly isolated, connected to the rest of the network through government health and human services. Large and diverse CSOs, and Huon-based CSOs, while involved in the network, are not overly central within this network.

As noted above, with only one government health organisation participating in Wave 2, comparative analyses for this shrink in network were severely limited and are not presented here.

4.9. Network similarity preference: Who's involved with whom?

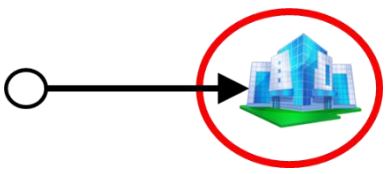
4.9.1. Reputations

Several themes emerging from initial conversations between the Swinburne research team and members of the service system is the importance of reputation within the service system in Tasmania and the Huon Valley in particular. It was asserted that word-of-mouth was a powerful force given the relatively small geographical size and population. Several key reputations mentioned on several occasions were developed into network questions, including the following:

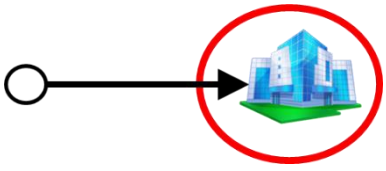
- Effectiveness
- Community's best interest
- Difficulties working together

4.9.2. Effective organisations

It was asserted that, given the small size of the Huon Valley, an organisation's reputation as an effective organisation (or ineffective) spread quickly, shaping impressions accordingly. Survey respondents were therefore asked who they thought was particularly effective. The following network patterns emerged.



❖ ***Wave 1:***
Huon-based CSOs,
Organisations serving the Indigenous population,
and ***Government health services***
were regarded as particularly ***effective***

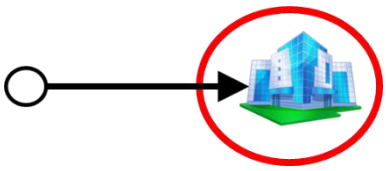


❖ ***Wave 2:***
Huon-based CSOs, *and*
Organisations serving the Indigenous population
were regarded as particularly ***effective***

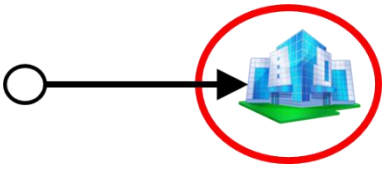
There was only one Government Health Service in the Wave 2 data, so it was not possible to predict effects for this.

4.9.3. Community's best interest

A common assertion within informal interviews was that some organisations had the "community's best interest at heart," while others did not. Again, there was only one Government Health Service in the Wave 2 data, so it was not possible to predict effects for this. However, for Wave 2 we did find an effect for Government Human Services, which were seen as having the community's best interests at heart, along with Huon-Based Community Service Organisations. Interestingly, organisations serving the Indigenous population were *not* a type of organisation that were seen at Wave 2 as being more likely to have the community's best interest at heart. This does not mean that organisations serving the Indigenous population were viewed negatively, just that they were not viewed as positively as at Wave 1. This may be a negative result for Indigenous organisations, or it may also reflect the fact that there were only two related organisations in Wave 2 compared to three in Wave 1, and this other organisation may have been 'driving' the effect in wave 1.



- ***Wave 1:***
  Huon-based CSOs,
  Organisations serving the Indigenous population,
  and ***Government health services***
  were regarded as having the community's best interest at heart



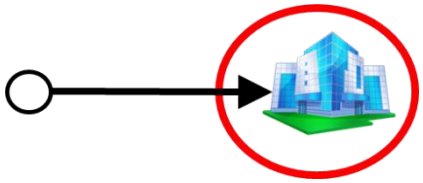
- ***Wave 2:***
  Huon-based CSOs,
  and ***Government human services***
  were regarded as having the community's best interest at heart

4.9.4. Difficulties working together

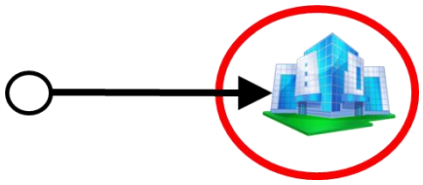
Not all network ties are positive. An important issue may be social ties that have been difficult to manage. Difficulties working together might be an *understandable* occurrence, or an inherent feature of work that is difficult to do. Alternatively, these difficulties might signify actual emotional tensions between organisations. We took an open-ended approach, asking our respondents about the organisations with whom they had difficulties working, regardless of whether this was understandable or not.

At both Waves 1 and 2 Huon-based CSOs and Indigenous Organisations were selected as being difficult to work with. It is interesting that both also featured as organisations that were effective, and that had the community's best interest at heart.

