

Spatial Networks: a participatory workshop tool

Using **Spatial Networks** involves building a **network 'graph'** (i.e., diagram) of a system, and including the representation of **physical space** using concentric rings. By adding this **spatial** element to standard network graphs, it is intended we can more easily **understand the importance of physical distance** in the operation of networks, and thus the system being mapped.

Spatial Network diagrams can represent **any kind of network** or combination of networks. Connections can be undirected or directed denoting a directionality to the connection, the latter would be represented by arrows such as in the example below. Of course, any type of actor (such as companies, governmental organisations) can be included in the diagram.

7 Steps in creating your own Spatial Network:

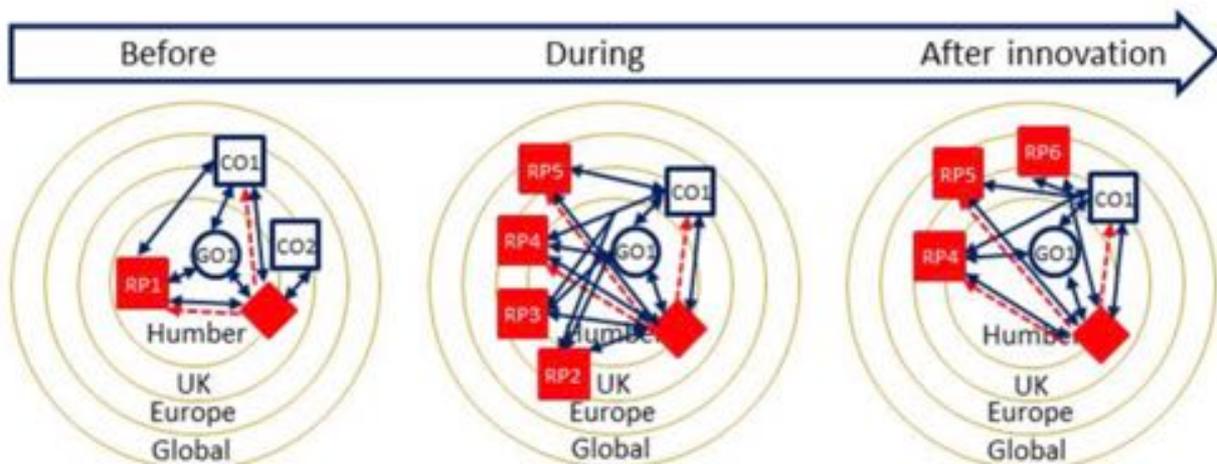
1. Use an existing, or generate a new, network graph
2. Prepare network data
3. Decide on time scales
4. Decide spatial scales
5. Draw Spatial Network
6. Draw legend
7. Save and share your Spatial Network

Detailed instructions on pages 2-4

Why should I use Spatial Networks?

Many people find drawing network graphs a valuable way of understanding a system; **Spatial Networks add an important dimension - physical distance - to use of network graphs**. The diagram can be used to represent one (part of a) network at one moment in time. Additionally, the diagram can also be used to represent **network evolution by repeating the diagram and visualising the network at different moments in time**, as below. This enables interpreting whether the spatial dimension of a network changed over time.

An example of a Spatial Network diagram for actors in the Humber, UK, Europe and Global spatial scales.



How to create your own Spatial Networks

Thinking Guide: Before you Start

Before you create your Spatial Network, let's first consider what we are hoping to achieve, and what we might look out for.

- By adding spatial and temporal dimensions to network graphs we hope to include these dimensions in our thinking more easily.
- We hope to use the networks graphs in our own thinking, but also in communicating to others.
- We should use the Spatial Networks to identify the key changes in spatial and temporal characteristics of the system, and consider how these changes affect us, and our decisions.

1. The first stage requires that we have a network graph of the topic for which we are interested in exploring the network affects of physical distance. Any network graph can be used. We may already have a graph, or we may need to create one from scratch.

To generate the graph itself, you may wish to use an online tool such as Gephi (<https://gephi.org>), Draw.io (<https://www.draw.io>), Mux Viz (<http://muxviz.net>), or simply use pen and paper. Using Gephi, there are some helpful tutorials at <https://gephi.org/users/>.

