Trustworthy Autonomous Systems
Town Hall meeting
Housekeeping

There will be a fire alarm testing at 11am

There are copies of the call document and additional information on the nodes available on your tables
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 – 10:30</td>
<td>Arrival, registration, refreshments</td>
</tr>
<tr>
<td>10:30 – 10:50</td>
<td>Introduction from UKRI and aims of the day</td>
</tr>
<tr>
<td>10:50 - 11:00</td>
<td>Ice breaker table discussion: What’s your interest in TAS and what do you want to get out of the day?</td>
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<tr>
<td>11:00 – 12:00</td>
<td>Guest speakers</td>
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<tr>
<td>12:00 – 12:30</td>
<td>UKRI view on the TAS programme &amp; brief Q&amp;A</td>
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<tr>
<td>12:30 – 13:10</td>
<td>Lunch</td>
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<tr>
<td>13:10 – 14:20</td>
<td>Networking Session 1: Defining the Hub and the research Nodes</td>
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<tr>
<td>14:20 – 14:40</td>
<td>Refreshment break</td>
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<tr>
<td>14:40– 15:10</td>
<td>Networking Session 2: world café - opportunity to explore other tables</td>
</tr>
<tr>
<td>15:10– 15:30</td>
<td>Feedback and closing remarks</td>
</tr>
<tr>
<td>15:30</td>
<td>Close</td>
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</tbody>
</table>
Introduction from UKRI

Anna Angus-Smyth
Head of AI & Robotics at EPSRC
Aims of the day

• To share the context, importance and UKRI’s vision for the TAS programme

• To bring research communities and industrial, government and third sector stakeholders together to foster new collaborations and relationships

• To explain how the TAS programme will be delivered, timelines and specific requirements of the funding
Overview

• UKRI
• AI & Robotics
• An Introduction to Trustworthy Autonomous Systems
The UKRI family

HM Treasury

Department for Business, Energy & Industrial Strategy

UK Research and Innovation

EPSRC
Science & Technology Facilities Council
MRC
Innovate UK
NERC
BBSRC
Research England

Arts & Humanities Research Council
UKRI – Our mission

Delivering UKRI’s vision and the Government target of 2.4% of GDP spend

Deliver economic impact
Create social and cultural impact

Push frontiers of human knowledge and understanding

Foundations for excellent research and innovation
Best environment for research and innovation

Trusted and diverse system
Leading talent
Global Britain
Infrastructure

UKRI as an outstanding organisation (corporate plan)
UKRI – Our values

Collaboration: We will work in partnership with the UK’s diverse research and innovation community

Innovation: We will build on international best practice, learn from what doesn’t work, innovate and take risks.

Integrity: We will be independent and objective, using rigorous analysis and robust monitoring and evaluation.

Excellence: We will ensure quality, value for money and sustainability are embedded in everything we do.
UKRI – working towards 2.4%

In 2015 UK’s expenditure on R&D represented **1.7%** of GDP – below the OECD average R&D intensity of **2.4%**.

The Government has committed to reaching **2.4%** of GDP investment in R&D by 2027, and to reaching **3%** in the longer term. As a first step it will invest an additional **£2.3bn** over what was previously planned in 2021/22. UKRI will work with the Government to develop a roadmap for meeting this target to be published in 2018.
UKRI – opportunities

UKRI National productivity Infrastructure Fund (NPIF) £7bn 2017/19 to 2021/22

So far:

- Strategic Priorities Fund: £580M
  To support research across disciplines

- Talent and Skills: £900M
  To support world-class research and innovation talent

- ISCF: £1.1Bn
  To tackle the big societal and industrial challenges of today

- Fund for International Collaboration: £110M
  To enhance the UK’s excellence in research and innovation through global engagement

- Strength in Places Fund: £120M
  To support areas across the UK to build on their science and innovation strengths
AI & Robotics in the UK

The political profile of AI and Robotics has grown significantly, and continues to do so:

• Industrial Strategy: AI and Data Economy is one of four Grand Challenges
• Hall and Presenti Review ‘Growing the Artificial Intelligence Industry in the UK’
• AI Sector Deal
• Office for AI & AI Council
• Robotics Growth Partnership to “put the UK at the cutting edge of the global smart robotics revolution, turbo-charging economic productivity and unlocking benefits across society.”
UKRI’s Objectives around AI & Robotics

Lead a review of AI across UKRI, which aims to set out how UKRI should support AI research and innovation

Put the UK in a world leading position in AI research and innovation

Lead new investments and manage existing strategic investments

Understand the UK’s position in AI and robotics, UKRI’s investment portfolio, and the activities of others

Understand the landscape, and the opportunities and gaps

Build mutually beneficial relationships with stakeholders

Work with the Office for AI, the Robotics Growth Partnership and stakeholders across the landscape
UKRI – opportunities

Gross Expenditure on R&D as a percentage of GDP

UKRI National productivity Infrastructure Fund (NPIF) £7bn 2017/19 to 2021/22

So far:

- **Strategic Priorities Fund**
  - To support research across disciplines
  - Additional funding from Autumn Statement 2016 and Budget 2017
  - UKRI Capital & Resource Funding

- **Talent and Skills**
  - To support world-class research and innovation talent
  - £580M

- **ISCF**
  - To tackle the big societal and industrial challenges of today
  - £1.1Bn

- **Fund for International Collaboration**
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  - £110M

- **Strength in Places Fund**
  - To support areas across the UK to build on their science and innovation strengths
  - £120M
The Strategic Priorities fund aims to:

- Drive an increase in high quality **multi- and inter-disciplinary** research and innovation
- Ensure that UKRI’s investment links up effectively with **government departments’** research priorities and opportunities
- Ensure the funding landscape system is able to respond to **strategic priorities** and opportunities

<table>
<thead>
<tr>
<th>Wave 1</th>
<th>Title</th>
<th>Total investment £m</th>
<th>Other partners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AI and data science for science engineering and government</td>
<td>39.3</td>
<td>BBSRC, STFC, MRC, NERC</td>
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<tr>
<td></td>
<td>Physics for life</td>
<td>31.2</td>
<td>MRC, BBSRC</td>
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<tr>
<td></td>
<td>Ensuring the security of digital technologies at the periphery</td>
<td>30.6</td>
<td>IUK, AHRC, ESRC</td>
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<td></td>
<td>Climate resilience</td>
<td>18.7</td>
<td>NERC, Met Office, ESRC, AHRC</td>
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<tr>
<td></td>
<td>Clean air: analysis and solutions</td>
<td>19.6</td>
<td>NERC, Met Office, MRC, ESRC, IUK, NPL</td>
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<tr>
<td></td>
<td>Landscape decisions</td>
<td>10.5</td>
<td>NERC, ESRC, BBSRC, AHRC</td>
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<tr>
<td></td>
<td>Constructing a digital environment</td>
<td>10.4</td>
<td>NERC</td>
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**Wave 2**

11 programmes have been announced so far
EPSRC – Big Ideas

• Big Ideas is a project that is developing a framework to identify and prioritise new “Big Ideas” from the research community
• Provides a mechanism to being able to respond to a changing environment
• Ensuring our community are ready to articulate their ideas in a manner that appeals to government audiences
• The Trustworthy Autonomous Systems programme is an output from this process
Trustworthy Autonomous Systems

- Trustworthy Autonomous Systems is EPSRC’s first ‘Big Idea’ that was co-developed to bid for and successfully obtain funding through the Strategic Priorities Fund
- The big idea was originally submitted by Michael Fisher @ the University of Liverpool
- Our successful SPF bid was made at a UKRI level in partnership with AHRC, STFC, ESRC, Innovate UK, and UKSA
- The bid was also originally supported by DfT, MOD, DSTL, the Home Office, National Security and Intelligence, CPNI, UKAEA, CCAV, the Royal Academy of Engineering, Lloyds Register Foundation, and a number of representative companies
Trustworthy Autonomous Systems