- ***Wave 1:***
  Huon-based CSOs,
  Organisations serving the Indigenous populations, *and* ***Government health services*** *tended to nominate others as difficult to work*



- ***Wave 1:***
  Government human services *tended to be nominated by others as being difficult to work with.*



- ***Wave 2:***
  Huon-based CSOs,
  Organisations serving the Indigenous populations, *and* ***Government human services*** *tended to be nominated by others as difficult to work with.*

A conclusion of these combined findings is that while these organisations may be hard to engage and work with, these organisations were effective at mobilising resources to a task or purpose, and when doing so, where acting with the community's best interest at heart.

4.10. Interviews

As part of Wave 2, a number of in-depth interviews were conducted with 12 individuals associated with the Joined Up place-based project. The interviewees consisted of the Regional Coordinator, CEOs and senior managers from various service provider organisation, as well as some frontline workers from various organisations. Participants were asked questions about the place-based project, directed towards how successful (or not) they thought the project had been, what were the most successful and useful aspects of the project, and what could be improved in future. Overall, we found the following:

- The overwhelming view of interviewees was that Huon Valley Service Providers Network was a significant success and of great value to service providers in their work.
- There was strong recognition that for the Huon Valley Service Providers Network to continue to be a success, it absolutely needs some formal structure. In this case, it is essential for the Huon Regional Care's Health and Wellbeing Coordinator (the Regional Coordinator) to continue in her role, a role which has dedicated time to coordinating the network.
- Some interviewees noted that much administrative work was being taken away from service providers by having a formal network Regional Coordinator disseminate information across the network for them.
- Some interviewees raised scepticism about the activities and that the Network needed to be more than just lunches, and that specific and real coordinated action between organisations was needed. However, these same people indicated that they had very limited engagement with, or had not engaged or attended, the networking events, suggesting this criticism may be more based on perception than reality.

Interviewees also discussed the following events, which represent anecdotal examples of positive effects of Huon Valley Service Provider Network events (bus tour and networking meeting):

Bus Tour

- After visiting an organisation that provides employment options to people with a disability, a worker who attended the tour was able to confidently describe the program's supportive setting to an anxious client so he felt comfortable enough to come for a trial. This client has now secured a work placement.

- After finding out about an education program run for disadvantaged adults at a neighbourhood house, a worker who came on the bus connected a client to the program and she is now planning to go on to further education through TAFE.

Networking Event 2017

- A woman at imminent risk of falling (and a likely hospital admission was avoided) was referred to an appropriate service due to a service provider connection made at the first networking event.

- A community centre staff member met someone from a service that supports people bereaved by suicide and was able to refer one of her clients who had experienced a recent suicide in the family.

- A local counsellor met the owner of an equine support program. As a result the counsellor referred a young female client who was not engaging in therapy. Since starting in the horse program the family has also become involved with a really positive impact on the girl's behaviour and the dynamics within in the family.

- A mental health worker connected with an aboriginal service, the Men's shed, Huon Valley Financial Services and a recreation program, and as a group they are now having conversations about running a project on supporting men over 40 who experience isolation.

- A men's shed member knew of an elderly lady in the community who was living alone and was struggling at home with no support. She had experienced a 'near-miss' with a fall a week or so before the network meeting. As a result of connecting with a social worker and finding out about the community social worker service, the member was able to facilitate an appointment which resulted in an assessment for the lady and a referral to in-home support.

This last story in particular demonstrates that the network is converting initial connections and knowledge by service providers of other services into coordinated service provision, a practice that Joined Up project was aiming for.

4.10.1. Financial Investment

It was noted by some of the interviewees that the cost and benefit of running the Huon Valley Service Providers network were very favourable. In particular, as mentioned above, there was anecdotal evidence that hospitalisations were prevented through the network improvements. Some network members commented that hospitalisation costs would likely be higher than network improvement funding costs[1] and that this is important when funders considered future support of this and other service networks.

4.11. Networking activities

The following network diagram represents various activities in the Huon Valley that organisations attend. In Figure 7, the five squares represent activities, and the circles represent organisations that attend at least *sometimes* or *regularly*.

- Huon Valley Health and Wellbeing Network (which includes the service providers' network meeting)
- Rural Alive and Well
- Huon Valley Mental Health Professionals Network
- The Right Place Initiative
- Huon Valley 26Ten

What we can see is that there is interconnectivity between these activities, such that some organisations attend more than one type of activity, sometimes multiple. Also, we can see that some organisations only attend one type of activity, and that there are a variety of organisations that attend no activities more than *sometimes* or *regularly*. Indeed, if we include any attendance the network is more connected, but we have restricted the visualisation to *sometimes* or *regular* attendance to show the stronger connections.

[1] The average admitted cost of a patient to a hospital in Tasmania in 2016 was $5,555 (Authority, 2018). Further, patients admitted through the Emergency Department have an average cost of $7,961 (Authority, 2018). Note, these costs are for the average episode and not a day rate. In the financial year of 2015-2016 in Tasmania, there were 42,271 admitted separations by the Emergency Department (Authority, 2018). If improvements to service networks are able to prevent 3-4 people being admitted to hospital in a year, then the investment given to the Joined Up Place Based approach pays for itself.

