DISRUPTORS AND ENABLERS OF RESEARCH FOR DEVELOPMENT (R4D) EXPLORING FUTURES FIRST REPORT

Fiona Marshall , Mari-Lise Du Preez , Brigid Cakouros , Rika Preiser , Tanja Hichert

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CENTRE FOR SUSTAINABILITY TRANSITIONS

DISRUPTORS AND ENABLERS OF RESEARCH FOR DEVELOPMENT (R4D)

EXPLORING FUTURES

FIRST REPORT

This report contains work by: Fiona Marshall, Mari-Lise Du Preez, Brigid Cakouros, Briter Bridges, Rika Preiser, and Tanja Hichert

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US UNIVERSITY OF SUSSEX

BRITER BRIDGES

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1. Introduction and rationale

This report is presented as a deliverable of the "Disruptors and Enablers of Research for Development (R4D): Exploring Futures" project undertaken by the UNESCO Chair in Complex Systems and Transformative African Futures located at Stellenbosch University, which is supported by an International Development Research Centre (IDRC) grant.

The project, which is global in scope, aims to use strategic foresight to assist R4D actors and stakeholders, e.g., funders, the relevant research institutions and other supporters, to be better prepared for the longer-term future., meaning the future beyond typical planning and economic cycles, e.g., at a minimum 10+ years, but not so long that it becomes difficult to imagine sensibly, e.g.,30+ years.

Like most subject matter these days R4D operates in a volatile, uncertain, complex and ambiguous (VUCA)[1] contextual environment and this necessitates new, different ways of working that can inform decision-making. Strategic foresight is one such new way of working.

The future – in this case the future related to R4D -- cannot be predicted or foretold, but one can build knowledge about the factors that shape the future, and one can imagine a range of different futures to help with strategic decision-making today. These factors, often called driving forces, or drivers, include not only challenges like persistent inequalities, climate change, technological disruption and increasing fragility, but also new (unexpected) disruptors aka shocks such as the Covid-19 pandemic and a war in Europe. Because drivers and disruptors can have extensive social, economic and political implications, they shape the future trajectory of R4D in a myriad of ways, e.g., changes in public spending patterns, social norm changes, security and mobility of researchers, access to data and research infrastructure, etc.

This project entails not only working with drivers and anticipating disruptors and emerging challenges, but also being able to better identify opportunities in the shape of enablers and catalysers that can be leveraged.

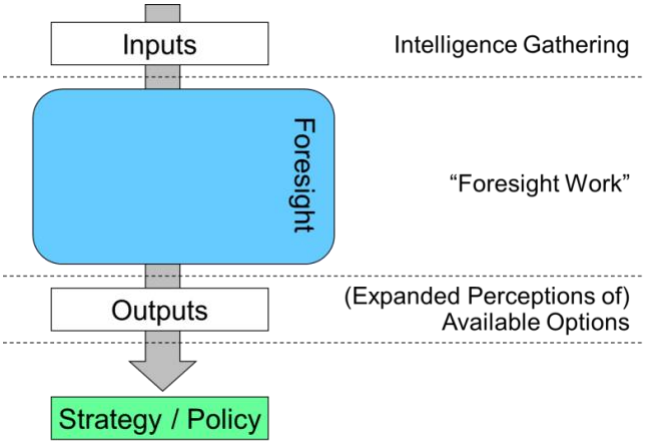
The objectives of this project are to:

- Generate structured and systematically derived ideas about the future of R4D and its operating environment, in particular ideas that centre around the change drivers (including disruptors and enablers) that affect R4D.
- Explore the impacts, implications and cascading waves of change brought about by these disruptors and enablers on R4D actors.

[1] VUCA is a term originating from the US Army and refers to current operating conditions where volatility reflects the speed and turbulence of change. Uncertainty means that outcomes, even from familiar actions, are less predictable. Complexity indicates the vastness of interdependencies in globally connected economies and societies, and ambiguity conveys the multitude of options and potential outcomes resulting from actions.

- Produce knowledge and foresight analysis of R4D futures that can contribute to strategy adaptation, greater organisational resilience, agility and clarity about the challenges and opportunities that could populate the unfolding future contextual environment of R4D.

The project will utilise a range of participative futures/foresight methods tools and approaches including i) horizon scanning, ii) morphological scenarios, iii) futures wheels and iv) three horizons frameworks. Sharing and disseminating the knowledge products and findings of this project will be a key element of this undertaking.



The project is structured according to the Generic Foresight Process Framework[2] as illustrated in Figure 1. This framework approaches strategic foresight as a broad sequence of 'knowledge-seeking activities' that moves through 'phases'. These phases are best considered as over-lapping 'foci of activity' rather than rigidly separated 'steps'.

Figure 1. Simplified version of the Generic Foresight Process Framework

The generic foresight process framework's phases range from the gathering of information as *Inputs*, then *Analysis*, towards critical Interpretation of these inputs, to the actual generation of 'forward views' or 'images of the future'— what is sometimes called '*Prospection*'— and then to the generation of specific *Outputs* aka generating options that may themselves become inputs to further strategy-creation, product development, analyses and/or planning processes.

This report covers the *Inputs* and analysis of inputs – also known as intelligence gathering – phase of the project.

Phase 1 of foresight approach

The intelligence gathering phase is about seeking information that will feed into the foresight phase of the project, and many methods, techniques and frameworks exist, of which horizon scanning – section 3 of this report – is perhaps the best known.

Horizon scanning is the 'art' of systematically exploring the external, aka contextual, environment to better understand the nature and pace of change, and to identify

[2] Voros, Joseph. "A generic foresight process framework." *foresight* 5, no. 3 (2003): 10-21.

potential opportunities, challenges, and likely future developments relevant to the field or topic under consideration.

Horizon Scanning focuses on surfacing early signs of potentially important developments through both exploratory research and a systematic examination of potentialities–both positive and negative in scope. By systematically exploring the contextual environment horizon scanning helps us to better understand the nature and pace of change, and to identify potential opportunities, challenges, and likely future developments relevant to the field or topic under consideration - in this case R4D.

For this project more than 200 scanning 'hits' were collected in a purpose built interactive database. Scanning hits typically describe events, innovations, policy shifts, social developments, changes in the way people use technology, emergent ideas and more. A scanning hit is regarded as useful if it

- helps you understand your issue,
- identifies a new way of seeing the issue,
- challenges existing assumptions underpinning current polices and practice,
- aims to identify and assess possible future threats and opportunities, including radical alternatives, and
- helps you to explore trends and their potential impacts.

A knowledge graph was constructed using hits deemed megatrends or drivers of change for R4D, and hits considered to be potential disruptors or enablers of R4D were identified as such. This addressed the specific research question of: "What are the major disruptors and enablers creating risks or opportunities for R4D and R4D alliances/partnerships in future (2030 – 2045)?" More details of the horizon scanning process and output follow in section 3 below.

The contextual environment covered by horizon scanning is all about the outside/ external environment, where we look for those factors, including driving forces, that shape the future of the topic under consideration. It is the broader overarching space that encircles or encompasses the transactional space[3] in which R4D operates.

R4D stakeholders can interact (influence, collaborate, co-design, etc.) in the transactional environment, but can only survey and adapt to the contextual environment where meta level driving forces (or megatrends) play out, e.g., geopolitics, climate change, demographics.

To gather information about the transactional environment, the first phase also involved ideas and insights through brainstorming or through what is called

[3] Based on Van der Heijden, Kees. *Scenarios: the art of strategic conversation*. John Wiley & Sons, 2005.

'constructing the near-future context'[4] – asking a set of key questions, designed to open out the thinking about the near future of the topic and its transactional environment. This approach is commonly referred to as *foresight framing*. For this project, a collective mapping exercise was used to identify the key challenges, attributes, and other important aspects of R4D. This is presented in section 2 of the report. It is important to note the following:

- Similar issues can crop up in horizon scanning and foresight framing. They are to be viewed through a different lens, though. As either in the contextual environment where the larger future is playing out, or in the transactional environment, where R4D actors can and do interact with these issues. Think of it as issues either in the background (horizon scanning derived) or in the foreground (identified by means of foresight framing). The boundaries between the contextual and transactional environments are also not 'hard' borders.
- Both the horizon scanning and foresight framing content presented here deal with change. A prime foundational concept of foresight is that the discipline is about change[5], in this case transformative change in R4D (as opposed to linear or incremental change). As a result, a good deal of attention is paid to exploring change in its various dimensions as the future typically changes at three levels: the organisation, the organisation's immediate environment (transactional) and the global environment (contextual).
- Foresight methods, especially those that will be utilized in phase 2 of the project, are deemed appropriate for addressing divergent viewpoints and power asymmetries. They provide a platform for stakeholders to examine and negotiate different perspectives on desired and alternative future outcomes. As a knowledge integration method, foresight methods assist in clarifying some of the complexities (such as those mentioned in the foresight framing section below) and uncertainties faced by R4D actors and stakeholders.

The final section of this report sets out the next phase of this project and provides a brief explanation of what is required for that.

[4] Slaughter, R A. 1996. "Mapping the future: creating a structural overview of the next 20 years", Journal of Futures Studies, Vol. 1, no.1, pp. 5-25.
[5] Bishop, P. & Hines, A. 2012. Teaching about the future. Palgrave Macmillan

2. Foresight framing

Foresight framing was undertaken to establish some clarity and boundaries around a 'unit of analysis' for deployment of futures methodologies. It is this agreement upfront, which is often an iterative process, that helps make exploring ideas about futures – that do not exist – a structured and systematic exercise. For this project, a graphic element is added as it will contribute to sensemaking of what might otherwise seem an overly complex topic.