2. **Prepare the network data.** So that we can build our Spatial Network, we must consider what actors and connections exist in the graph, and at what spatial and temporal scales they exist. This is perhaps the stage that requires most consideration.

Data can be prepared in any form, such as a table, excel file, network matrix or simply drawn on paper. You will need data about **actors**, their **connections**, and their (approximate) **locations**. Additionally, it might also be relevant to have data on actor types, connection types, directions of flows, and time that a connection existed.

As in the diagram here, you should **create a spreadsheet** (NB: this does NOT need to be written on a computer - you can use pen and paper if you wish). On the first sheet, **rows will represent each actor** in the network, and **columns will represent the information about the actors**: whether they are present on the map in each 'time step', their type, and location. On a second sheet, you should **note all the connections between actors**, using either a simple rule of 'there is a connection or not', or by denoting the type of connection, as in the diagram below.

Excel sheet 1: Actor details

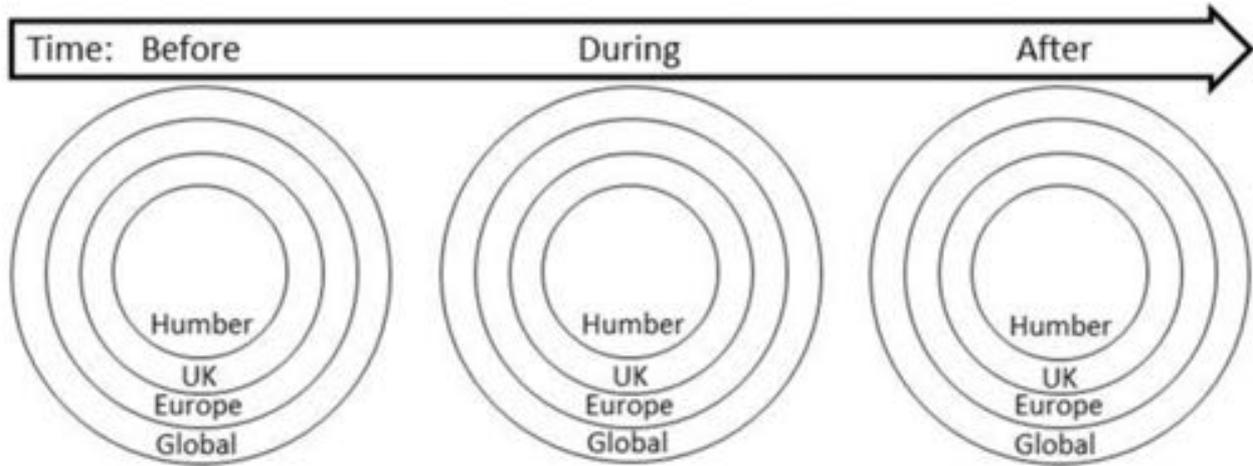
	B	C	D	E	F
				Actor type (Companies: Focal, Resource partner, technology provider, Other; Government: Local, Regional, National, EU, Outside EU; Local community; NGO/ Charity)	Location (Hull, East Riding of Yorkshire, North Lincolnshire, Northeast Lincolnshire, Great Britain, EU, Outside EU)
1 Actor name	Before	During	After		
2 Actor 1	1	1	1	Focal	East Riding of Yorks
3 Actor 2	0	1	1	Resource partner	Great Britain
4 Actor 3	0	1	0	Technology provider	EU
5 Etc.					

Excel sheet 2: Network matrix

Relations legend: 0 no relation; 1 social relation; 2 metabolic relation; 3 social and metabolic relation NB read as FROM vertical TO horizontal.

	B	C	D	E	F	G	H
1 Actor 1							
2 Actor 2	0	3	1	3	1	1	
3 Actor 3	1	0	0	0	1	0	
4 Actor 4	1	0	0	3	0	0	
5 Actor 5	1	0	1	0	1	0	
6 Actor 6	1	1	0	1	0	0	
7 Actor 6	1	0	0	0	0	0	
8 Etc.							