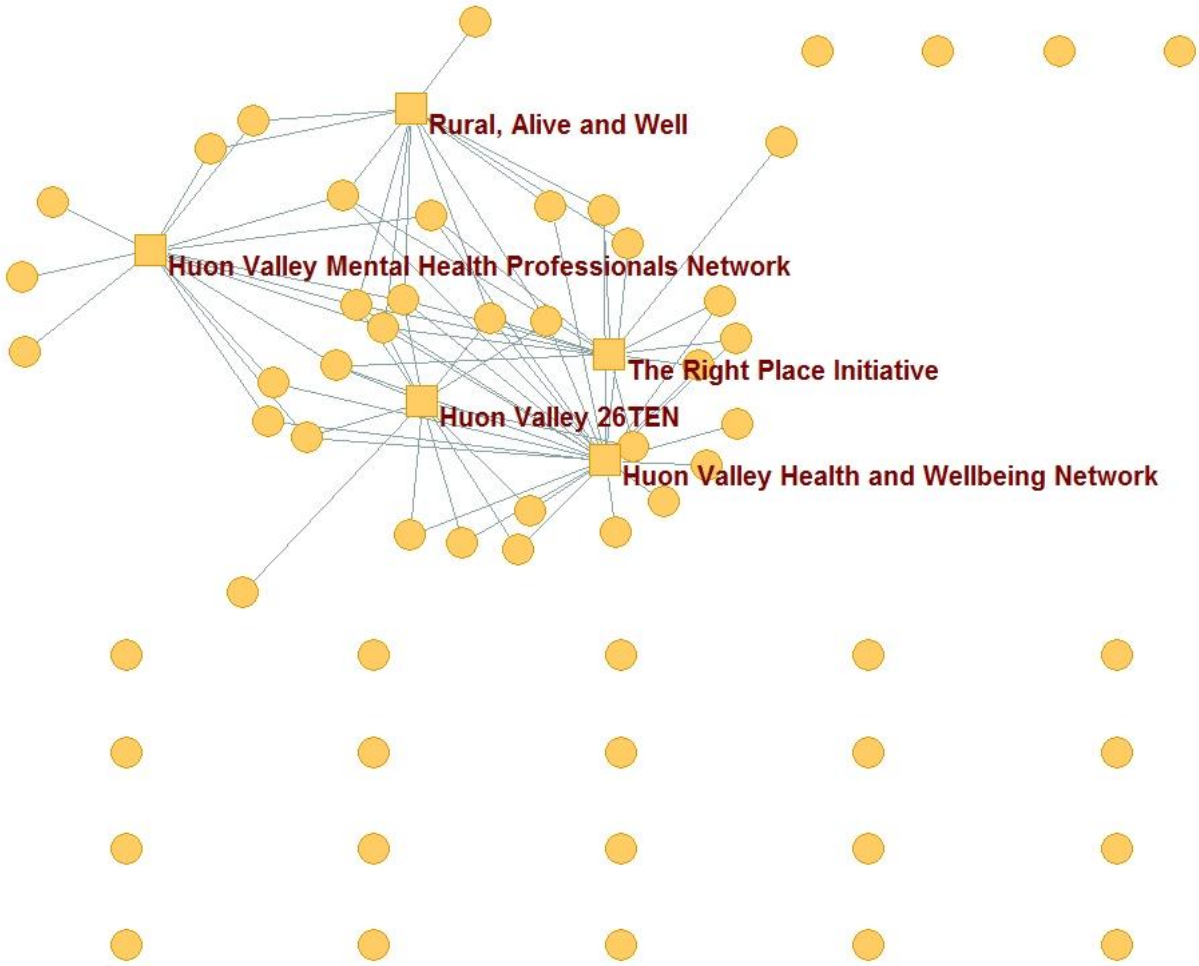


Figure 7: Activities in the Huon Valley that organisations attend

4.1. Summary of Joined Up Networks

The evidence from the various network analyses, interviews and insights from the Huon Valley Service Providers email network list provides some indication of the growth and value of Joined Up. However, there are a number of quantitative findings that both support and contradict the idea of network growth. As such, we do not have conclusive quantitative evidence that over time the networks have grown.

This inconclusive finding may be simply that the network did not materially grow. Or, it may be that the limited numbers of people participating at Wave 2 did not allow us to see the significant growth of the network from Wave 1 to Wave 2. Further, it is possible that the network was highly connected from the start, which is apparent from Wave 1, and as such we were unlikely to see significant growth or change.

As noted, there may have been issues with spam filters for the Wave 2 survey email invitation for some people. However, attendance at the Huon Valley Service Providers networking events has clearly shown an increase in the number of people attending such events.