The specific objective of the foresight framing process was to create a map of R4D landscape 'issues' – including key opportunities, challenges, ideas and debates. In line with the overall project goals, the R4D issues selected for the foresight framing were all connected to perspectives on transformative change, and on how change happens. A framing map was developed to organise these issues into domains and to highlight interactions between them across the R4D system.

The foresight framing exercise focused on issues as understood and articulated from 'inside' the R4D system. It did not try to address wider drivers of change that sit 'outside' but have influence on the R4D system; these were part of the horizon scanning exercise.

The process was intensive, consultative and iterative, and took place from November 2022 to February 2023. The issues included in the R4D map were based on published literature, insights from relevant contemporary panel debates/events, insights from the authors' research careers, and consultations with team members and relevant expert stakeholders. The issues were also informed by the mapping of country level science, technology and innovation systems in an earlier IDRC project on foresight for new collaborative platforms to support LMIC science systems.[6]

Two group consultation workshops were organised based on a draft version and presentation of the R4D map, and this was followed by a consultation with the projects' Reference Group. Feedback was incorporated into a further iteration of the map. With a rapid process such as this, there are inevitably blind spots (including those due to lack of consultation with non-traditional donors, diverse research users

[6] That work looked in particular contexts at the current directionality of science, technology and innovation and what sort of factors are reinforcing that, and then highlighted gaps, barriers and opportunities in relation to addressing sustainable development objectives as identified in that context. It allowed one to locate seeds of change or weak signals in relation to the wider system and reflect back on the attributes of the system that will enable them to flourish. For the R4D foresight framing, the starting point enabled a focus on a part of that science, technology and innovation system (R4D) and honed in a bit more on emerging system attributes that support weak signals.

etc.). The purpose of the foresight framing exercise was not intended to comprehensively cover all aspects of all R4D transformative challenges, but rather to provide input into foresight workshops involving scenarios, implications analysis and systemic change frameworks. In essence the foresight framework content serves as a prompt for discussion, debate and questioning.

Defining R4D

There are multiple definitions of R4D, which appear to have largely evolved from northern development agencies and from various practice traditions. All are concerned with embedding research and research evidence into development processes and development impact. However, there is considerable variation in emphasis on priority focal areas and approaches to be deployed. Whilst we recognise various established R4D definitions, this current initiative will also unpack and challenge the assumptions that underpin them, as part of the process of exploring transformative change.

The IDRC Act defines research for development as "research into the problems of the developing regions of the world and into the means for applying and adapting scientific, technical and other knowledge to the economic and social advancement of those regions" International Development Research Centre Act (justice.gc.ca)

Our working definition from the original proposal for this study was amended from (Currie Alder, 2014)[7] as follows:

"R4D entails systematic activity that development agencies, philanthropies, bilateral donors, specialised agencies and others engage in to enhance knowledge-based development. It is done for different underlying reasons with different goals, e.g., to

- 'influence' those, such as policy- and decision-makers, who 'drive change in pursuit of development goals',
- to generate knowledge and evidence about foreign aid,
- to invent new technologies to serve marginalised people (changed from 'poor' people in the original source), and
- to strengthen research capabilities in low and middle income (LMIC)/ emerging countries (changed from 'poor countries)."

The Currie Alder definition goes on to say that "R4D funders in particular pursue multiple approaches including funding researchers 'at home, abroad in developing countries, or collaboration between these two groups."

[7] Currie-Alder, B. 2014. "Changing Governance of Public Research: Research-for-Development (R4D) Funders in the United Kingdom, Canada and Australia." PhD diss., Carleton University, 2014.

This definition doesn't pay explicit attention to the central role of equitable partnerships and institutional change/innovation.; or to addressing persistent inequalities in the research landscape, for example, promoting capacity building to reduce persistent inequalities in the research landscape.

The following was added to the definition for the purposes of the foresight framing: *learning from and enhancing development practice on the ground*.

It reflects a key feature of some of the alternative definitions available. For example, the CGIAR challenge programme on food and water defined R4D as "an engagement process for understanding and addressing development challenges defined with stakeholders. Stakeholders are champions and partners in the research process as well as the change it aims to bring about." (Hall, 2013)[8]. And it is exactly this learning from development practice on the ground that forms the basis of many of the issues presented in the foresight framing exercise.

Research for development systems[9] refers to a framework that integrates research and development processes to address complex social, economic, and environmental issues in developing countries. It involves the collaboration of various stakeholders, including researchers, policymakers, farmers, and communities, in identifying research priorities and developing solutions that are context-specific, participatory, and sustainable. The research for development system is embedded in a wider science, technology and innovation system which encompasses the actors, institutions and processes involved in the development and diffusion of scientific knowledge and innovation.

R4D actors include academia, business, government, civil society, community-based organisations and philanthropists alongside bilateral, multilateral and south-south international research and development agencies, research institutes and think tanks – and potentially others.

The 'transformative challenge' as the entry point to R4D mapping

To establish a suitable and appropriate 'focus of enquiry' for the futures work, the exploration began with a review of perspectives on the challenge of transformative change in R4D. The foresight framing activity all evolved from this entry point, with periodic references made back to it for reflection.

For the purposes of this exercise 'transformation' in R4D was framed in terms of its role in contributing to transformational development pathways to meet societal needs. The focus of this exercise was on how R4D can respond to transformation al

[8] Hall, A. 2013. "The Challenge Program on Water and Food: opportunities for adding value to experiences of using research for development (R4D)" Available at: CPWF-Hall-R4D-Report-8-August-2013.pdf (publishing.service.gov.uk
[9] Francis, J., Mytelka, L., Huis, A. van and Röling, N. (Eds.). 2016. Innovation systems: Towards effective strategies in support of smallholder farmers. Wageningen, The Netherlands: Technical Centre for Agricultural and Rural Cooperation and Wageningen University and Research Centre.

challenges and play a more effective role in offering more just and context relevant responses. The underlying premise was that R4D has delivered development gains and has the backing of Western funders but is associated with several areas of concern and has failed to reach its potential in supporting widespread sustainable transformative change. There are both long-standing persistent challenges, and new emergent unpredictable challenges and opportunities on the horizon to embrace.

Thus, the rapid foresight framing process attempted to summarise and provide examples of a diversity of issues concerning:

- Imperatives for transformative change in R4D – relating to its contribution to addressing current and emergent development challenges. Here transformative change refers to the transformations in how R4D takes place that will contribute to a transformative R4D system which is better able to support transformational development pathways.
- The attributes of transformative R4D systems, and
- Change processes – promising developments, challenges and neglected areas in R4D policy and practice.

There is widespread acknowledgment that achieving systemic change necessitates a focus on learning and adaptation throughout various components of a system, involving actors and networks. It also requires attention to the types of institutional and governance structures, resources and capabilities that foster systemic change processes. Furthermore, there must be a critical focus on the leverage points that facilitate the transition from incrementalism to systemic change, or at least the concurrent evolution of the two. The analytical framework created for the foresight framing aimed to prevent the inclination to concentrate solely on incremental developments in various parts of the R4D system. Instead, it was designed to cast light on concepts and emergent initiatives that have the potential to make a meaningful contribution to more extensive systemic change processes.

The structure of the foresight framing map is indicated in Figure 2 below and is unpacked in the following sections of this report.