Trust in Technology
• Benefits, safe and reliable, well regulated, can be investigated, has public support.
• Many scenarios where technology is not trusted

Autonomous Systems
• Range of systems – software to robotics, can include AI
• Gain information, potentially learn, adapt & make decisions
• Varying levels of autonomy & control

Trustworthy Autonomous Systems might be...
Designed, tested, verified and regulated within an understanding of human expectations, legal constraints, and ethical considerations, and ensuring that they do not reflect human biases, either conscious or unconscious.
Objectives of the Programme

a) **Coordination and collaboration** - To build a coherent, interconnected and multidisciplinary UK research community around the theme of Trustworthy Autonomous Systems, bringing together pre-existing activities and a diverse range of stakeholders.

b) **Creativity and multidisciplinarity** - To invest at scale in world-leading creative and adventurous fundamental research into the technical, social and ethical challenges surrounding Trustworthy Autonomous Systems, drawing on diverse approaches from across disciplines.

c) **Advocacy and engagement** - To establish a UK focal point for active engagement with the autonomous systems agenda and enable engagement with key stakeholders including wider academia regulators, policy makers, industry, businesses, Non-Governmental Organisations and the public.
How the programme will be delivered

- Trust
- Responsibility
- Legality
- Resilience
- Verifiability
- Functionality
- Security

Hub
Provides coordination
Leads on advocacy and engagement activities
Aims of the day

• To share the context, importance and vision for the TAS programme

• To bring research communities and industrial, government and third sector stakeholders together to foster new collaborations and relationships

• To explain how the TAS programme will be delivered, timelines and specific requirements of the funding
What is in for you?

- Understanding the programme (context, objectives, delivery)
- Awareness of the specific requirements associated to this funding stream
- Early engagement
- New ideas
- Networking and Multidisciplinarity
A question for you:
What’s your interest in TAS and what do you want to get out of the day?
Jamie Hodsdon
Centre for Connected and Autonomous Vehicles
Established in 2015, with the mission of ensuring the UK remains a world leader in CAV technology development and deployment

- A clear regulatory pathway
  - Automated and Electric Vehicles Act 2018 (insurance framework)
  - 3 year regulatory review - Future Primary Legislation
  - Code of Practice (updated Feb 2019)

- Joint investment in R&D
  - £230m investment into R&D
  - Over 200 organisations
  - 81 collaborative R&D projects

- An integrated testbed ecosystem
  - £200m investment into testing
  - Meridian mobility hub established
  - 6 testbeds

Over 200 organisations involved in 81 collaborative R&D projects. £230m investment into R&D and £200m into testing. Meridian mobility hub established with 6 testbeds.
What happens when you remove the human?
Who was that person?

- The person we trusted to do the ‘right’ thing
- The person we tested, to various degrees, to perform as expected
- The person we hold to account if things go wrong
We’re asking a system to make decisions previously reserved for humans
Terra Incognita

- We don’t know what we don’t know
- We need to ask high-level questions to shape sector-specific questions
- This is where the Trustworthy Autonomous Systems programme comes in
How safe is safe enough?
Highly and fully automated vehicles (AVs) have no driver, challenging existing safety assurance schemes.

International exemptions could mean AVs are introduced on UK roads before we’re ready.

We need to be prepared for trials without a driver.
How does an ethical machine behave?
Beyond the trolley problem

- Whose ethics?
- Who’s responsible?
- What would the human do?
Is the law up to the task?
A new paradigm

- Can no longer focus on the driver
- Safe deployment
- The transition
Thank you

jamie.hodsdon@ccav.gov.uk

gov.uk/ccav

@ccavgovuk
Technology isn’t scary, what’s scary is us…. and what we will do with technology”

The true question is not whether technology is scary, it is, how human are you?”
How will governance differ, and in what ways, if the earning of trust was considered systemically throughout the design process?