From the network visualisations presented here, there are not a lot of differences between Wave 1 and Wave 2 network maps. There does appear to be more isolated organisations in Wave 2, but this is most likely because these organisations are new to the network, and represent a contingent of *local* organisations who were not present at Wave 1, and it seems have not yet integrated their organisation into the network.

Importantly, networks which show bonding and positivity (e.g. trust, effectiveness, collaboration) are much denser (i.e. connected) at both waves than networks which show fractures and disquiet (e.g. competition, protecting own turf). This is a positive thing for the Joined Up Place Based project.

In all, for Wave 1 reputational links displayed some important network patterns. There was a general level of agreement on who was effective, who had the community's best interest, and who was difficult to work with. The community's best interest was an important idea when describing alliances and common orientations among organisations, as well as indicating a willingness to work together on difficult problems. Altogether, "the community's best interest" is an important – though inexact – idea and serves as an important relational principle in the Huon Valley service system. Expressions of the "community's best interest" should be noted and addressed when raised in various forums that aim to strengthen the service network.

For Wave 2, for reputational links we noted that many of the same organisation types arose again as they did for Wave 1, though with some changes. Importantly, we noted that some types of organisations are viewed as effective, had the community's best interests at heart, but at the same time were difficult to work with. What is clear is that there is overlap in the types of relationships that organisations have with one another, and that these can be quite complex.

The longitudinal statistical analysis of a subset of organisations that participated at both Wave 1 and Wave 2 (of which there were 27 organisations in total) shows some interesting relationships between different sorts of network relationships and organisations. Mutually agreed upon collaboration in 2016 is likely to lead to continued collaboration in 2018. Further, when both organisations agree that the collaboration is easy, it is also likely to continue. When the network is in competition, it can evolve to collaboration. Additionally, being seen as effective can also generate collaboration at a later time point. Again, these effects show the complex interconnection between these different types of network ties or network relationships.

4.2. Agreement on the issues

As part of the initial research by the Joined Up team and the Swinburne research team, a number of key challenges and issues facing the Huon Valley service system were raised.

- Competition and collaboration
- Training and location of services
- Funding and privacy rules

To assess whether these issues were *commonly* viewed as problems or challenges, the survey included a number of statements that the research team constructed to represent the range of views held by those we spoke to. In the survey, respondents were asked to indicate whether they believed that statement to be **True** or **False**.

Responses were analysed using a technique called *consensus analysis* (Romney, Weller, & Batchelder, 1986). This is meant to determine whether there is an overall "common wisdom" of shared beliefs across the service system. First, it tells us whether respondents generally have a more-or-less unified point of view, or whether viewpoints are polarised, with different factions believing different things. Second, if there is a single common viewpoint, it tells us what that viewpoint is, in terms of answers to the survey. Finally, it scores each participant in terms of how closely he or she comes to the "common wisdom". The analysis identified what the common wisdom consisted of. This is reported in Table 6 below. You can think of this as what a hypothetical "ideal" respondent would report with respect to the common thinking of the group[2].

Table 6. Statements of belief regarding the Huon Valley Service System

	The "common wisdom" in…	
	2016	**2018**
The following statements have a "common wisdom" answer of TRUE….		
Transportation issues in the Huon Valley should be one of the foremost priorities of decision makers	TRUE (3.59)	TRUE (3.76)
Having service providers physically located within the Huon Valley is critical to good client outcomes.	TRUE (3.55)	TRUE (3.59)
The quality of interpersonal relationships between service providers is what make services work.	TRUE (3.49)	TRUE (3.49)
The idea of a collaborative model of place-based care coordination across the entire health and human services is, ultimately, achievable.	TRUE (3.09)	TRUE (3.3)
The idea of a collaborative model of care coordination is achievable within some limited areas (e.g. housing).	TRUE (3.08)	TRUE (3.15)
Competition among organisations ultimately leads to an inefficient duplication of services.	TRUE (2.77)	TRUE (2.95)

[2] Please note here that one limitation of this analysis is that it does not identify which items are agreed-upon and which items are not. It assumes that all items are agreed-upon equally

Some organisations/people have unfair advantages in obtaining funding, and this is more than just an isolated instance.	TRUE (2.69)	TRUE (2.76)
The move to a commissioning model of funding is a good idea.	FALSE (2.27)	TRUE (2.6)
The following have a "common wisdom" answer of FALSE….		
Generally speaking, when push comes to shove, it's better for clients to have a highly-trained service worker come in from outside the community than it is to have a less-trained worker with lots of local knowledge.	FALSE (2.34)	FALSE (2.48)
The practical reality of the current set of privacy rules is that they do more harm than good when it comes to the ability of service workers to support the needs of their clients.	TRUE (2.63)	FALSE (2.43)
An emphasis on universal/mainstream services would work better than an emphasis on specialist services, at least with respect to the Huon Valley.	FALSE (2.33)	FALSE (2.32)
Competition for funding resources to provide services to people in the Huon Valley is a good thing.	FALSE (2.14)	FALSE (2.18)
There are currently enough services present in the Huon Valley to effectively meet peoples' needs.	FALSE (1.81)	FALSE (2.02)
The Huon Valley currently has a sufficient supply of adequately trained workers to meet client needs.	FALSE (2.01)	FALSE (1.92)