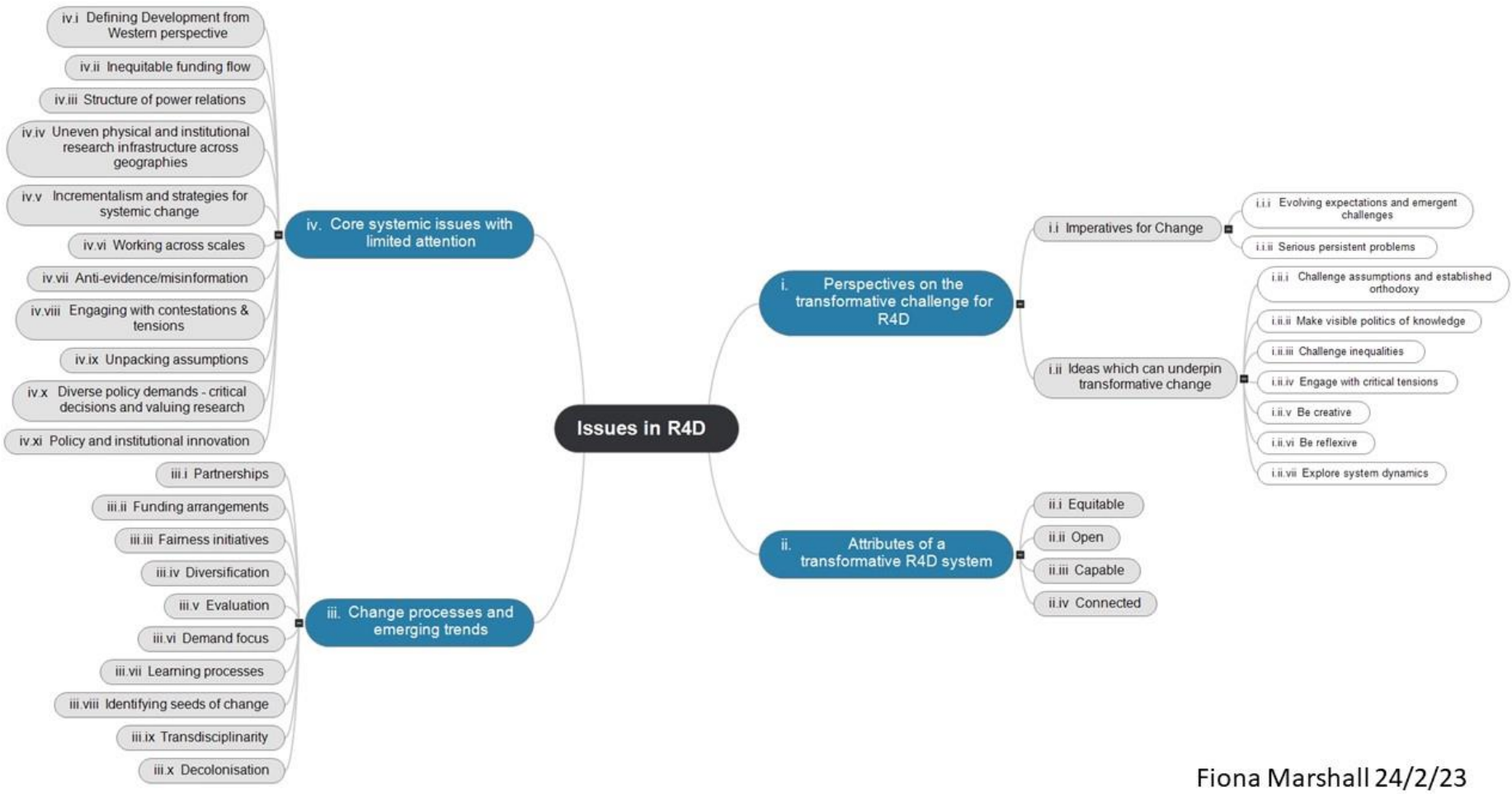


Figure 2: Overview of the R4D 'issues' landscape map with core issue areas identified (labelled i-iv) and example issues

Perspectives on the transformative challenges for R4D

Diverse perspectives on the transformative challenges facing R4D were considered in terms of both the imperatives for change, and ideas on ways of thinking and doing which will underpin processes of transformative change.

Imperatives for change

These were considered in terms of the need to i) respond to an increasingly complex and challenging development agenda, alongside the aim to ii) address persistent problems or concerns with R4D initiatives and impacts to date.

Our first imperative for change was the need for transformational development pathways (involving fundamental systemic change across economies and societies) (Leach et al. 2018)[10] which will in turn need transformative knowledge; in terms of its focus, how it is produced and how it is mobilised for change (IGS, 2019)[11]. It is essential for R4D to more effectively contribute to the transformative knowledge systems required.

Other issues noted here included the changing social contract between science and society; the need to maintain momentum in priority areas in the face of a VUCA world and the need for agility in the face of crisis, instability and conflict.

Serious and persistent problems that have been identified included the following:

- Exclusionary: in terms of problem framing, research process, mobilisation of knowledge, evaluation and accountability:
    - Development is defined from the Western perspective – emphasis on catchup and convergence.
    - Lack of challenge and focus on politics of knowledge, political economy of investment choices, power dynamics and path dependency.
    - Pace and scale of research and innovation trajectories can tend to be prioritised over close attention of directionality (towards particular societal goals) and the distribution of risks and benefits.
    - Elite bargains and patronage can trump evidence, science and opportunities to bring in diverse knowledges and build equitable partnerships.
- Lack of delivery against global and national development targets:
    - Poor line of sight between research investment and SDG progress.
    - Agenda 2030 – is leave no-one behind being left behind? (e.g., BOND).
    - Still limited attention to how research is/can be valued and utilised in critical decision making.

[10] Leach, M. et al. 2018. Equity and sustainability in the Anthropocene: a social–ecological systems perspective on their intertwined futures. *Global Sustainability* 1, p. e13. pp1-13

[11] IGS. 2019. 'Independent Group of Scientists Appointed by the Secretary-General', Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development, New York, NY: United Nations. Available at: 24797GSDR_report_2019.pdf (un.org)

- Lack of understanding of enabling conditions for transformative change – including capabilities:
  - Lack of attention to politics of knowledge and power dynamics.
  - Limited focus on innovation processes beyond technical to institutional and policy.
  - Lack of attention to context, history, culture – undermines appropriate, effective and sustained development impact.
  - Narrow definitions of impact can detract from long-term transformative change.
  - Lack of coordination between funders – and lack of architecture to do so.
  - Uneven physical and institutional research infrastructures across geographies.
  - Challenges in understanding what does and doesn't work at scale, why and for whom.
- Anti-evidence/misinformation/disinformation.
- Fragmented and inequitable access to digital technologies
- Inequitable funding flows/political economy of funding flows:
  - National interest funding flows can result in pressure to follow foreign agendas (effectively tied international aid) or in tensions between local priorities and national research funds.
  - Procurement rules and other conditions attached to funding can be barriers to addressing context appropriate societal challenges in a timely and effective manner.
  - Local CBOs and others lack fundraising capacity and can be excluded by complexity/requirements of application process.
  - Emphasis on large programmatic funding difficult for new entrants.
  - Local agendas drowned out by HIC/LMIC mutual benefits and grand challenges.
- Traditional modes of R4D research programming outmoded and constricting:
  - Barriers to entry for new actors.
  - Restrictive short-term funding – difficult to put voices of community at the centre or fully realise longer term transformative opportunities that rely on partnership development.
  - The development and use of appropriate tools and approaches for defining and measuring development impact, beyond selective inputs and outputs, are limited.
- Tensions across temporal, geographic and organisational scales:
  - Time lag between research and development impact.
  - Being responsive to dynamic contexts and taking risks good for development impact but can clash with contractual requirements.
  - Multi-donor programmes can create conflicting expectations and barriers to progress.
- Research career incentives misaligned with transdisciplinary approaches and impact focus:
  - Competition for skilled researchers (high paying consultancies).

- Disciplinary focus of teaching and learning misaligned with problem focussed R4D capability building.

Ways of thinking and doing that underpin transformative change

This section of the foresight framing mapping was intended to highlight some fundamental cross-cutting ideas concerning the requirements for transformative change in the R4D system. The foresight framing exercise was not intended to impose any particular viewpoint in terms of priorities amongst the issues raised. However, during the initial stages of developing the map, fundamental ideas – such as the need to surface and engage with power dynamics, address underlying inequalities, and hardwired assumptions about the role of R4D – were embedded within many of the other more specific issues raised. Feedback indicated that their importance in interacting with issues across all aspects of the R4D system, paradoxically resulted in them being somewhat obscured. The intention of drawing out perspectives on ways of thinking and doing is to highlight them as core underpinning requirements for addressing the transformative challenge. Ideally, this might encourage reflection on how they can be operationalised in relation to other more specific issues. For example, how can reflexivity be embedded and operationalised for learning and adapting research in practice?

Figure 3 below summarises the issues that will be discussed in more detail.