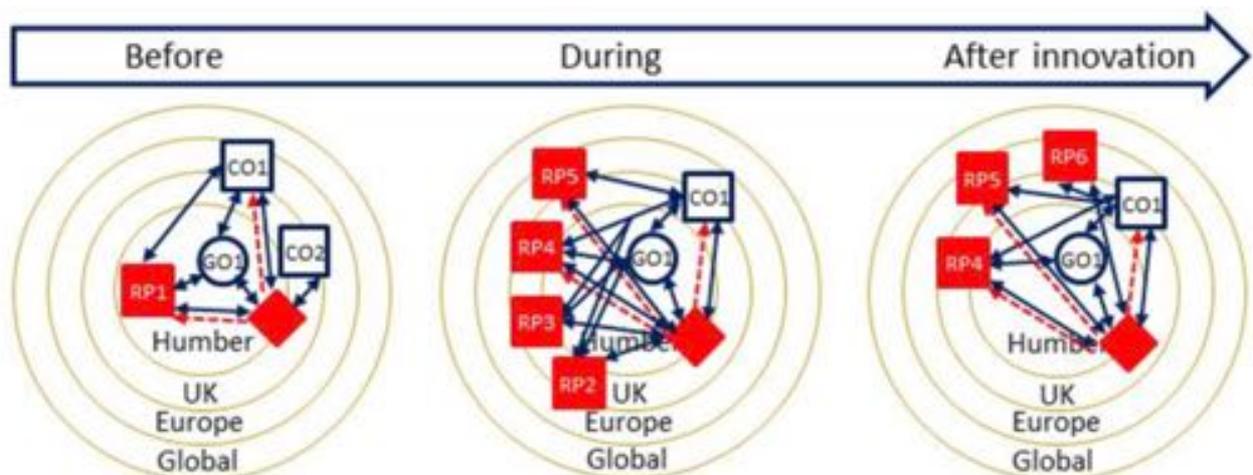
3. Decide whether you want to represent **one network at one moment in time or a series of networks developing over time**. Decide how many diagrams you need to make. This is entirely dependent on your case and the data you have available. For example, in the first diagram on page 3 the focus was on understanding network dynamics before, during and after waste-to-resource innovation and hence three diagrams were created for each innovation to observe changes in each stage separately.



4. Decide **spatial scales relevant to your case and data**. Create the circles yourself or use our blank version which can be downloaded at http://steerplex.org.uk/images/SN_blank.pdf, and add the name of the spatial scales. In our example diagrams the relevant spatial scales were Humber region, United Kingdom, Europe, and Global. You may wish to draw your Spatial Network using pen and paper, or software such as PowerPoint, or an online tool.

Deciding what scales are relevant here is very important. Is it simply the location of an actor that is most important, or is the scale on which they have influence or operate which is relevant? For example, a Tesco shop may have a local location near your home or work, but is part of a much larger organisation. Thus Tesco as an actor may be classed as local, national or international, depending on the focus of your topic.

5. **Draw the network data into the diagrams**, placing the actors in their associated spatial scale. As the networks may involve many elements, it may help to have sketches of the network(s) on paper and cross off the elements that you have represented in the diagram.



6. **Optional:** If you have used different actor types and represented these in the network graph, make sure you have a legend. Prepare the legend including all relevant elements, for example including actor types and connection types.



7. **Finished.** The creation of the Spatial network graph should have been a valuable exercise itself, but you may also wish to think about how to store/save the graph itself, and share with other stakeholders/users/clients.

Thinking Guide: Once You Have Finished

- What have you learnt, if anything, from creating a Spatial Network?
- Is the value for you, in the process of creating the graph, or in the interpretation of the final graph itself?

Depending on your answer to these questions, you may want to tailor your focus when creating graphs in the future. If the process itself is most valuable, you may wish to broaden the number and type of stakeholders you work with to build the graph. You may also want to devote more time to the process. If it is the final product - the graph itself - that is more valuable, you may wish to focus more on how you can present it most clearly, and how you can communicate it to others.

This material is based on the doctoral thesis of Anne Velenturf, a PhD student based at ERIE.