At Wave 2, a consensus analysis revealed a consensus score of 3.45, which indicates that there is a modest consensus for the following statements presented in Table 6. This is a small increase from the previous wave of data collection in 2016. Statements with a consensus answer of more than 2.5 have a consensus answer of "true", with higher scores indicating a higher level of agreement. Conversely statements with a score of less than 2.5 have a consensus answer of "false", with lower scores indicating a stronger level of disagreement. Consensus on these statements is notably stable across the two time points. The move to a commissioning model of funding has marginally gained in acceptance, moving into the "true" category, while concerns over the practical constraints imposed by privacy legislation have eased, moving into the "false" category. Neither change, however, reaches a level of statistical significance in this particular sample.

The analysis showed that there was a **modest but discernible** level of agreement among the respondents regarding the main challenges facing the Huon Valley service system. While there is room for further agreement to build, and there are disagreements, the respondents' answers amount to what can be considered a "common culture" of thought.

5. Future use of SNA to Evaluate Health Service Impact

From the evidence presented in this report, we argue that Social Network Analysis (SNA) is an appropriate, informative and innovative way to understand the presence, structure and impact of networks in health services. In our view, there is no other comparable measure of networks that is capable of providing a combination of (a) highly visual network visualisations and (b) statistical insights into network structures and outcomes.

Insights from SNA are not as clear as they could be for this report, mainly due to issues around:

- Low participation rates (~20%) means that we only get a partial view of the overall service system, not a complete aerial view of all organisations and their connections.
- Having some different informants/participants from Wave 1 to Wave 2 for some organisations may mean inconsistent information is being provided about organisations.

5.1. Network measurement, statistical analysis, and simulation

The network visualisations provided above can be extremely informative and powerful ways to represent interconnectivity in health service provision, referral and collaboration. However, network visualisations are not always easily interpretable. As mentioned above, the complexity of social systems means that it is almost never possible to intuitively understand the many agents and social connections among them. For this reason, simply looking at network pictures comes with considerable limitations. To analyse them with more certainty, we need statistical models for social network data. Statistical network models help us determine whether

we should be confident that certain network positions are important with respect to a certain outcome (e.g. performance, health), or whether evidence is required.

The collection and statistical modelling of social network data is a cutting-edge and quickly-developing area of research, especially within public health, covering a range of different types of network data. Below is a partial list of immediate opportunities for network data collection and measurement, both within the community, and among the service provider workforce.

5.2. Opportunities for network data collection and measurement

The following represent different ways that the service system might be measured:

5.2.1. Surveys

Workforce

The Joined Up survey represents a possible model for regular and repeated surveys of leaders and front-line workers regarding their professional network connectivity. Direct social surveys provide the most reliable lens on individuals' *viewpoints*, *attitudes*, and *beliefs*. Network analysis can then tell us how social relationships shape these person-level factors, such as one's level of job satisfaction, or general agreement on key issues facing a community.

The community

Network surveys of the general population (Bryant et al., 2017) are also a cutting-edge and very useful, albeit resource-intensive, way to understand more about how relationships and social participation shape important outcomes, like physical and mental health, life satisfaction and quality of life, and other indicators of community wellbeing and resilience. Regular ethnographic work (observation, in-depth interviews with key stakeholders and informants) greatly enrich these insights.

5.2.2. Building network measurement into everyday administrative activities

It may be possible to collect a great deal of information on network connectivity among service providers through two general efforts:

- **Centralising and standardising record-keeping,** specifically for funding applications and project awards. Such an approach would provide information on:
    - *Network connectivity*. Who collaborated with whom on funding submissions? Who competed against whom?
    - *Performance.* Who won? Who did not?
    - *Service area.* What need will the project address?
    - *Time.* How long is the collaboration due to last?
    - *Geographical area*. Where is the service to be provided?
- Keeping track of **organisations' participation in professional bodies**, including boards, forums and networks. As seen in Joined Up and in Figure 8 below, organisations' participation can be used to measure network connectivity where collaboration may take root.