But trust is a feeling - so our project takes into consideration the ‘science of human thinking’. Focused on understanding:

- The psychology of trust & why it matters to society & governance
- The biases we all have which blind us to important issues - particularly ‘expert’ biases
- Understanding ‘how people really think and act’ incorporated into design, process and delivery
Trust?
“How can we restore trust? is on everyone’s lips.

The answer is pretty obvious.

First: be trustworthy.

Second: provide others with good evidence that you are trustworthy.”

Baroness Onora O’Neill
Winner 2017 Berggruen Prize

(but psychology tells us, one person’s evidence is another’s propaganda!)
But trust is contingent…

- We wouldn’t trust our bus driver to fix our central heating…
- …or a bank to run air traffic control

And about specific expectations fulfilled

- Important to know what those expectations are
Drivers of potential distrust - new tech = new challenges for governance process

- **New concepts of human rights** - privacy, genetic discrimination, self expression, access to benefits, equality of opportunity

- **New dilemmas** - meds vs human enhancement; personal privacy vs public goods; eco sustainability vs human development

- **New context** - new products eg ‘digital consumer manipulation’ & consumer law

- Growing expectation of ‘**democratisation**’ of governance in critical areas of tech and human development
Respect
- dignity, fairness

Respect = single most powerful determinant of perception of fairness and justice

- Respectful dealings on a personal level
- Respect shown for one’s perspective
- Noticeably embedded in purpose, process and outcomes?
Fairness
- impartiality, equality

- Fairness and unfairness - critically important to human psyche
- Already an important consideration in law in many areas
- Fairness in process really helps in trust where there are values clash judgements
  - Respectful treatment throughout
  - Voices - listened to, heard and evidence they contributed
  - Honest, understandable explanations for decision-making processes & outcomes
Inclusion
- diversity of views, which count

- Equal inclusion and reflection of all perspectives in decision making

- My voice and my ‘tribe’s’ voice really counts

- Importance of listening to, respecting & responding to views you disagree with

- Respectfully listening is one thing, but changing behaviour based on the opinion of someone who’s opinion you don’t value - does that ever happen - I rarely do it - do you!? 
For every complex problem there is an answer that is clear, and simple, and wrong.

H L Mencken

Beware our need for ‘the way’…
Chris White
Lloyd’s Register Foundation
Engineering a safer world
Critical infrastructure is vital to modern society.

Lloyd’s Register Foundation is an independent global charity that helps to protect life and property at sea, on land, and in the air.

To do this, we support education, engineering-related research, public engagement, and promote scientific excellence.
21st century model for doing business

Commercial business:
Delivering global engineering, technical and business services to our clients and the sectors we serve

Charity:
Providing grants and undertaking direct charitable activities for the wider benefit of society and communities we serve internationally

Working together for a safer world
Our vision:
Engineering a safer world

Goal 1:
Establish the best evidence and insight

Goal 2:
Focus on the most pressing challenges

Goal 3:
Build global coalitions for change
Goal 2: Focus on the most pressing challenges

- Safety at sea
- Safety of food
- Skills for safety
- Safety of digital systems
- Safety for a sustainable future
- Safety of physical infrastructure
- Public understanding of risk
There is much to build on

Suggested priority areas

<table>
<thead>
<tr>
<th>Openness and Sharing</th>
<th>Assurance and Certification</th>
<th>Security and Resilience</th>
<th>Public Trust, Understanding and skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Data Standards</td>
<td>Asset self certification</td>
<td>Cyber security of RAS</td>
<td>Ethical and trusted RAS frameworks</td>
</tr>
<tr>
<td>Open Data Sets</td>
<td>Assurance of RAS Learning Systems</td>
<td>Software system integrity</td>
<td>Assured skills for RAS</td>
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<tr>
<td>Shared Curation of RAS knowledge</td>
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What are LR Group and Foundation Supporting

[Link: https://www.york.ac.uk/assuring-autonomy/about/]
What are LR Group and Foundation Supporting


LR Safety Accelerator
What are LR Group and Foundation Supporting

https://www.lr.org/en-gb/aurora/

LR Aurora
Thoughts

- Society
  - International development
  - Health
  - Quality of life
- Your research
  - Policy
  - Knowledge
    - Scientific advances
    - Techniques
- People
  - Skills
  - People pipeline
- Economy
  - Wealth creation
  - Inward investment
  - New companies
  - Products & procedures
Rob Richardson
Chair of the EPSRC UK-RAS Network
Professor Robert Richardson, University of Leeds
UK-RAS NETWORK:

Membership

Membership continues to grow as awareness of the UK-RAS Network increases.

