

Mapping Networks

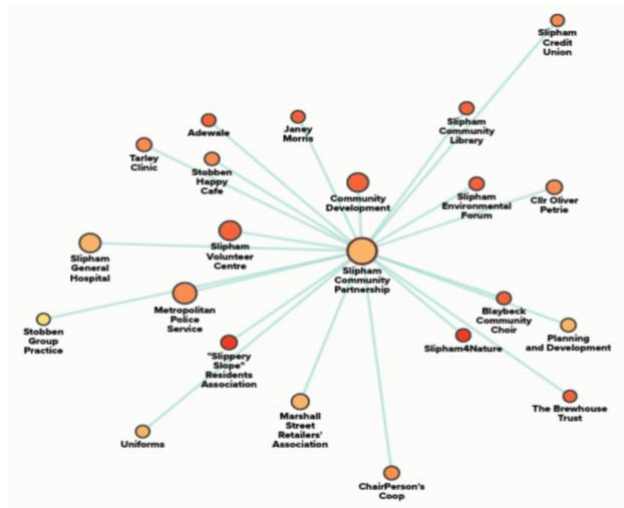
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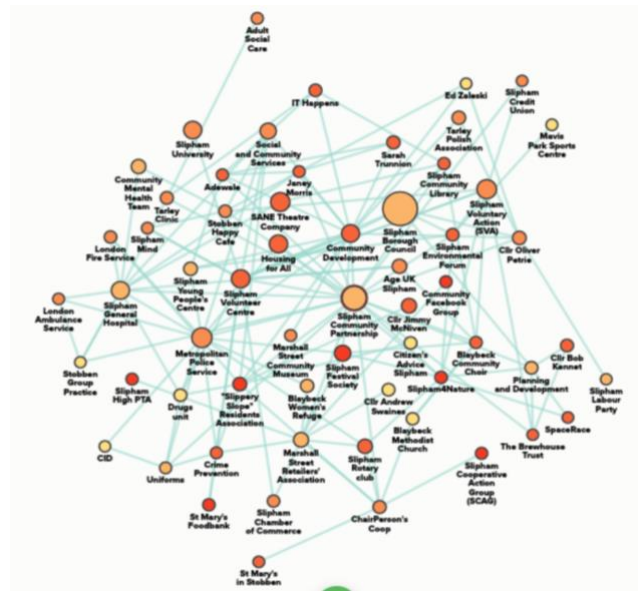
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Network Thinking

One of the most overused words in the discussion of communities and the agencies that serve them is *network*. At workshops, conferences, and informal networking sessions of all sorts the term crops up constantly – ‘He’s got a really good network of contacts’ – ‘She’s part of the xx network’ and so on. Acting in a ‘networky’ way is generally approved, as is the strengthening of networks through the use of social media. Yet, when you probe deeper, it becomes apparent that the knowledge of what networks are and how they work is limited. For instance, any individual that has a list of contacts and doesn’t really know the connections that exist between themselves and between them and a wider network, has a **list** and not a network. Being part of a network doesn’t really tell you about the wealth of collaborations that may exist between the network’s members beyond your immediate contacts. Map 1 shows immediate connections to a central node - essentially just a list of contacts. Map 2 shows connections two steps out from the same node and the interconnections that make up a network.