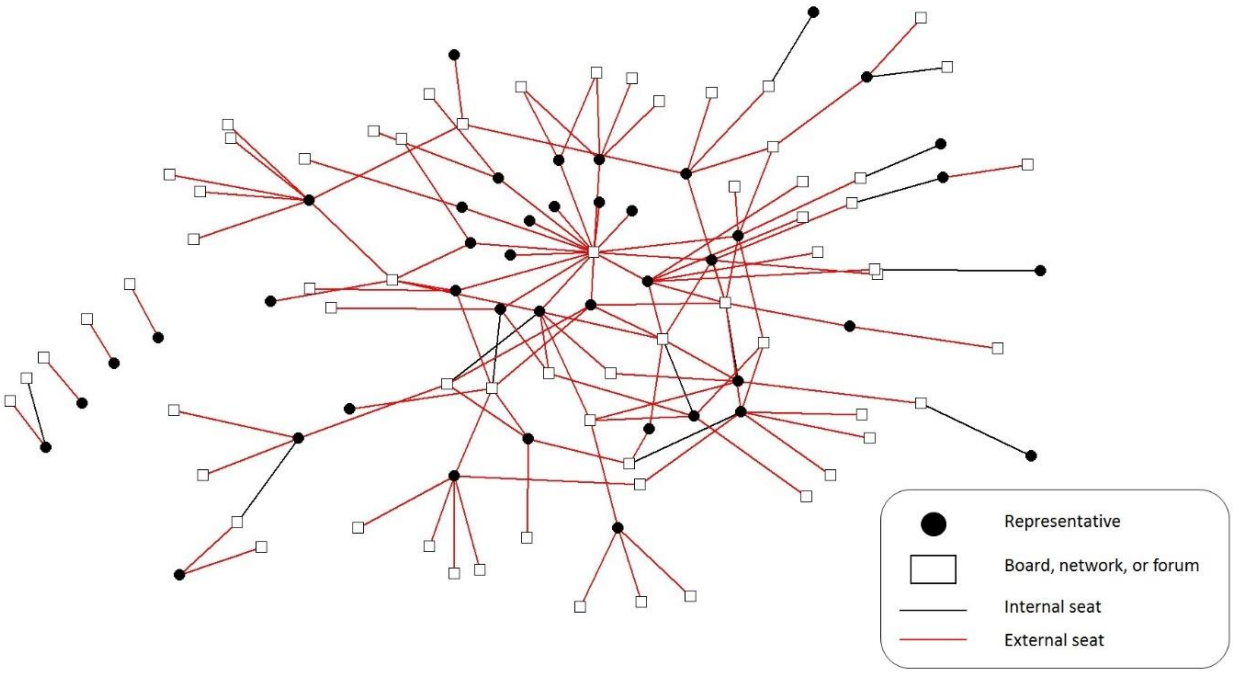


Figure 8: Network of professional memberships

5.2.3. Health tech and social media, and the Web

One possible source of important data is to blend data collection with digital health interventions using digital technology. The recently launched (April, 2018) Digital Health Cooperative Research Centre (CRC) lists among its key themes "Improving the efficiency and integrity of Health Services" and "ensuring efficient and complete data flows to enable seamless care." https://www.digitalhealthcrc.com/research-themes. Digital media and technologies are becoming increasingly popular in healthcare as an adjustable and cost-effective way to provide custom-tailored information and feedback for individual patients (Slater, Dear, Merolli, Li, & Briggs, 2016). A variety of new technologies can be used to share experiences, information, and to meet and talk with new people. These new tools offer new avenues for interventions, and for engaging with patients and members of the community in an innovative way. Among these, interactive health communication applications are designed to give health information via computer-based program, but also along with social support, and guidance for behaviour change.

Under the appropriate ethical guidelines, these new technologies could be used to trace network linkages among both service providers and community members, to understand the course of service delivery, and track its effectiveness.

Another example of using digital data to understand service provision is through *web connectivity*. Figure 9 demonstrates direct connectivity among four relevant websites (Tasmania DHHS, Healthconnect.com.au, Huon Valley Council, and Primary Health Tasmania). As can be seen, while some of these websites link directly with one another, other sites are fairly distant.

