Participatory modelling

Using system dynamics to involve stakeholders in flood risk decision making in Southwell

FACTSHEET

Project area: *Stakeholder communications*
Intended readership: *Practitioners, academics, interest groups*

Members of the local community in Southwell, Nottinghamshire have been busy building a conceptual model of risk based on their experience of a recent flood event and exploring the potential interventions that the community could employ.

The aim is to develop a causal diagram depicting a shared view of the current problems, pressures and impacts as perceived by the participant group. This will achieved this through the co-production of a simulation model to support analysis of alternative future scenarios. System dynamics was chosen as the technique to support the participatory process. The technique, which has been used for over fifty years to understand the relationships between feedback structure and dynamic behaviour, is particularly useful for supporting the analysis of long term consequences of alternative policies. It is facilitated by graphical software, standard diagramming techniques, and a wealth of case study examples from a range of disciplines.

The workshops were based in Southwell, Nottinghamshire, which experienced flash flooding, primarily from pluvial sources, in July 2013. Difficulties in designing for extreme events such as those of summer 2013 has led to a detailed process of options identification and appraisal. This process is centred on hydraulic modelling of the event being conducted by URS Consultants (in partnership with Nottinghamshire County Council), exploring the potential effects of different management options.

The modelling group

Modelling took place over five workshops, each roughly two hours in length, with interviews before and after to investigate stakeholder views on the process and to evaluate both the process and its short and long-term outcomes. The workshops have been attended by roughly 12-15 stakeholders from a range of organisations, both local and regional, as well as residents and academics. Key partners include Southwell Flood Forum, Nottinghamshire County Council, the Environment Agency, Severn Trent Water, and Newark and Sherwood District Council (Figure 1).

Figure 1: Stakeholders identify risk hotspots

Figure 2: Risk hotspot locations are identified using large scale maps of the catchment

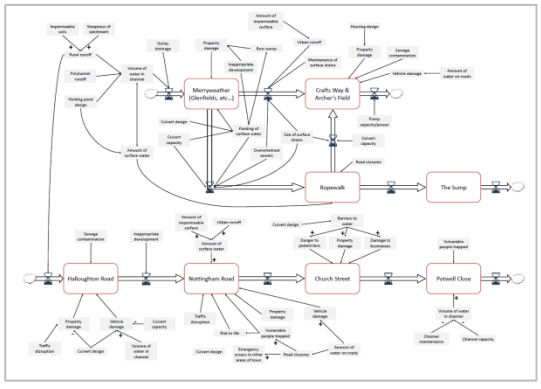

Figure 3: An early stock and flow diagram showing different factors affecting risk at each location

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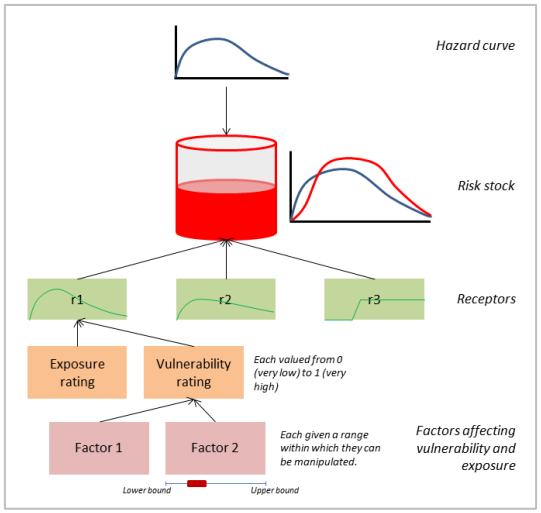

Figure 4: Model schematic showing how a 'risk curve' is derived from the combinations of the risk to each receptor at that location. The risk to each receptor is a function of its exposure and vulnerability, each of which can be changed by altering the relevant factors.

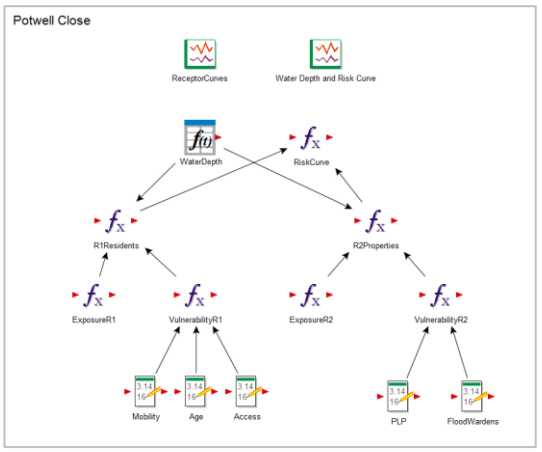

Figure 5: A portion of the model showing one of the eight risk hotspot locations

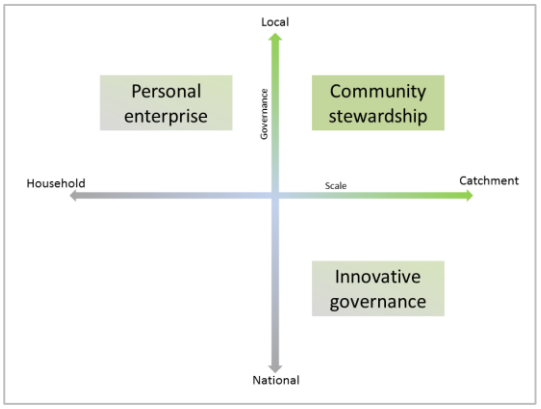

Figure 6: Future scenarios for managing flood risk

The workshops

Prior to the workshop schedule, interviews were conducted with key stakeholders identified in collaboration with Southwell Flood Forum. These interviews sought to identify the key flood risk issues in the community, expectations of the participants, and to establish a baseline of social capacity. The first workshop moved from generic issues to identifying eight physical locations in the town, which represented areas of significant risk (to people, property, safety, assets, etc…) during the 2013 event (Figure 2). These locations identified three clear flow routes through the town, and formed the basis of a conceptual model developed in workshop two (Figure 3). Model development meetings held between workshops two and three further refined the flow diagrams.

In the last of the development workshops (workshop three) the source-pathway-receptor concept was communicated to the stakeholders, as a way of showing how different factors affect the vulnerability and exposure of receptors at each of the eight risk hotspots. Figure 4 shows the structure for the resultant model. A risk stock at each location fills or empties during a flooding event, and is a function of the hazard (water depth) and the vulnerability and exposure of the receptors at that location. With the focus on flood resilience, the group was interested in exploring interventions that affect these levels of vulnerability and exposure. Participants were integral to sketching the relationships between risk and depth for each receptor, and in deciding the relative weighting of each receptor in arriving at overall risk.

The model was built using GoldSim http://www.goldsim.com/home (Figure 5), and plots overall risk and individual receptor risk over 180 time steps (minutes). A testing and validation workshop (workshop four) acquainted participants with the modelling software, and engaged them with adjusting the factor values so that the model represented the current situation in Southwell. Once hydraulic modelling is complete in Southwell, the depth curves for each of the eight locations will be incorporated directly into the model

In the final workshop, participants designed three future scenarios to run in the model, altering the factor values to simulate the effectiveness of different interventions that would be expected under those scenarios (Figure 6). The results of this scenario testing will be disseminated to participants as soon as the hydraulic model results are available. Shortly after, a thorough evaluation will investigate the ability for the technique to deliver both short-term outcomes (based on participants' goals); longer term indicators of social change; and the potential for the technique to be applied in other flood risk contexts.

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