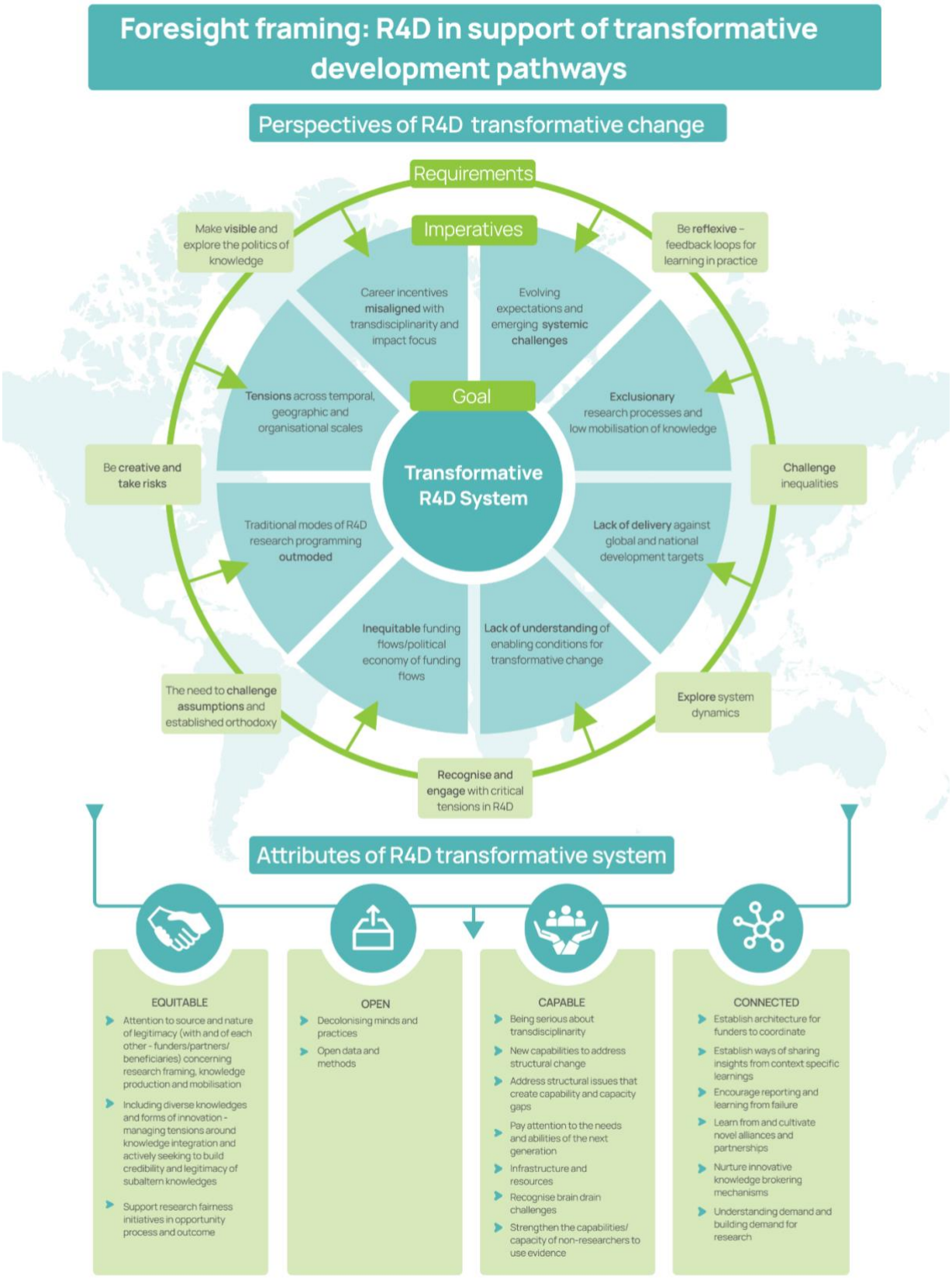


Figure 3: Foresight framing – R4D in support of transformative development pathways

The key underpinning perspectives highlighted in the map are as follows:

- The need to challenge assumptions and established orthodoxy:
  - Move beyond ideas of catch-up convergence in STI for development.
  - Explore what counts as development research and for whom.
- Make visible and explore the politics of knowledge:
  - Framing, producing, mobilising and quality assuring in R4D.
  - Surface power dynamic, politics/political economy of alternative research and development impact pathway choices.
  - Political economy of research uptake and use.
- Challenge inequalities:
  - Power dynamics that shape knowledge production agendas.
  - Skewed distribution of risks and benefits from R4D.
  - Ways of engaging and information sharing.
  - Ways of measuring success.
  - Access to physical and electronic infrastructure.
- Recognise and engage with critical tensions in R4D:
  - Tensions across scales (temporal, spatial, institutional).
  - Tensions between excellence and impact (including in multi-donor initiatives).
  - Tensions in appreciating/integrating different forms of knowledge.
  - Tensions resulting in mismatch between development goals and research and innovation policy and practice (foreign agendas, fragile system etc.).
  - Tensions in resource availability and allocation.
- Be creative:
  - Social innovation for transformation – learning from other areas and partnerships (e.g., new cooperatism, commoning).
  - Tools and approaches for thinking out-of-the-box.
  - Embrace creative arts with novel transdisciplinary approaches.
- Be reflexive – feedback loops for learning in practice:
  - Complexities of history and context shaping responsibilities, process and outcomes.
  - Regressive and progressive transformation.
  - Positionality in the R4D process.
  - Navigating uneven power dynamics and tensions constructively.
  - Learning from failure.
  - Equitable partnerships and process.
- Explore system dynamics:
  - Engage with the need for radical and systemic change in policies, practice, mindsets and behaviour.
  - Focus on socio-technical-ecological systems – including non-human actors and interdependencies rather than narrow ‘fixes’.
  - Recognise the functions of a transformative R4D system and how they evolve. For example, what works in terms of increasing responsiveness, agility and nurturing different forms of resilience building.
  - Emphasise enablers of systemic change, e.g., with focus on:
    - Relationality.
    - Knowledge system infrastructures.

— Social innovation as central (recognising and nurturing from ground up, developing in leadership across scales).

The attributes of transformative R4D systems

In the previous section of this report, we focussed on imperatives for transformative change, persistent problems to be addressed, cross-cutting issues and concerns and ways of thinking and doing which may underpin the change process. Here we focus on desirable properties and attributes of a transformative R4D system. The idea being that these attributes will support the functionality of a transformative R4D system.

Under each of these four 'attribute' headings there are a set of exemplar issues regarding areas for improvement in policy and practice which will contribute towards developing these attributes. In most cases there is some progress to date. There is inevitably some overlap and considerable interaction with issues raised in other areas of the map – the intention being to encourage reflection on interacting issues and on the potential connections between different entry points and perspectives across the R4D system.

Four key attribute categories were selected for the purposes of collating and providing a logical grouping of the material gathered. They reflect perspectives on the need for R4D systems to be more: 'open'; 'equitable'; 'capable' and 'connected'. Details of the four selected attribute categories are as follows:

Open (open science in terms of production and use)

- Decolonising minds and practices:
  - Moving from dispossessing to inclusive (attention to power dynamics, histories and cultures, respect and agency).
  - Moving beyond attention to 'co-production' of solutions and embracing diverse non-western problem framings, methodologies and approaches.
- Open and interoperable data and methods:
  - Attention to open source, crowd source, ethical data management, equitable data use.
  - Address tensions around being open and secure (malicious AI, misinformation, national media landscapes etc.).
  - Increase opportunities to access journals and publish – attention to global south journals, digital access, languages.
- Being serious about transdisciplinarity:
  - Attention to appropriate institutional arrangements and career incentives.
  - Recognise and nurture key skills and attributes of transdisciplinary researchers and researcher activists.

Equitable

- Pay attention to sources and nature of legitimacy:
  - With and of funders/partners/beneficiaries.
  - In research framing, knowledge production and mobilisation.

- Actively seek diverse knowledges and forms of innovation:
  - Manage tensions around knowledge integration.
  - Actively seek to build credibility and legitimacy of subaltern knowledges.
- Support research fairness initiatives (e.g., Logan, 2018) in opportunity process and outcome:
  - Consider funding schemes that restrict access and leave little time for participatory design.
  - Consider terms of engagement for diverse stakeholders and speak about power – avoid inclusion without equity.
- Equity in scaling:
  - What works at what temporal and spatial scales and for whom?
  - Address tensions that arise.
- Access to resources:
  - New modes of accessible and flexible funding.
  - More attention to geographic disparities in research infrastructure.

Capable

- New capabilities to address structural change:
  - New leadership for transformative science (bottom-up and top-down).
- Address structural issues that create capability and capacity gaps:
  - Career structures and flexibility and diversity of opportunity.
- Pay attention to needs and abilities of the next generation – schools and communities.
- Infrastructure and resources:
  - Attention to appropriate physical and material infrastructures.
  - Recognise what is possible and appropriate in different geographies.
  - Appropriate institutional and social research infrastructure.
  - Review granting mechanisms and experiment with novel ones.
- Recognise brain drain challenges.
  - When highly skilled individuals leave their home country to seek better opportunities elsewhere, it results in a loss of knowledge and expertise that is critical for knowledge innovation and development.
- Recognise, reward and nurture creativity and support risk taking amongst researchers and other R4D stakeholders:
  - Seek and engage with seeds of change.
  - Creativity rewarded in career progression.
  - Enable risk taking through funding mechanisms.
- Strengthen the capabilities/capacity of non-researchers to use evidence.

Connected (including nurturing new areas of cooperation and coordination across stakeholders and initiatives and addressing research waste)

- Establish institutional infrastructure for funders to coordinate with each other:
  - Many benefits include learning across contexts, building the evidence base on engaged research, and building synergies between programmatic efforts.
- Establish ways of sharing insights from context-specific learnings.
- Encourage reporting and learning from failure, as part of collaborative reflexive approaches
- Learn from and cultivate novel alliances and partnerships.
- Nurture innovative knowledge brokering mechanisms:
  - Bridging the 'formal' and 'informal'.
  - Increased focus on intermediaries and communities of practice.
  - Integrate indigenous knowledge research centres.
  - Diversity and nurture research-industry linkages.
  - Integrate knowledge brokering mechanisms at different scales.
  - Invest in knowledge intermediaries/champions and frameworks to support knowledge brokerage.
- Understanding demand and building demand for research:
  - Which governments and government departments are interested, why, and under what circumstances?
  - How parliaments hold governments to account for using research and in what circumstances different approaches are effective.
  - Recognising and building on the different types of 'value' research creates in policy decision making.
  - Understanding how institutional processes, networks and capacities shape policy decision making in different contexts.
  - Engage in temporality challenges/lag between research and development impact.
  - Explore better tools and metrics for understanding research investment and development impact process.

The mapping process focussed on ideas/debates about ways in which knowing, thinking and doing need to change. During this process many examples of emerging promising developments were apparent[12]. Listed below are a limited number of examples of promising developments/and arguably emergent trends. It is important to note that these examples largely refer to initiatives led by international research agencies and donors, they are not at all representative of promising developments led by other R4D stakeholders:

- Increase focus and appreciation of novel/diverse R4D partnerships and alliances – indigenous knowledge, grassroots innovation, knowledge brokering etc.

[12] The collation and analysis of promising developments was not in the remit of the foresight framing exercise, although could be developed as a follow on activity.