29 University Partners to date

UK Robotics Week

UK Robotics has now been firmly established and supported by increasing participation and media coverage.

Run for 4 successive years

Each Showcase Event has featured:

- < 25 Speakers
- < 30 Sponsors
- < 500 Delegates
- < 53 Countries / 5 Continents
- < 20 Robot Demos
- < 40 Exhibitors

(average nos. over 3 years)

Challenges

The Challenges has been a huge success, with international participation and industrial collaboration.

9 Challenges established

- School Robot Challenge: participation from over 100 schools and 1000 students;
- 2 Film Challenges: ‘Finding Lucy’ (Extreme Environments) & ‘Moving Forwards’ (Health & Social Care);
- Autonomous Driving Challenge
- Field Robotics Challenge
- Health & Social Care Challenge
- Resilient Infrastructure
- Surgical Robot Challenge

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(average nos. over 3 years)
Cambridge Dictionary definition of trust is:
“to believe that someone is good and honest and will not harm you, or that something is safe and reliable; to hope and expect that something is true”
Download PDF
Ethical Issues for Robotics and Autonomous Systems

Download PDF
Surgical Robotics: The Next 25 Years, Successes, Challenges & the Road Ahead

Download PDF
Space RAS: Widening the Horizon of Space Exploration

Download PDF
Robotics for Emergency Response, Disaster Relief & Resilience

Download PDF
RAS for Resilient Infrastructure

Download PDF
Urban Robotics & Automation

Download PDF
Robotics in Social Care: A Connected Care EcoSystem for Independent Living

Download PDF
Manufacturing Robotics: The Next Robotics Industrial Challenge

Download PDF
Agricultural Robotics: The Future of Robotics Agriculture

Download PDF
Artificial Intelligence & Robotics
Robotics & Autonomous Systems

Existing investments

- Hubs
- Capital infrastructure
- Programme Grants
- Philanthropic initiatives
- Private (industry) investments

What’s new here?

- Interdisciplinary
- Fast-paced and evolving
- Global outlook
- High stakes
**Trustworthy Robotics & Autonomous Systems**

*Technology is trusted if it benefits us, is demonstrably safe and reliable, is well regulated, and can be investigated if errors occur* – RAS are not there yet

Trust and justified confidence have the potential to accelerate technology adoption, job creation, and prevent a backlash against RAS BUT only if trust is not misplaced.

The UK is a trusted source for research, and has a history of international leadership in legal, ethical, regulatory, and safety reform.
Trust includes:
• Legality, accountability and regulation
• Confidence and verifiability
• Safety and Security
• Responsibility and ethics
• Social acceptability and interaction
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UKRI view on the programme

Victoria Mico
Senior Portfolio Manager, AI & Robotics at EPSRC
Overview of the programme

- UKRI is investing £33 million through the Strategic Priorities Investment Fund
  - Up to £12 million for a central Hub
  - Up to £21 million for several research nodes
Programme delivery

- Central **Hub** to build a world-leading multidisciplinary research community
  - Provide coordination to the programme
  - Lead on advocacy and engagement activities
  - Conduct research into cross-node issues
  - Deliver pump prime funding

- Several **research nodes**, each focusing on one aspect relevant to the programme
  - Deliver creative, multidisciplinary research
  - Collaborate widely with other nodes and the Hub
Features of the programme

• Cross-UKRI activity – multidisciplinarity is expected
• Pump prime funds for flexibility
• We expect this programme will NOT focus on applications
• To be funded through the Strategic Priorities Fund
  • Specific reporting requirements – quarterly progress reports
  • Fixed start and end dates
  • Fixed financial spending profile – grant extensions will be an exception
Programme delivery

UKRI TAS programme

a) Coordination and collaboration
b) Creativity and multidisciplinarity
c) Advocacy and engagement.