Map 1



Map 2

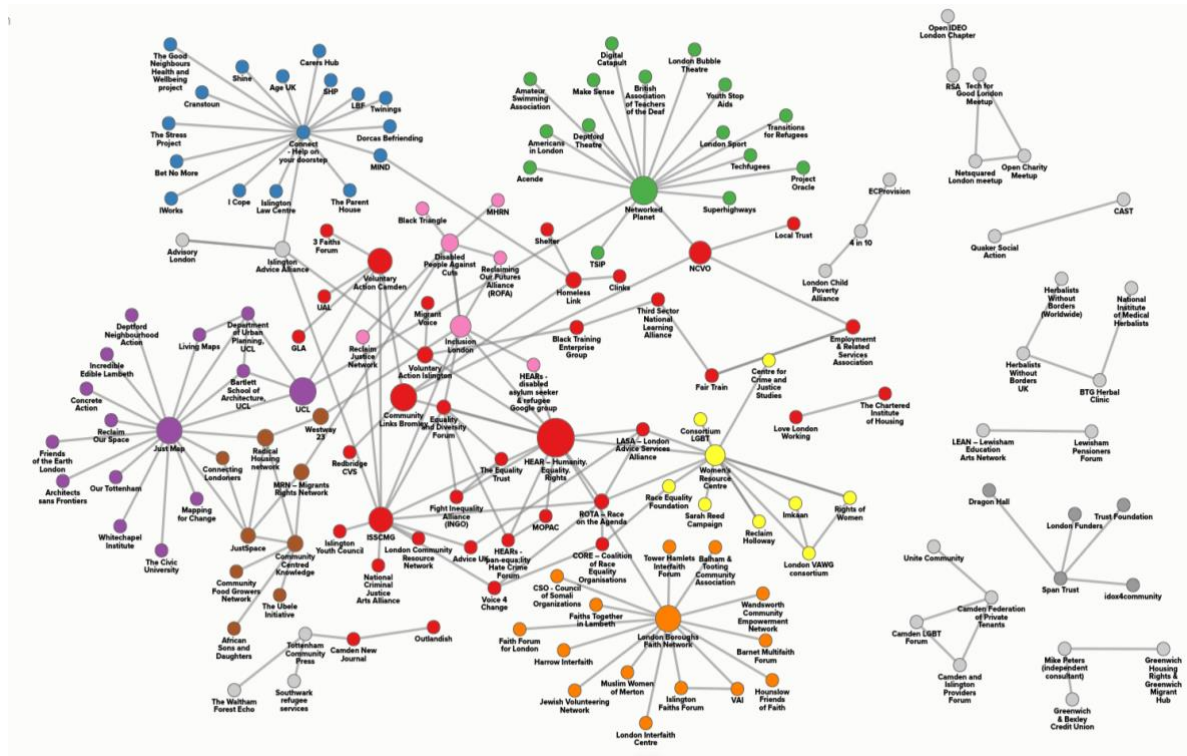
Anything that can be drawn as a set of nodes and connections is a network. In small networks - up to about 20 nodes – it is usually pretty easy to see patterns. As network size increases, this becomes increasingly difficult so that specialist software has to be used to identify clusters and which nodes might be most influential. The patterns of nodes and connections can be analysed using the concept of *centrality*. Complex networks need Social

Network Analysis (SNA) software to predict who may be the most influential or who may be the best at spreading information throughout the network. Unfortunately, not many of the professions that have adopted the network idea know much about this emerging science of networks.

Network Maps and Geomaps

A map itself has no immediate purpose. It will have been drawn to illustrate a general framework such as the structure of roads or the relative heights of land or the location of points of interest. It is the canvas on which any number of individual purposes may be plotted. Take a road map for instance. There are many different ways to travel through the map. The routes you take depend on the purpose of your journey - a meandering scenic route when sightseeing, the motorway when you have to get to a business meeting and so on.

The worlds of geographic and network mapping have been pretty separate. Geomaps locate organisations within a representation of the physical environment. Netmaps show the inter-relationships between organisations, individuals, ideas and so on within an abstract space. Proximity is not normally a factor in most network maps. Connections are based on functional relationships. Geomaps have the advantage of being familiar. We are used to reading road maps or consulting atlases so they form a useful framework for the community information that we wish to store and display. Geomaps are good at showing proximity based factors such as density and access. Netmaps are good at showing interactions such as sharing, and the potential spread of influence and information.



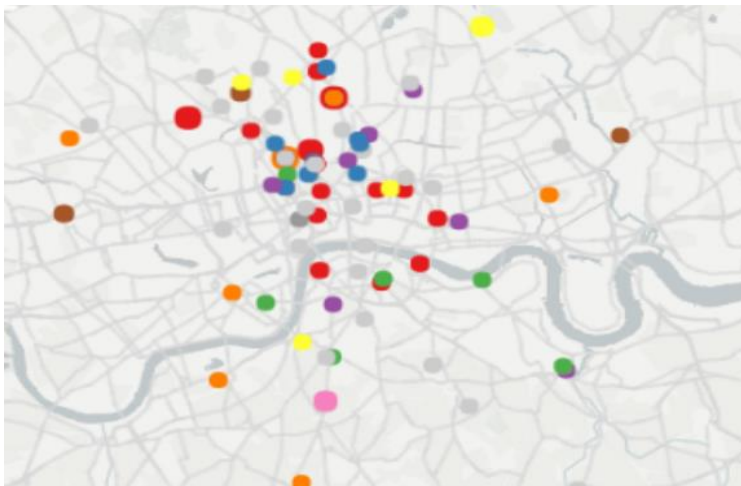
Map 3

The Kumu online software we use (<https://kumu.io>) explores the collaborative connections between various actors in a community. The aim is to collect and make publicly available, information about local assets, projects and collaborations. The network map below shows community organisations and agencies in London. The data was created and displayed in real time at a conference and fed into Kumu as participants added nodes and links (this map is still being developed). Kumu can analyse which nodes are most central (node size) and how they cluster (node colour). Each node can hold searchable data in text, number, video, soundclip and date format. The clicking on the node or link reveals the data. The map is not just a visualisation. It is a visually organised database.

