

## Characteristics of induced events

0 1 0 0

### Challenge 4

Frequency of magnitude events

1 2 1 0

Impact of numerous lower magnitude events

Scaling up / development of shale gas

0 0 2 0

Maximum magnitude

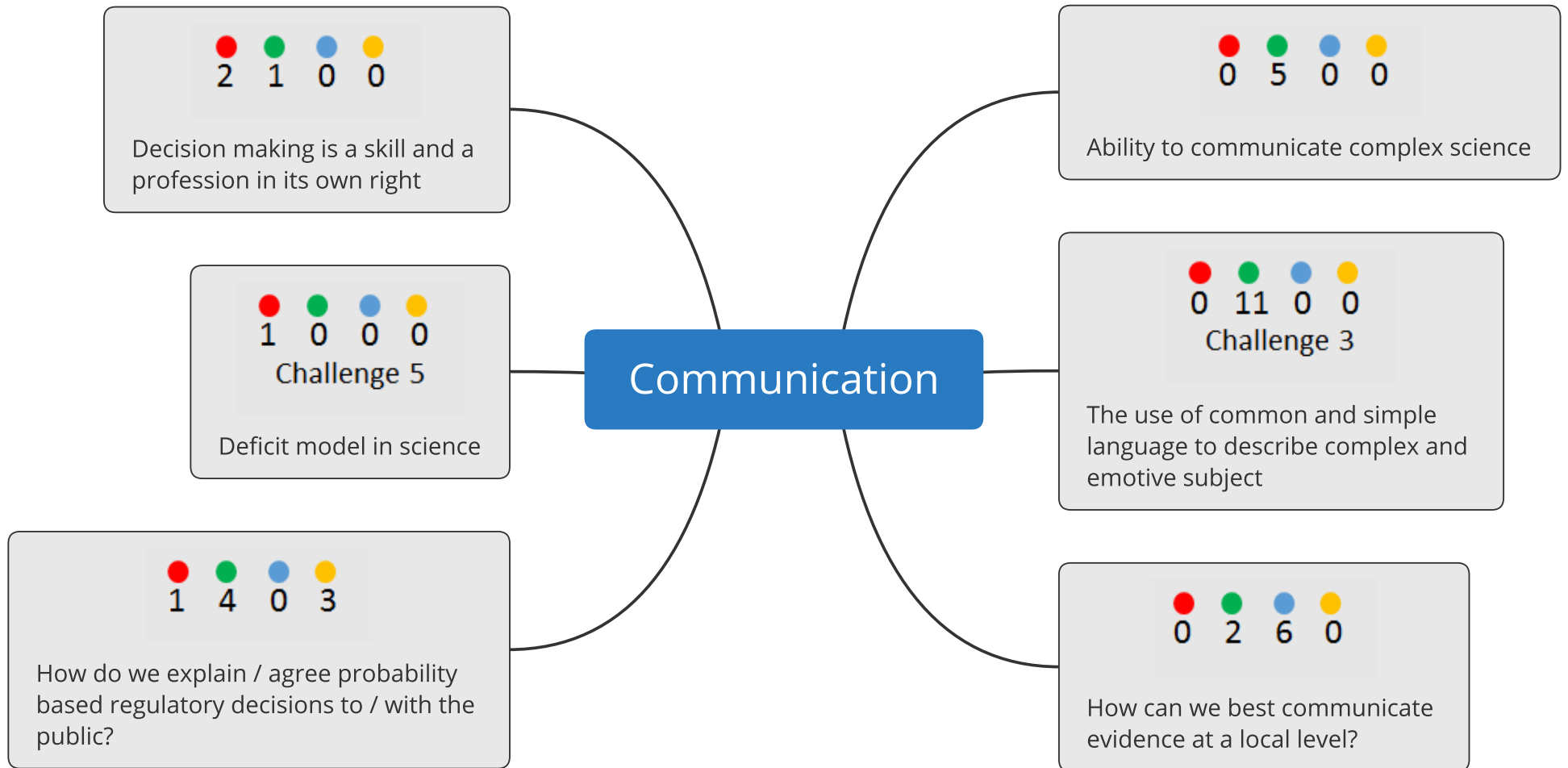
0 0 1 0

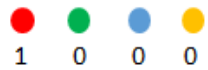
### Challenge 3

Induced vs triggered

1 4 0 0

How robust / reliable are predictive models of Mmax and induced ground motion?

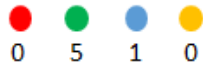




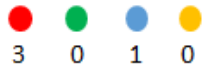
Challenge 3

Why have a TLS for shale gas, but no other subsurface industry?

Comparison and ethics



common / consistent language / terminology

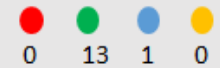


Challenge 5

definition of conventional vs unconventional oil and gas

Language

## Context



Challenge 3

Is what we have seen so far [in Lancashire] representative of what we will see elsewhere?



How do we compare seismic risk with other risks?

0 10 3 0

Why do some hydraulic fracture wells produce lots of induced seismicity and others don't?

0 2 1 0

What the seismicity says about pathways (closed or permeable faults)?

0 4 0 0

Faults / Fractures

Uncertainty in subsurface stress and how this may vary spatially across an area of exploration interest

Maximum horizontal stress regime

Heterogeneity of subsurface rocks and structures

How long will it take for a subsurface stress state to return to normal after hydraulic fracturing has ceased?

High regional stress anisotropy should make it more difficult to induce events, but make bigger events when it happens

1 3 2 0

Stress

How are ground motions modulated by local geology / shallow subsurface characteristics?

Improved characterisation of the shallow subsurface to better constrain ground motion prediction models

Which ground motion models are fit for purpose?

Uncertainties re: long term impact of accumulation of induced seismicity (in US/UK or elsewhere)

0 5 4 0

Challenge 4

Ground shaking

0 0 1 0

Challenge 2

Geological data

2 1 1 0

How much more can we know about induced seismicity without further drilling?

0 5 0 0

Transparency / translation of data and its uncertainty

1 0 1 0

Challenge 5

Trust

Characteristics of induced events

Governance /  
regulation / politics  
and practicality of TLS  
implementation

1 5 5 0

TLS and review (political issue)

Is the TLS the most appropriate way to regulate  
induced seismicity from shale gas extraction?

Challenge 5

Regulator - capacity and scope

On what basis are regulators making decisions?