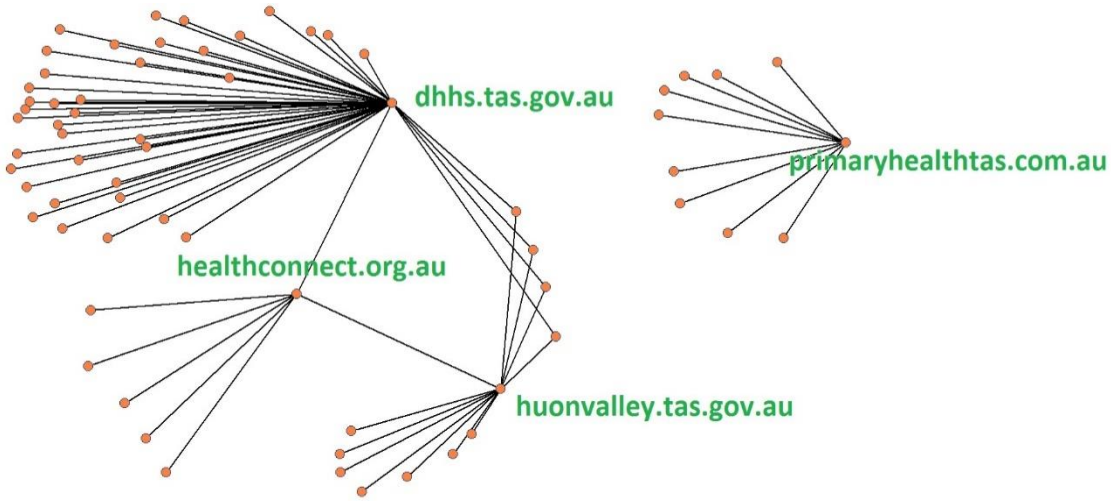


Figure 9: Website connectivity between relevant service providers using VOSON (Ackland, 2010)

5.3. Possible SNA providers

If the Tasmanian State Government were considering using SNA as a tool for assessing impact of health services in regions of Tasmania and across the state as whole, there are two main types of social network providers that may be appropriate:

- **Academic** social network researchers
- **Commercial** social network providers

We do not suggest any preferred suppliers here – either academic or commercial – but rather wish to discuss the value that each may play moving forward. For **academic social network researchers**, a clear advantage is the depth of knowledge of SNA but also of the applied areas of health. Academics have access to cutting-edge techniques that can provide significant insights way beyond what is possible from most commercial providers. They can also form new and flexible collaborations with other academics with complementary knowledge, in areas of health and community, for example. For this group, research impact and engagement with community and policymakers is a KPI that is quickly gaining in importance. Furthermore, academics work under their own stringent ethical review guidelines with well-established training and compliance regimes. The downside of academics is that this depth takes times, and the desire to collect nuanced data and conduct publishable analyses in academic forums may provide more complex solutions than is required, and on an extended timescale.

Commercial suppliers have the advantage of providing scalable solutions, but generally possess less depth of understanding of SNA, and particularly around network evaluation. Their expertise and focus on communities or health is often not as extensive, so they lack some of the contextual information appropriate for a comprehensive solution. However, their scalability means that they can provide a simpler solution that can be applied in multiple domains, and one that is more quickly implemented and provides feedback more readily.

We would suggest that the set-up of SNA tools to deliver assessments of impact and collaboration across community and health projects in Tasmania would require a combination of academic and commercial network researchers. This is likely at least for the initial phases to deliver a solution that is both robust and appropriate, and that is also scalable. It is our view that in the end, to monitor and trace networks in many communities with timely insight into possible areas of intervention and impact requires a commercial solution that is easy to use and scalable.

However, assessing the precise nature and impact of this solution in a robust way should be carried out by academics that have the knowledge to assess if something will deliver the intended results.

5.4. Collaborative design of network evaluation with SNA providers

Finally, if the Tasmanian Government is keen to substantially invest in evaluations of the level of connectivity and networks of various service providers, we strongly recommend holding a workshop or similar event so that the Tasmanian Government and possible SNA providers can collaboratively design what these network evaluations may look like. As detailed above in Section 5.2, there is a vast array of possible network data that can be collected. Working together with SNA providers will enable the Tasmanian Government to more fully understand what is possible and what might provide the most value for money and parsimonious way to evaluate networks, connectivity and coordination. For example, the authors of this report are currently developing a framework for assessing network effectiveness, while researchers at other institutions have specialised skills in online network data collection and assessment. Being across the possibilities, and the level of effort required to obtain and analyse such data, will lead to better decision-making on future course of action for network evaluation.

End of Report

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This report is provided by the Networked Innovation group, Centre for Transformative Innovation, Swinburne University of Technology. We are a core member of MelNet (http://www.melnet.org.au/), a Melbourne-based consortium of universities with expertise in social network analysis (SNA). MelNet conducts research and training in the theory, methods, and applications of social networks. Our primary focus is on social networks of innovation and organisational culture, with projects spanning numerous industries and sectors, such as health, biotechnology, polymer technologies, sport, schools, and the public sector.

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Glossary of acronyms and terms

DHHS – Department of Health and Human Services

DCT – Department of Communities Tasmania

ERGM – Exponential random graph model - a special statistical model for analysing social networks that uncovers prominent patterns therein.

Shrink network - a method of visualising a network in which entities (here, organisations) of the same category are combined into a single node.

SNA – Social Network Analysis – a general method for analysing social ties among members of a system.

THS – Tasmanian Health Services

LWG – Lead Working Group

References

Ackland, R. (2010). WWW Hyperlink Networks. In D. Hansen, B. Shneiderman & M. Smith (Eds.), *Analyzing Social Media Networks with NodeXL: Insights from a connected world*: Morgan-Kaufmann.