- Increased focus on equitable partnerships and process (UKCDR and ESSENCE equitable partnerships resource hub).
- Increased attention to contextually relevant initiatives.
- Increased emphasis on gender, disability and inclusion.
- Research fairness initiatives (e.g., COHRED research fairness initiative).
- Increased diversity in grant evaluation panels.
- Support for science systems in and across African nations (e.g. SGCI, DELTAS programmes).
- Decolonising development movements and funder initiatives (e.g. IDRC Decolonising Knowledge Systems).
- Objectives and partnerships focussed on system wide change (e.g., education, infrastructure).
- Increased focus on research demand – building capacity to use research and evidence in policy (e.g. FCDO BCURE).
- Expanding metrics and tools for evaluation – relevance and legitimacy, rigour, process and positioning for impact (e.g., IDRC RQ+).
- Increase flexibility in some funding arrangements (others more constrained?).
- Reflexivity, and changes based upon it, are recognised as integral to some ongoing research programmes and projects – (e.g. ISC Transformative to Sustainability programme.

Whilst these, and other examples, show promise, there appears to be limited progress in addressing many core issues of concern, and there is arguably still insufficient vision, ambition and/or coordination to meet the transformative potential of R4D.

Attention tends to be focused on success in particular projects and tools in R4D. These are indeed to be celebrated and may lead to incremental improvements in components of the system. The issues raised in this foresight framing exercise, however, point to the urgent need to consider these incremental improvements in terms of strategies for deeper systemic change. They point to the need to work collectively to challenge assumptions that reinforce inequalities, lock in outmoded ways of doing things, accept path dependencies and leave little space for creativity. They also point to ways of building capabilities and deploying resources for more open, connected and equitable R4D; addressing infrastructural needs and supporting innovations in policy and institutional contexts and social innovations to enable transformative change initiatives to flourish.

The issues raised point to several underpinning inequalities and contestations that need to be surfaced. They also suggest that key areas of tension need not only to be recognised and made transparent, but also to be actively engaged with as a central pillar of the transformative learning process.

3. Horizon scanning

We are living in a time of major change and upheaval. The scale of change is such that some would argue that our whole "civilisational stack"[13] is in the process of being reconfigured. Much of what we thought we understood about how the world works is shifting. This is destabilising and it is hard to make sense of what is happening.

The horizon scanning part of this project attempts to start making sense of the external or contextual environment for R4D, by considering what is shifting and how we can start thinking about what is next.

Horizon scanning is the 'art' of systematically exploring the external or contextual environment to better understand the nature and pace of change, and to identify potential opportunities, challenges, and likely future developments relevant to the field under consideration.

Horizon scanning – a working definition

"The systematic outlook to detect early signs of potentially important developments. These can be weak (or early) signals, trends, wild cards or other developments, persistent problems, risks and threats, including matters at the margins of current thinking that challenge past assumptions. Horizon scanning can be completely explorative and open or be a limited search for information in a specific field based on the objectives of the respective projects or tasks. It seeks to determine what is constant, what may change, and what is constantly changing in the time horizon under analysis. A set of criteria is used in the searching and/or filtering process. The time horizon can be short-, medium- or long-term."

Source: Models of Horizon Scanning, Fraunhofer Institute

In practice this means that in the context of R4D we consider questions like:

- What are the major driving forces of the changes we are experiencing?
- What are some of the shocks or disruptors that could surprise us, and how are they connected?
- Where are signs of a new reality or different way of doing things? Are there any sources of inspiration and hope?
- And what are some of the enablers of a desirable future?

[13] The idea of a civilisational or societal stack is borrowed from the field of technology, where a "tech stack" refers to the combination of technologies a company uses to build and run an application or project. Examples of thinkers using the idea of a civilisational or societal stack, include:

- Michalski, J. 2022. "Designing from Trust in the Never Normal", an interview with Peter Hinssen. Available here: https://www.peterhinssen.com/blog/designing-from-trust-in-the-never-normal
- Burja, S. 2021. "The End of Industrial Society", in Palladium. Available here: https://www.palladiummag.com/2021/03/24/the-end-of-industrial-society/

For this project the horizon scanning methodology was based on desk research and followed the 'formal search' mode[14] ' meaning it was a systematic targeted exercise requiring high effort looking at many different sources, as opposed to 'conditioned viewing', which is on-going tracking[15] type activity.

This meant it had a focus to start off with – R4D – some keywords emanating from the first domain mapping exercise and a system of tagging those and others that emerged as the scanning progressed. A shared bookmarking and annotation tool was used for the initial content collection, as was the STEEP-V framework, (S)ocial, (T)echnological, (E)conomic, (E)nvironmental, (P)olitical and (V)alues to ensure that broad areas were covered. A vast variety of sources were accessed including, but not limited to news sites, social media, think tank websites, blogs, wikis, databases, podcasts, videos, newsletters, magazines, book reviews, presentations, reports, surveys, interviews, seminars, trend observers, philosophers, artists, science fiction writers, sociologists, researchers, experts, university research reports, industry publications, academic journals, and conference material.

Horizon scanning is most effective if the output is presented in a user-friendly format. For this project that necessitated prioritising, and then relocating, the hits from the annotation/bookmarking site to a customised, accessible database platform that presents the categorised hits as virtual cards (see screenshot of the database in Figure 4 below).

In terms of taxonomy, hits were categorised according to domain as societal, technological, environmental, economic, political or values (the STEEP-V acronym), and where relevant, as disruptors or enablers. The type of hit is also categorised in term of its maturity; weak signal, trend, megatrend / driver as per the S-curve of emerging issues analysis shown in Figure 5 and defined in Box 2.

Click the hyperlink to browse the entire database in Notion and feel free to post comments. Use the filter function to isolate any of the domains or types, e.g., tick the 'enablers' box and only those scanning hits judged to be potential enablers will be shown. The reset button restores the database to its entirety.

[14] Choo, C.W., 2003. The art of scanning the environment. *Reframing environmental scanning*, 7.
[15] The scanning output is set up in such a way that it can easily be converted to the 'conditioned viewing' mode with its emphasis on on-going tracking.

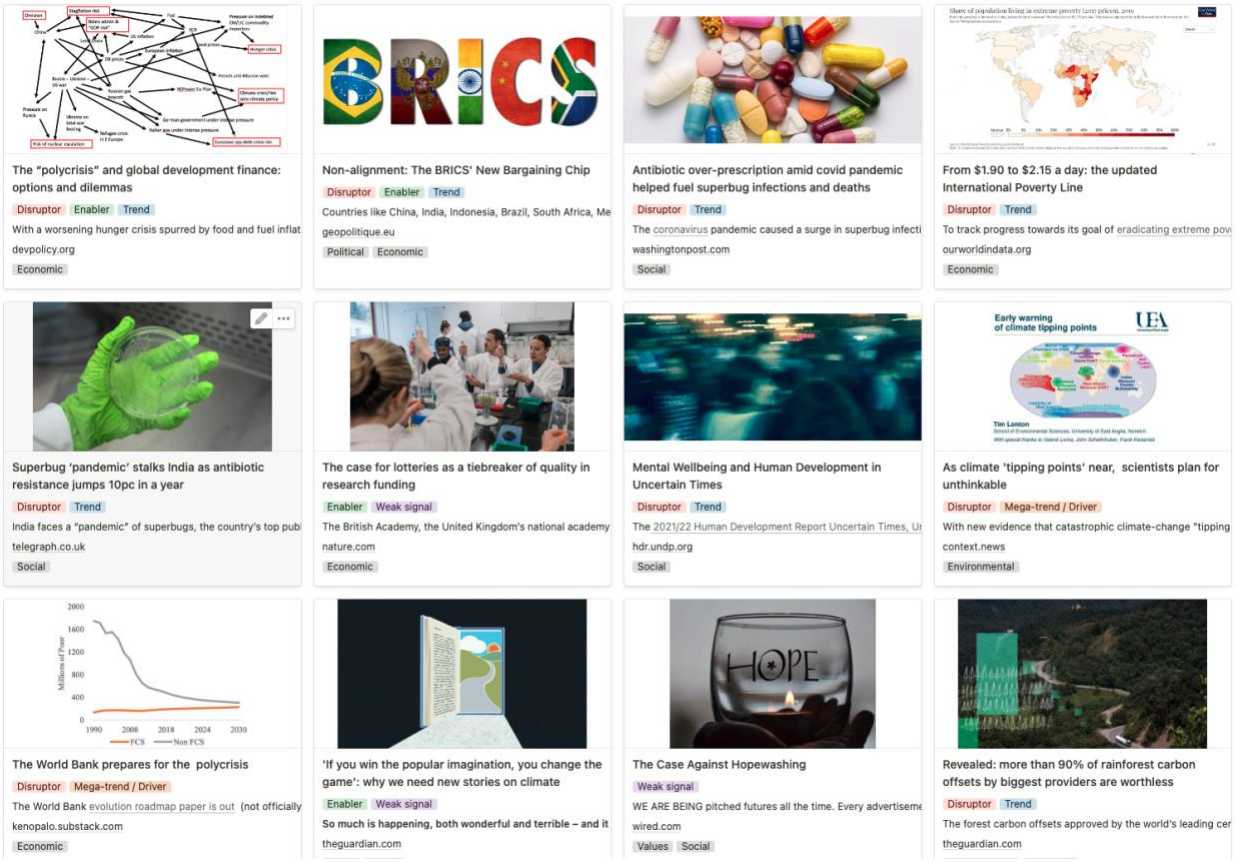


Figure 4: Screenshot of the scanning hits database

Before exploring the major drivers, we first share some key terms and an S-curve diagram that shows how issues emerge as weak signals, diffuse as trends over time

Box 2: Keys terms

Drivers: Macro-scale forces that are shaping or reshaping the operating environment. A driver may cause change not only within a particular category or sector but may have multiple effects across categories or sectors.