Geomaps in Kumu

Kumu is also able to place the nodes on a geographic map created in OpenStreetmap using several different geolocators - postcode, street address and map reference. This is a fairly recent innovation in Kumu and it is very valuable. Previously, we have tried to bring together netmaps and geomaps using different systems that share a common database with varied success. Having these functionalities in the same system simplifies everything. At the press of a button we can move from a netmap to a geomap derived from the same data.

In other exercises, we have attempted to combine map types into a composite map, but the result is often visually confusing. The web of connection lines can start to obscure the geographic elements of the map and positioning the network nodes in their geographic location destroys the clustering and centrality insights that network maps give. We have come to the conclusion that the map types are best kept separate. Kumu gives us the option to switch off the connections when we create a geomap while retaining the sizing and colouring. It can sometimes be useful to note the connections and relate them to location.



Map 4

Map 4 shows the geographic distribution of the nodes on a map of central London. All node and link data is preserved and accessible by clicking. The connections have been switched off, but can be restored at any time.

The audiences for netmaps and geomaps are likely to be different. A geomap is more likely to be used by community members seeking a particular service or access to a particular asset. A network map is more likely to be used by organisations wanting to explore how local groups and agencies work together.

Table 1 shows the likely audiences for network maps, geographic maps and “catalogues” - the listing of organisations and what they can offer that might be published by a local authority.

	what is it?	who can use it?
Network Map	A clickable online map of the various assets and how they work together. This will include organisations, premises and existing collaborations.	Used by the organisations to trace patterns of existing collaboration and to explore future possible collaboration. Also to identify key organisations, groups and individuals and to hold asset information derived from the asset catalogue and available online through URL.
Location Map	Clickable online map showing the location of various assets and linking to the list of assets to provide individual asset descriptions	Used online by the community and their support agencies to identify assets with a location.
Catalogue	A catalogue of asset types showing their possible use by local people and how and when they can be accessed	Publishable on and offline to be used by local people and their support to identify available assets. Links to both Location and Network maps.

Table 1

Data collection and storage

We collect information through events, workshops, on and offline surveys and interviews. We use initial Kumu maps drawn from client interviews as the basis for people to add their nodes and connections. GoogleForms or SurveyMonkey online questionnaires can also feed information into a GoogleSheet which then links automatically to a Kumu map. SumApp is a dedicated online questionnaire system that feeds a JSON file into Kumu to create and update a network map automatically.

Data distribution

Kumu can capture data in several ways:

- Direct input on screen through drawing or keyboard
- CSV or JSON files
- Linking to a SumApp survey or GoogleSheet - this then restricts input to the map directly. Updating from these sources is continuous and automatic.

Map output

There are three reasons that people and organisations connect:

Proximity

People know each other or organisations collaborate because they are close together.

Neighbours meet each other in the street. Businesses are in the same street. Community groups get together over some local and locational issue - these are reasons to act together. Local threats and opportunities bring groups and individuals together. This is the realm of the geomap.

Activity

The sharing of an activity leads to connections being formed. The activity can be business-centred, sporting or based on clubs of all sorts. Such links will often (but not always) be place-based. Online activities can be shared. The connections may be local or distant. This is the shared realm of geomaps and network maps.

Affinity

Connections may occur around a shared belief or set of concepts. People collaborate across great distances but with modern communications they could be next door. We have regular contact with the developers of Kumu who are based in Hawaii and San Francisco. Slack, Zoom, Skype, Facetime allow us to have conversations. The Kumu community brings in people from Boston, Milwaukee and Delft as if they are next door. Such connections are “scale free” - the don’t depend on proximity at all - this is the realm of the netmap.

Figure 1 shows the connections between netmap and geomap input processes and outputs.