Authority, I. H. P. (2018). National Hospital Cost Data Collection Cost Report: Round 20 Financial Year 2015-16 – February 2018.

Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *science, 323*(5916), 892-895.

Bryant, R., Gallagher, H., Gibbs, L., Pattison, P., MacDougall, C., Harms, L., . . . Ireton, G. (2017). Mental Health and Social Networks After Disaster. *American Journal of Psychiatry, 174*(3), 277.

Caimo, A., Pallotti, F., & Lomi, A. (2017). Bayesian exponential random graph modelling of interhospital patient referral networks. *Statistics in medicine, 36*(18), 2902-2920.

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *The New England Journal of Medicine*.

Cunningham, F. C., Ranmuthugala, G., Plumb, J., Georgiou, A., Westbrook, J. I., & Braithwaite, J. (2012). Health professional networks as a vector for improving healthcare quality and safety: a systematic review. *BMJ Quality & Safety, 21*(3), 239-249. doi: 10.1136/bmjqs-2011-000187

Expert, P., Evans, T. S., Blondel, V. D., & Lambiotte, R. (2011). Uncovering space-independent communities in spatial networks. *Proceedings of the National Academy of Sciences, 108*(19), 7663-7668.

Fortunato, S. (2010). Community detection in graphs. *Physics reports, 486*(3-5), 75-174.

Fortunato, S., & Hric, D. (2016). Community detection in networks: A user guide. *Physics Reports, 659*, 1-44.

Gibbs, L., Waters, E., Bryant, R. A., Pattison, P., Lusher, D., Harms, L., . . . Forbes, D. (2013). Beyond Bushfires: Community, Resilience and Recovery-a longitudinal mixed method study of the medium to long term impacts of bushfires on mental health and social connectedness. *BMC Public Health, 13*(1), 1036.

Hawe, P., Shiell, A., & Riley, T. (2009). Theorising interventions as events in systems. *American journal of community psychology, 43*(3-4), 267-276.

Isard, W. (1954). Location theory and trade theory: short-run analysis. *The Quarterly Journal of Economics*, 305-320.

Iwashyna, T. J., Christie, J. D., Moody, J., Kahn, J. M., & Asch, D. A. (2009). The structure of critical care transfer networks. *Medical care, 47*(7), 787.

Krackardt, D. (1987). QAP partialling as a test of spuriousness. *Social networks, 9*(2), 171-186.

Krackhardt, D. (1988). Predicting with networks: Nonparametric multiple regression analysis of dyadic data. *Social networks, 10*(4), 359-381.

Lomi, A., & Pallotti, F. (2012). Relational collaboration among spatial multipoint competitors. *Social networks, 34*(1), 101-111.

Lusher, D., Koskinen, J., & Robins, G. (2013). *Exponential random graph models for social networks: Theory, methods, and applications*: Cambridge University Press.

Maher, C. A., Lewis, L. K., Ferrar, K., Marshall, S., De Bourdeaudhuij, I., & Vandelanotte, C. (2014). Are Health Behavior Change Interventions That Use Online Social Networks Effective? A Systematic Review. *Journal of Medical Internet Research, 16*(2), e40. doi: 10.2196/jmir.2952

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual review of sociology, 27*(1), 415-444.
Powell, W. W. (1990). Neither market nor hierarchy: Network forms of organization. *Research in organizational behavior, 12*, 295-336.
Preciado, P., Snijders, T. A., Burk, W. J., Stattin, H., & Kerr, M. (2012). Does proximity matter? Distance dependence of adolescent friendships. *Social networks, 34*(1), 18-31.
Ripley, R. M., Snijders, T. A. B., Boda, Z., Vörös, A., & Preciado, P. (2018). Manual for SIENA version 4.0. Oxford: University of Oxford, Department of Statistics, Nuffield College.
Robins, G. (2015). *Doing social network research: Network-based research design for social scientists*: Sage.
Romney, A. K., Weller, S. C., & Batchelder, W. H. (1986). Culture as consensus: A theory of culture and informant accuracy. *American anthropologist, 88*(2), 313-338.
Slater, H., Dear, B. F., Merolli, M. A., Li, L. C., & Briggs, A. M. (2016). Use of eHealth technologies to enable the implementation of musculoskeletal Models of Care: Evidence and practice. *Best Practice & Research Clinical Rheumatology, 30*(3), 483-502.
Sterman, J. D. (2006). Learning from Evidence in a Complex World. *American Journal of Public Health, 96*(3), 505-514.
Valente, T. W. (2010). *Social networks and health: Models, methods, and applications*. Oxford: Oxford University Press.
Wang, P., Robins, G., Pattison, P., & Koskinen, J. (2018). MPNet: A program for the simulation and estimation of exponential random graph models. *Swinburne University of Technology*.
Wasserman, S., & Faust, K. (1994). *Social Network Analysis: Methods and Application*. Cambridge: Cambridge University Press.