Trends: Established or emerging patterns supported by data. A trend may be strong or weak, increasing, decreasing or stable. It could be local, national, regional, and/or global. Context is key.

Megatrends: The great forces in societal development that will very likely affect the future in all areas over the next 10-15 years. Note that trends describe history, not the future. There is no guarantee that a trend observed in the past will continue in the future.

Weak signal: An early indication of a potentially important new event or emerging phenomenon that could become the source of a new trend or even a major driver. All trends were, at some point, weak signals, and these emerging issues can (and often do) arise from unusual spaces and places.

and eventually become part of a new normal. The S-curve has been populated with some examples from the scanning hits database.

An emerging issue is something that is regarded as a new concept or idea that might be fringe thinking now, or may be regarded as niche and marginal given the context of the issue under consideration, but which *could* mature and develop into an everyday issue or practice, or problem/opportunity in the future. In the present, they are usually encountered as weak signals.

Selected example emerging issues (all of which are collected in the Notion database as weak signals) are shown on the far left tail of the S-curve of R4D issues as illustrated in Figure 5. They are nascent and 'immature' and are deemed to be in the foresight zone when conducting emerging issues analysis (EIA)[16]. Their relevance to R4D, and their future trajectory, is quite uncertain. They should, however, be regarded as important as trends which are further along the S-curve with a higher level of maturity and in the competition/reactive zone. The 'new normal' zone contains issues that are regarded as mature and 'institutionalised' that are driving and shaping the R4D operating environment, regardless of what decision-makers do. By identifying weak signals and conducting EIA, foresight practitioners aim to identify what may become problems/opportunities even before they become trends, and working with them while they are uncertain, problematic, but potentially malleable emerging issues.

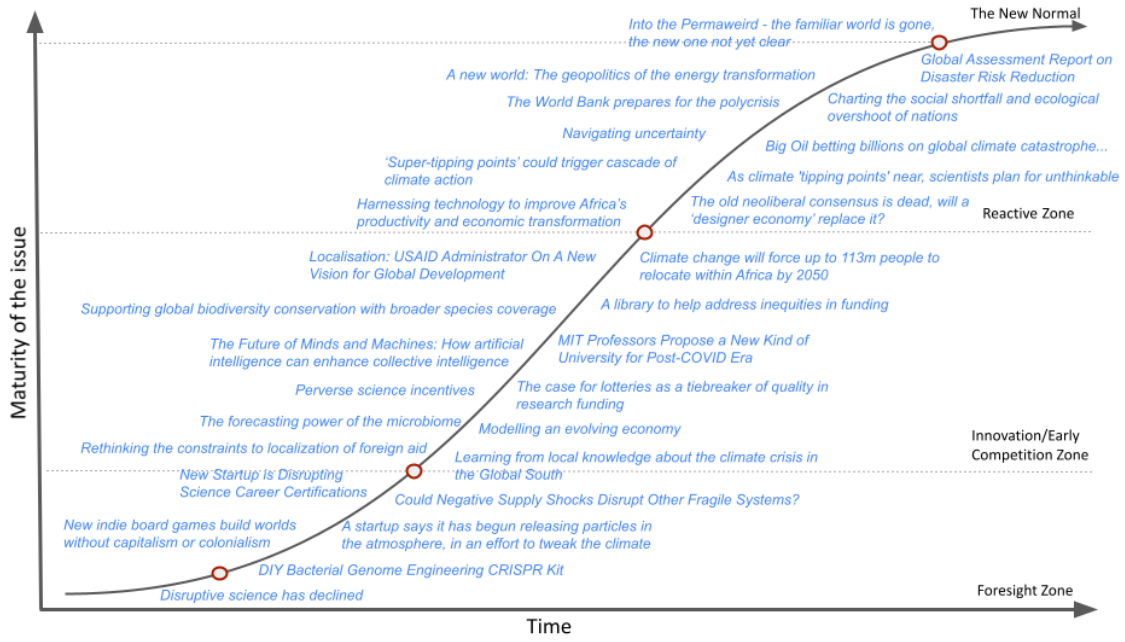


Figure 5: The S-curve of R4D issues with some examples from the scanning hits database.

[16] EIA is regarded as a foundational tool in futures studies and is "a way to identify things that might (1) interrupt existing trends and current processes, and/or (2) become new trends themselves that might eventually become problem/opportunities". Dator, J., 2018. Emerging issues analysis: *World Futures Review*, *10*(1), pp.5-10.

Drivers of change

Climate change

Climate change is arguably *the* defining issue of our time, with knock-on effects for every part of society. For years, exasperated scientists have been exclaiming, "You can't negotiate with science!" though that is exactly what we have been trying to do at our annual climate change conferences. A recent Met Office study shows that pledges to cut greenhouse gas emissions agreed at UNFCCC COP 26 in Glasgow are not likely to be sufficient to restrain global temperature rises of 1.5°C or below compared with pre-industrial levels. We are more likely to overshoot this target and then come back down to 1.5°C by 2100.

In the meantime, irreversible climate tipping points loom. A recent study in Science points to four such tipping points. For example, one that may already have been triggered is the eventual collapse of the Greenland ice sheet, which could set in motion a seven-metre sea level rise, enough to swamp key coastal cities. These sobering (or terrifying) prospects show that climate mitigation remains crucial.

On one hand, not enough has changed. On the other, a lot has. A study published in Nature shows that, contrary to what most Americans believe, a large majority of citizens support climate action. An article by Rebecca Solnit in The Guardian argues that outright climate denial has been rendered largely obsolete – outside pockets of social media – by climate-driven catastrophes and the work done by activists and journalists (and researchers).

Sustainable solutions are also becoming more economically feasible. Some changes could trigger positive tipping points – instances where zero-carbon solutions become more competitive than existing high-carbon options. A study released at the World Economic Forum point to three interventions that could trigger a cascade of tipping points for zero-carbon solutions in sectors covering 70% of global greenhouse gas emissions. These are switches to electric vehicles, green fertilisers, and plant-based proteins.

The fact that many of the changes wrought by a changing climate are already happening, and will only get more pronounced with time, necessitates that we focus not only on mitigation but also on adaptation. The worst effects of the climate catastrophe are likely to be felt by those the least prepared and who contributed the least to the problem, as shown in Figure 6.

Figure 6: Maplecroft Climate Vulnerability Index

A resource like the UNDP Human Climate Horizons Data and Insights Platform provides valuable hyperlocal insights on the potential humans costs of climate change through the end of the 21st century, allowing the exploration of implications for adaptation based on different policy choices.

When it comes to climate justice, the establishment of a Loss and Damage Fund at COP27 saw the culmination of decades of pressure from climate-vulnerable developing countries. As a UNEP article explains: "Loss and damage refers to the negative consequences that arise from the unavoidable risks of climate change, like rising sea levels, prolonged heatwaves, desertification, the acidification of the sea and extreme events, such as bushfires, species extinction and crop failures". The success of this fund will depend, amongst other things, on how quickly it launches.

Energy transition

Closely related to climate change and pollution, is the energy transition from fossil fuels to clean energy. The fossil fuel era has been a relatively short (though highly influential and disruptive) one. To prevent catastrophic climate change, this era that started with the dawn of the Industrial Age in the late 18th century and accelerated exponentially in the last five decades, must end faster than it grew. While some argue that the planned transition towards 2030 and beyond to 2050 is not ambitious

enough, others point out that a transition of the scale and speed projected will be highly disruptive, resulting in adverse supply shocks.

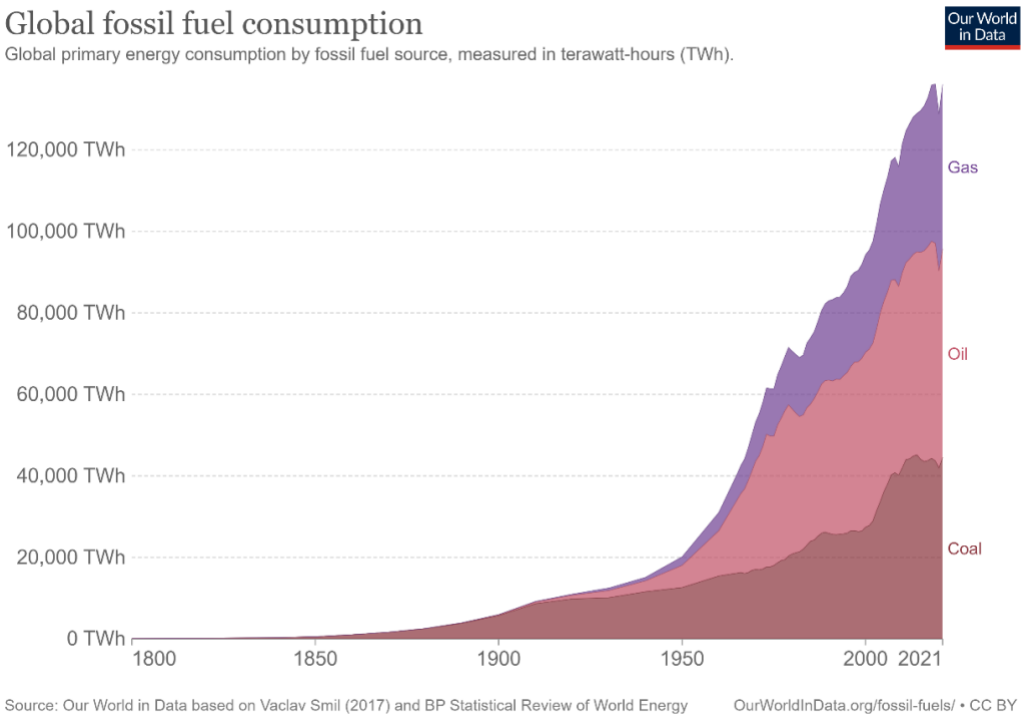


Figure 7: Global fossil fuel consumption over time

In an article for the IMF, Daniel Yergin summarises the scale of the required transition by noting that its objective is not merely to bring on new energy sources, but to "entirely change the energy foundations of what today is a $100 trillion global economy". This has profound geopolitical implications. Just as, for the last two centuries, oil, gas and coal have played an important role in shaping the geopolitical landscape, the transition from fossil fuels to renewable energy will transform global power relations in the decades ahead. It will lead to shifting alliances, new geographies of trade, new patterns of conflict and new natural resource requirements (notably key minerals).