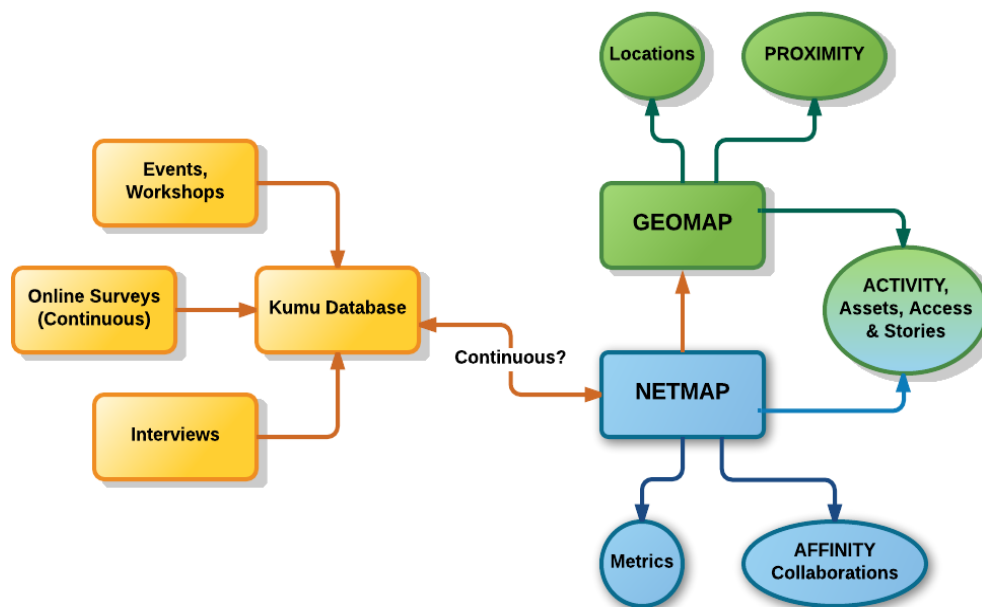


Figure 1

So what?

Network maps are useful to chart social landscapes and plot ways in which people and organisations travel through it and gather together. The following ten questions can help you understand and use such maps.

1. Who connects to whom?

This is the most basic information that you can get from a network map. It will show organisations or key individuals as nodes and collaborative activity between them

(conversations, working together, giving advice, funding) as lines. Any situation that can be expressed in this way is a network. So at its most basic the map is a visual representation of how people and organisations work together. The pattern of nodes and connections can be further analysed using specialist software. This approach is known as Social Network Analysis (SNA) and has a long pedigree of use in research, business and security.

Why is this useful?

Just knowing the collaborations between the organisations and people that you are dealing with can be really helpful in deciding who to involve in a project or programme. There may be key collaborations that you wish to be a part of or you may wish to bring together organisations that don't collaborate at the moment. The network map can help you identify these and assess the possible effects of new connections

2. What are your closest connections?

A network map will show your immediate connections - the people and organisations that you collaborate with directly. It will also show the nodes that are connected to your immediately connected nodes. You can step out from your initial node to see the possible pathways to others.

Why is this useful?

Identifying your own connections and the exchanges you have with them is itself a useful process. You can add to this an estimate of how strong you feel a connection to be and what stories you share. This can become more powerful when you also identify what further connections they have.

3. Who is most central?

In any real life network, some nodes will be more *central* than others because of their position on the map. These nodes will be able to influence the network more than others and are best placed to distribute information to other nodes on the map. In small, simple maps, it is usually easy to identify these nodes. In maps with large numbers of nodes and connections, specialist software is needed to pinpoint the key nodes. The concept of centrality is key to network analysis. Although there are a number of metrics of centrality the most commonly used are:

Closeness measures the distance each element is from all other elements. In general, elements with high closeness can spread information to the rest of the network most easily and usually have high visibility into what is happening across the network. - Discover the sensors / spreaders

Betweenness centrality measures how many times an element lies on the shortest path between two other elements. In general, elements with high betweenness have more control over the flow of information and act as key bridges within the network. They can also be potential single points of failure - Discover the brokers / bottlenecks

Why is this useful?

You can use centrality to identify who is most likely to influence the network - these are the organisations or individuals that you should involve in your campaign or programme. You can also identify the nodes that would have the greatest impact on the network if they were removed.

4. How do nodes cluster?

Most maps will show areas that are more dense than others - where the nodes hang together because of how they are connected. We can highlight these clusters using software. Although the clusters have been entirely created from the geometry of the map, there will often be a remarkable fit to functional clusters - nodes that share some activity interest or asset. Finding these congruities gives you some confidence that the map is reasonably accurate representation of the real life networks it seeks to portray.

Why is this useful?