Hub

Leads on coordination
• Building an interconnected community

Leads on advocacy and engagement
• Engaging with stakeholders proactively

Nodes

Deliver against the creativity and multidisciplinarity objective
• Undertake focused, fundamental research

Collaborate within and beyond the programme
The Hub

Aims:

• Central body for programme and community coordination

• Single point of contact for the community and key stakeholders in industry, businesses, government, regulation, policy making and the public

• Capable of undertaking cross-cutting research to complement the activities conducted within the programme

• Advocate for TAS research
The Hub

What we think good looks like:

• Builds a connected, coherent and multidisciplinary world-leading community
• Facilitates community engagement and international collaboration
• Creates an inclusive environment where creativity can thrive
• Allocates pump priming funds through a competitive, transparent and efficient process
• Undertakes highly cross-disciplinary research to complement the nodes’
• Engages proactively with stakeholders, including the public
• Provides a clear, single point of engagement, simplifying the landscape
The research nodes

- Undertake creative, fundamental research focused in one topic (as below)
- Collaborate with other nodes, the Hub and the wider community
- Explore new research directions through accessing the pump prime funds
The nodes

What we think good looks like:

• Collaborate widely with other nodes and the wider community
• Work closely with the Hub to deliver the objectives of the programme
• Designs and undertakes creative, focused fundamental research
• Build a multidisciplinary team appropriate to address the topic
• Address new and emerging areas of research through accessing the pump prime funds managed by the Hub
• Engage with stakeholders to design application-oriented research
• Provides a clear, single point of engagement, simplifying the landscape
Delivery timeline

Hub Outline Call launches 18/10
Hub deadline for Outlines 16:00 12/12
Hub Outline panel wb 27/01
Hub Full Proposal deadline 16:00 12/03
Hub Full Proposal interview wb 20/04
Hub fixed start date 1/06


Town Hall meeting
Nodes Outline Call launches
Nodes deadline for Outlines
Nodes Outline panel
Nodes Full proposal deadline
Nodes interview panel
Nodes Fixed start date 1/10

Tentative timeline

PPR
The benefits

By the end of the programme, we expect:

• A connected, multidisciplinary TAS community built around a single coordinating body
• A world-leading environment that attracts talent and investment
• The UK to be recognised as a world leader in TAS research
• New tools, techniques and approaches to designing TAS
• Applicability and benefits of fundamental research in TAS demonstrated
• A clear single point of contact for TAS expertise
• Design for trustworthiness
• Accelerated adoption of autonomous systems
Next steps

• Copies of the call document and additional information on the research nodes are available on your tables (call document also online)

• We will have an UKRI ‘drop-in’ table during the networking session

• Free parking space available for comments or questions

• Presentation and outputs from the day will be published alongside the call

• We expect you to share your knowledge with your colleagues at your institution
Lunch
Networking session 1

Defining the Hub and the Research nodes

- Nine tables to discuss:
  - Hub- table 14
  - Node 1: Trust- table 5
  - Node 2: Responsibility –table 12
  - Node 3: Resilience- table 7
  - Node 4: Security- table 3
  - Node 5: Functionality- table 15
  - Node 6: Verifiability- table 10
  - Node 7: Legality- table 9
  - Bonus table: UKRI drop-in –table 1

Rules:
1. Rotations every 25min approx. – everyone must move
2. Tables have limited capacity – please distribute equally across the room
3. Please write your discussions down – will be made accessible to all
Networking session 2

World Café

- Move freely around the tables
- Add any additional thoughts
  - Who else should be involved?

Rules:
No additional rules!
Feedback and closing remarks
Thank you