The old system is not going down without a fight. A (now outdated) study into the climate denial movement, for example, shows that amongst the funders of this movement are foundations with a link to the fossil fuel industry. The last ten years have seen changes to the climate denial debate (including the movement being mostly relegated to the fringes). Even so, it has not disappeared. As recently as 2022, a fossil fuel-funded climate denial group has been leading a combined legal and public relations effort to stop US offshore wind power development by co-opting the language of the climate movement in a climate disinformation strategy that has been described as "woke-washing".

In the energy sector too, there are questions of equity and justice shaped around the concept of a "just transition". A just transition aims to mitigate the negative impacts of

a net-zero transition on workers and communities while aiming to ensure that the benefits are fairly distributed. This includes, for instance, cushioning the effects of closing coal mines. The just transition provides another motivation for channelling climate finance. For instance, South Africa – a large, emissions-intensive middle-income developing country – benefits from a Just Energy Transition Partnership in which France, Germany, the UK, US and EU agreed to channel $9.5 billion to support a just and equitable transition.

Climate change and the energy transition count among several environmental stressors we are facing. Two others include biodiversity collapse and pollution.

Inequality

Issues like climate justice and a just transition reflect efforts to address fairness and equity in the global system. A sceptical perspective could find many examples of how our current system perpetuates a trickle-up of wealth to the top, working against the goal of shared prosperity.

The most obvious form of inequality is in income or wealth, and there are many extreme examples: Oxfam's recently released annual inequality report titled "Survival of the Richest" shows how the world's richest 1% grabbed nearly two-thirds of all new wealth since 2020, almost twice as much money as the bottom 99% of the world's population.

By way of another example, the Balanced Economy Project seeks to curb excessive concentrations of economic power and the abuses that flow from this power. The organisation shows how corporate dominance and monopolisation is a challenge in sectors ranging from agriculture and digital economy to finance, healthcare, manufacturing, pharmaceuticals, music, accounting, eyewear, academic publishing, social care, military procurement and dentistry.

In addition to growing economic inequality, a recent UNRISD report discusses social and political inequality as well as its intersect with inequalities related to group identity (e.g., gender or race). Taken together, these inequalities "create a gravity toward multiple crises" that hit the disadvantaged hardest while those with resources can shield themselves and recover more quickly. It argues that "economic, social, environmental and political privileges accumulate at the top of the income and wealth pyramid, building the foundation of elite power that often opposes transformative change towards greater social, climate and economic justice". From this perspective, inequality is a "feature not a bug" of the system. Ultimately, however, a highly unequal system is a very unstable system, as illustrated not only by the number of crises that can be linked to inequality but also by the number of protests around the world.

Capitalism in crisis

"It is easier to imagine the end of the world than the end of capitalism" – this quote from Fredric Jameson and Slavoj Žižek is used to describe just how entrenched the liberal capitalist system is. Increasingly however, the once widely held belief that "there is no alternative" is being called into question as multiple crises – of the environment, of inequality, of debt – compound an economic system in crisis. In the disruption of a dominant system losing legitimacy, alternative ideas are vying for prominence. These include ones long considered marginal (e.g., universal basic income, degrowth).

It is also useful to remember that the economic system we have today was not always the dominant one. The book "The Great Persuasion" by Angus Burgin provides a fascinating history of free market advocacy from its origins in the aftermath of the Great Depression. It shows how a group of intellectuals sought to "reconstitute the theory and practice of capitalism" in the face of opposition to their ideas. What started out as a purely intellectual pursuit eventually evolved into pressure for political change facilitated through the formation of the Mont Pèlerin Society. The Society was assisted in achieving its goals with financing from a series of supportive charitable foundations. In conclusion, the book argues that the growth of free market ideas highlights that "those who set themselves against the prevailing opinions of today can take comfort in the knowledge that discursive constraints are never absolute, and often help create the conditions of their own decline". This story can serve both as inspiration and as a warning for those who seek to influence the current economic system, whether through ideas or funding.

One indication of the change that is already underway is the move beyond gross domestic product (GDP) as an indicator. UN Secretary General António Guterres joins Nobel laureates Amartya Sen and Joseph Stiglitz in calling for GDP to be dropped as the world's primary go-to indicator. Countries including Finland, Iceland, Scotland, Wales and New Zealand are members of the Wellbeing Economy Governments partnership – a coalition that also looks beyond GDP and growth and aims to transform economies around the world to deliver shared well-being for people and the planet by 2040. In the words of Scotland's First Minister Nicola Sturgeon: "The need for a new economic model has never been clearer".

Democracy in decline

Democracy is in decline. This is the conclusion of different democracy trackers, including the IDEA Global State of Democracy report, V-Dem Democracy Report, the Economist Intelligence Unit Democracy Index, Freedom House's Freedom in the World and Pew Global Public Opinion surveys. This decline is characterised by a growth in authoritarianism, populism and polarisation and a decline in democratic norms and civil liberties. Over the past six years, the number of countries moving toward authoritarianism is more than double the number moving toward democracy.

This trend can be linked to economic, social and geopolitical upheaval and crises, including but not limited to the climate crisis, the 2008 economic crisis, COVID-19 related lockdowns and the associated economic downturn, and the growing antidemocratic influence of China and Russia – the world's leading autocracies. The Pew Trust's research has shown that feeling that democratic countries are performing poorly on economic performance, governmental competence and the overall fairness of the political and economic system contribute to a decline in support for democracy. This decline is linked to a lack of trust in democratic institutions, which in turn provides fertile ground for populist leaders and movements some of whom have embraced disinformation as a tool to shape domestic and international opinion.

Some questions to consider: Is the loss of trust in institutions also linked to a decline in support for underlying democratic values and principles? What can one do to address the perceived loss of legitimacy in institutions? If populism is, at least in part, a reaction to elitism, how does one address that? How does the likelihood of continuing crises and instability bode for democracy? If not democracy (or the current form of democracy), then what? What desirable alternatives are there?

Demographic change

The world's population is still growing, though the pace of growth is slowing down. In 2020, the global population growth rate fell below 1% per year for the first time since 1950. Declining birth rates and increased life expectancy are conspiring to contribute to a rapidly aging global population. Globally, the working age population is projected to see a 10% decrease by 2060. However, there are big differences among countries and regions. The working age population will decline in many OECD countries, with countries like Israel and Australia providing notable exceptions. The aging pattern holds across much of Asia, including in Japan, China and Korea while countries like the Philippines, Malaysia and India continue growing. India recently surpassed China to become the world's most populous country and is projected to continue growing into 2050. This comes as China announced its first population decline in six decades, with 850,000 fewer people at the end of 2022 than in 2021.

While much of the world, and the West certainly, has been preoccupied with the implications of entering an "Asian century", another demographic transformation has gone largely unnoticed. Africa's population has increased more than tenfold in the last century and is projected to continue growing at pace. The continent's population is expected to grow from today's 1.4 billion to somewhere in the order of 2.2 billion to 2.5 billion by 2050, and likely exceed 4.2 billion by 2100, at which stage Africans will account for as much as 40% of the world's population. By mid-century, Africans will comprise the largest population of prime working age in the world. Absorbing this population has been described as a challenge "comparable in pace and scale to China's giant wave of urbanization between the 1990s and 2010s". Clearly, no account of the 21st century is complete if it does not fully include the African story (told from an

African perspective). As is, institutional blind spots are stark. For example, the G20 has only one African member and Africa has no permanent seat on the Security Council.

Geopolitical uncertainties

The world seems to be splitting into Cold War blocs (which at first glance look strikingly like the old Cold War blocs): Western Europe and the US are engaged in a proxy war with Russia. Russia's invasion of Ukraine upended energy security in Europe and food security in Africa. China and the US are at odds over Taiwan and many other things. And Africa is emerging as a battlefield between China, the US and the European Union (EU). Taken together, we are likely to face a more fragmented global order going forward and a further retreat of the global rules-based system.

One of the big fault-lines is between the US and China. This plays out in several arenas not least of which in the technology space. The US currently has a lead in artificial intelligence (AI) which it is trying to retain by implementing trade restrictions to cut China off from the semiconductor supply chain. China is trying to leverage the same. In an article for Noēma, Yuen Yuen Ang argues that, despite their great power rivalry (which does have an impact on the rest of the world as per the above example, for instance), America and China are more similar than most people think. She explains that both confront sharp inequality, corruption or elite state capture, ongoing financial risks to ordinary people, and are struggling to reconcile tensions between capitalism and their (albeit different) political systems.