Identifying such communities of interest or action is useful in deciding who to include in events or campaigns. Some nodes may act as vital bridges between otherwise disconnected clusters.

5. What's the shortest route?

You may want to know how near to another person or organisation you are - how many connections lie between you and them. In a small network this is easily seen. In a large network this is much more difficult and software can help. You may also want to know the shortest pathway between nodes that you think *should* be collaborating.

Why is this useful?

Many campaigns, ranging from the medical to the military have found it more effective to target the network of nodes surrounding their actual target. It is therefore useful to know the most immediate connection pathways to the node you want to influence.

6. What assets and attributes do nodes have?

So far we have concentrated on the *form* of the network rather than on the individual character of its component nodes and connections, but we can also record information in nodes and connections. This might typically relate to the skills and resources held by that organisation or individual. It is also possible to determine a list of attributes across nodes and connections and to add tags. This allows us to carry out complex searches. The map becomes a database.

Why is this useful?

Knowing what you *have* makes it easier to decide what to *do*. The spread of assets within a network may be sparse or plentiful. Knowing which will help you set a strategy. Knowing where these assets are located and how willing organisations are to share, is a useful guide to action.

7. What is the strength of connection?

Some connections are stronger than others. The strength of connection will affect how information and influence spread throughout the network. This can also change how nodes cluster and how central various nodes are. Again, software can help by incorporating the strength of connection in calculations of centrality and clustering. Further detail can give different strengths of connection based on different factors such as money, information, power and so on. Software can show how the map changes according to which factor is being considered.

Why is this useful?

Knowing how strong connections are can refine the calculation of centrality. It can also help identify the nodes that will have a strong influence on a target node.

8. What is the density of the network and how does it change over time?

Some networks are more connected than others - the density of connections is greater. It is often useful to measure the degree of connectedness of a network and to show how this measure changes over time - to illustrate the effect of a strategy or programme where connectedness is an important factor. A common way of assessing density is to compare the maximum number of links possible within a network with the actual number of links. The problem with that is that the number of possible links rises dramatically with the number of nodes according to the formula: $n \times (n-1) / 2$. Most organisations tend to have an upper limit for real interactive collaborations of around 15 and most individuals are half that. We must distinguish between membership organisations where most links are one way and tenuous, and collaborative organisations that interact on projects.

Why is this useful?

Many complex delivery issues are concerned with connectivity. We talk of being more joined up, of collaborating and sharing. Yet we have few means of measuring what that means. Social capital is defined as the degree to which people and organisations are linked. Social network analysis provides a way of evaluating the changes in connectivity that occur as a programme develops.

9. How do assets compare with network position?

It is possible to measure how central nodes are and then compare that with the skills and resources that they control. Often you will find that the most central nodes are not the best equipped. In some cases, they may not be able to exercise the role that the network has assigned them because they lack the assets to do so. On the other hand, a node may have plenty of resources but be so poorly connected that it can't use them to benefit the network. Comparing the balance of assets and network position gives an insight into network performance and specialist software can demonstrate this in a mic-mac chart which displays quadrants which show:

- High centrality/high assets
- Low centrality low assets
- High centrality / low assets
- Low centrality / high assets

Why is this useful?

Comparing assets held with how central organisations are gives some idea of how they contribute to the network and how they might contribute in the future.

10. How reliable / credible is network analysis?

In the last 20 years or so, there has been an upsurge in thinking about how networks of all sorts shape our lives and our surroundings. Although the approach is called *social network analysis*, its principles and methods have been applied in many diverse fields from public health to cell biology, military strategy, family dynamics and

farming. The NHS NICE website cites over 16,000 references to social network analysis in its Evidence section.

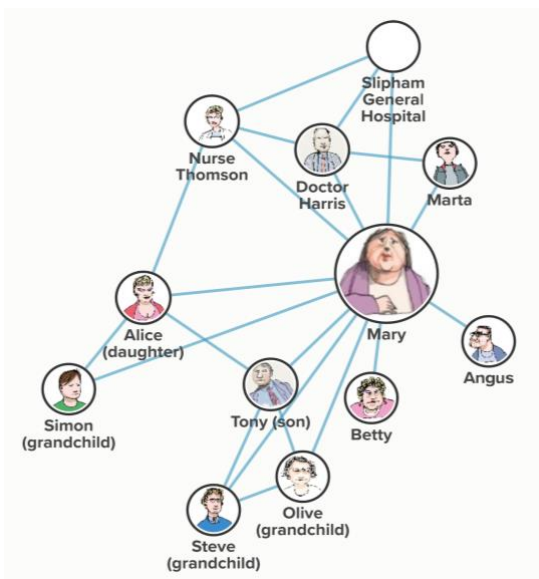
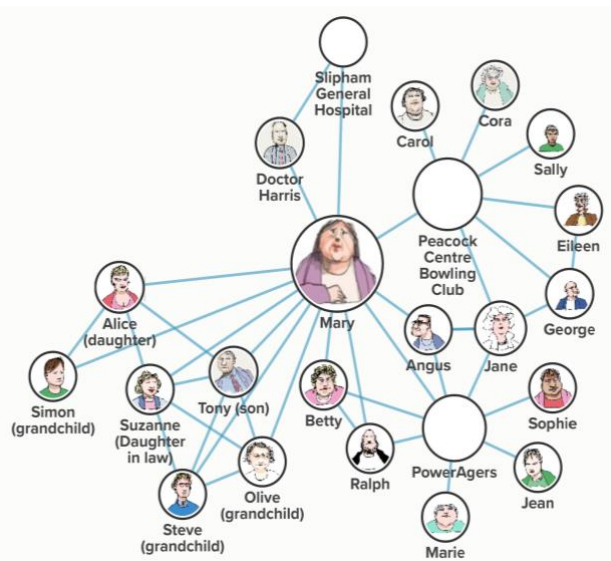
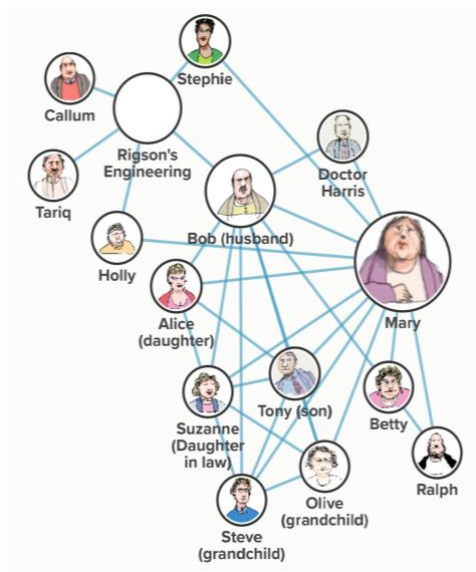
Why is this important?

The spread of network ideas and their adoption across many fields gives some confidence in their use. Although the UK has been slow in adopting such methods, we are coming to recognise their usefulness and accept their results.

Examples

The following examples demonstrate the use of the method at family and local scales.

Centre for Ageing Better



Work for the Centre for Ageing Better developed a number of network maps based on personas of typical older people developed by IpsosMori through national research. The

mapping was part of the CfAB sponsored “Joined Up Digital” program that looked at the ways that older people might benefit from the use of digital technology.

The maps show the social connections that Mary has in late middle age through to old age. The first map shows connections between Mary, her family, friends and a minimum of health support in late middle age. The second map shows how Mary has responded to the death of her husband by joining a walking group and a bowling club to create a new circle of friends. The third map shows how her connections have collapsed in old age with the onset of arthritis which now limits her physical activity, and how these have become dominated by formal support which now takes up a third of the total.

Slipham Living Lab

Slipham is an imaginary place that has been created to explore various urban issues and possible scenarios that have collaborative working at their core and assists in exploring:

- What are the patterns of existing collaboration and sharing?
- What resources and skills do various groups, agencies and key individuals have to share and how do they communicate their knowledge, needs and willingness to share with others?
- How do the various actors on the Slipham stage cluster in terms of their shared activity?
- Who is most central and therefore most influential in local networks?
How can we help individuals find pathways to opportunities and services in the community?

Map 5 shows the interactions of organisations in the fictitious London Borough of Slipham. This map is the focus of several events where real organisations and practitioners add their suggestions to simulate typical organisations in their field. As part of an event in London in 2017, which showcased the work of **Harold Jarcho**, we asked participants to help build the Slipham network map.

The larger nodes on the map indicate potential influence because of their *position* on the map (calculated by the network mapping software). Nodes shade from red to yellow to indicate their willingness to share assets (Resources and Skills). Each node carries a set of information explaining its role, listing its assets and scoring its willingness to share.

The network map can be analysed to show who is most central, to identify clusters of nodes and can be searched in complex ways based on information in the nodes and connections. The main purpose of the map is to explore how organisations collaborate and to experiment by adding new nodes and connections - or to see what happens when nodes or connections are removed, simulating withdrawal of funding and other changes.