While the great powers battle it out, the old Indian grand strategy of nonalignment is re-emerging. And, as Tim Sahay argues in an article for Groupe d'Études Géopolitiques, "this time, the rise of China assures that the new counter-hegemonic bloc will enjoy considerably greater resources than did the old communist powers". Like India, Brazil and Indonesia are also taking advantage of their new pull. Sahay warns that Europe should not underestimate the interest of postcolonial elites in charting an independent course and to avoid a costly and risky confrontation with a Sino-Russian axis.

Even as countries are forging new economic alliances, geopolitical uncertainties join other forces (including climate change, technological change, crises and shocks – COVID-19 being a notable example) to reconfigure geographies of value chains and production networks in what some foresee may lead to "globalisation in reverse" as economic nationalism is joined by policies for onshoring or domesticising or regionalising value chains.

Technological disruption

Depending on who you follow, technology is either going to save us or sink us. Tech optimists believe we can geo-engineer or innovate ourselves out of a climate catastrophe, gene-edit our way to better food and bodies, and algorithm ourselves to

more efficient and effective government. Tech pessimists fear that technology will break all our systems, and us with them. Whichever side you fall on, the reality is that technology is changing the world.

While the last decade has seen several (not always very effective) attempts to regulate technology companies, the last few years have seen the "tech-lash" – a term coined by The Economist as far back as 2013 – really gain momentum. Factors contributing to a growing hostility towards the tech giants include a growing tech monopoly, a mis- and disinformation epidemic, issues around data processing, privacy and security as well as the impact of digital technology on mental health. This has also translated to the stock markets, where tech stocks have been bleeding even as the crypto bubble burst. While some believe that the tech-lash is the first step to restoring a fair economy, others argue that it is a threat to growth and progress.

Tech-lash notwithstanding, 2020 saw software-based infrastructure established as a critical load-bearing element of our response to the COVID-19 pandemic. More recently, generative AI has broken the AI hype cycle and even tech sceptics do not expect a bust.

The impacts of technology will continue to reach into the economy, politics, law, people, even our world view. It is, however, important to note that the trajectory or direction of technological development is not inevitable. Technology is embedded in social, economic and political systems. We have agency and can shape these systems. In fact, when we consider the stakes, it is imperative that we do so. For this reason, something like the lawsuit against Microsoft, Github and Openai is worth following, as it could change the rules of AI copyright and reflect (or shape) broader changes to intellectual property. So too, plans for Web3 will reshape the internet of tomorrow. The aim is for it to be user-centric with data (and therefore power) lying no longer with tech platforms but decentralised, in the hands of users. As Laurence van Elegem explains in a blog titled Web3 for Dummies: "The impact could be huge: power shifts, privacy, security, trust, equality, interoperability, less polarization etc. Web3 has great potential to change how we handle money (DeFi), how we organize ourselves (DOAs) and how we perform business (business model change)". Then again, Web2 also started with a utopian vision, and Web3 is still being built, so we will need to see. The important point is to be part of shaping these technologies and systems.

From the perspective of development, it is also important to consider dimensions of technological inequality. See, for example, Figure 8 by The Mozilla Internet Health Report 2022 titled “The World Map according to the data AI sees”. Initiatives to address inequities range from rolling out affordable connectivity, to funding and supporting the digital commons (this includes standards and tools for open hardware, data, software and content), and promoting participatory AI.

Figure 8: The World Map according to the data AI sees

The interconnectedness of issues

None of the drivers shaping the future of R4D exist in isolation or as a single issue. They are all interconnected and interrelated. Figure 9 illustrates these drivers and key issues that emerged from the horizon scanning in a knowledge graph format. A knowledge graph is a visual way to represent interconnectedness or multidimensional relationships. The nodes represent issues and the edges/lines the relationship between them. Nodes were classified according to the STEEP-V taxonomy and lines or relationships as either disruptive or enabling. An interactive version of the visual can be accessed here: https://graphcommons.com/graphs/749dc196-cd77-4184-8282-c8a486a1fb2f When clicking on a node, it shows all the other nodes that are connected to that one. When clicking on a line/edge, it shows the relationship.

The visual serves to illustrate the interconnectedness of issues, which explains the cascading nature of crises (see reference to the polycrisis below). It also allows one to identify key drivers: running a betweenness centrality analysis on the graph yields the following ten most influential nodes (i.e., drivers), in order: capitalism in crisis, climate change, distrust, geopolitics, energy transition, migration, democracy in decline, misinformation, AI, inequality.

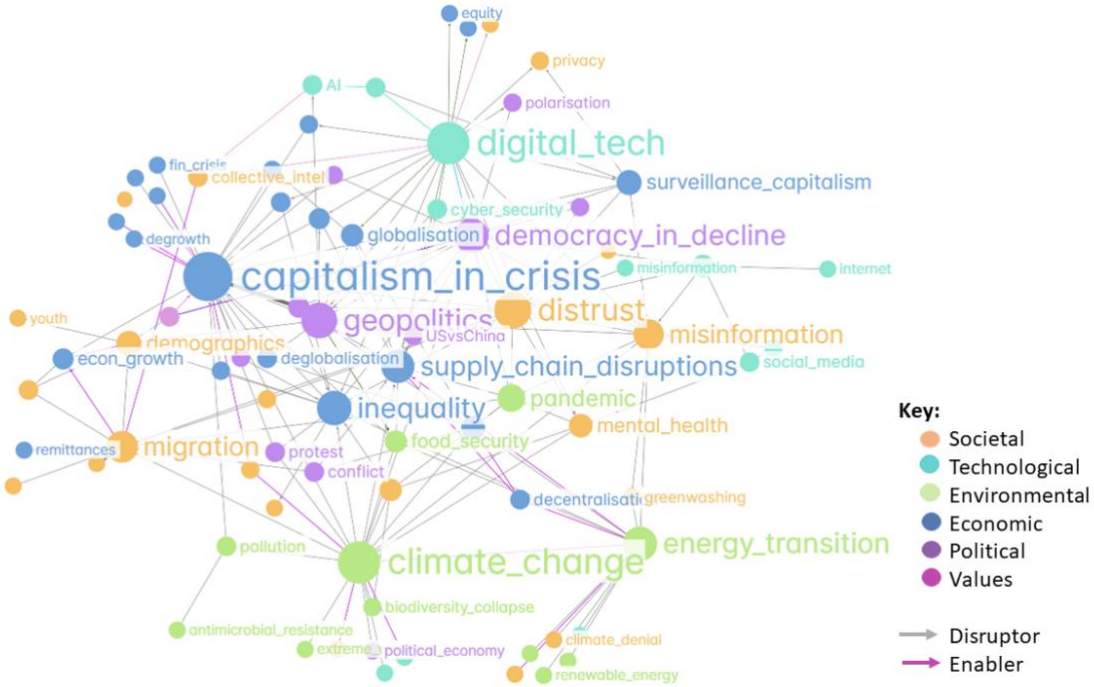


Figure 9: R4D horizon scanning knowledge graph

Potential disruptors

As is clear from the discussion to date, our current systems are highly susceptible to shocks. Even as shocks leave us surprised when they happen, it is likely that many of the shocks that we will face in the next couple of decades will fall in the category of "predictable surprises" or "known unknowns" rather than true "black swan" or "unknown unknown" events (especially to those in the habit of tracking global trends and drivers). An easy example is the COVID-19 pandemic – a big shock that was initially described as a "black swan" event, until multiple voices emerged saying they had flagged this type of pandemic as a risk for years. The concept of predictable surprises is also related to that of "wilful blindness" (after work by Heffernan), or in layman's terms the idea that "we'd rather not know".

However, knowing about or expecting some of these disruptors, shocks or crises is a first step in anticipating or preparing for them. Herewith then an incomplete (but still long) list of potential disruptors, followed by a discussion of potential enablers.

The fact that many of the disruptors mentioned below are related or reinforce each other have led many to describe the time we are in and the challenges we face as a "polycrisis" (See examples 1, 2 or 3).

Long list of potential disruptors:

- Global debt crisis.
- Asset bubbles bursting (e.g. recent crypto bubble or potential of climate change housing bubble in future).
- Cost of living crisis.
- Supply chain disruptions e.g. semiconductor shortage linked to Covid19 and US vs. China tech trade war, or food shortages linked to Ukraine war. Suez Canal obstruction of 2021, or Maersk cyber-attack of 2017.
- Excessive concentrations of economic power/monopolies enable abuses of power including crushing economic ecosystems, locking down markets to extract wealth, escaping taxes, environmental rules and other civic obligations, distorting politics, law and public opinion and threatening democracy. Monopolisation is an issue in sectors ranging from agriculture and digital technology, to finance, healthcare, manufacturing, pharmaceuticals, music, accounting, eyewear, academic publishing, social care, military procurement, dentistry, and retail.
- Retreat from a rules-based global system.
- Wars, conflicts, tensions and proxy wars e.g. invasion of Ukraine upends energy security in Europe and food security in Africa.
- Trade wars e.g., US vs. China AI/tech war. US ahead in AI and wants to maintain lead including by implementing trade restrictions to cut China off from the semiconductor supply chain. China trying to leverage the same.
- Fears of nuclear escalation.
- Knock-on effects of biodiversity collapse (e.g. rapid decline in pollinators causing serious decline in human health, as well as other challenges).
- Climate change has far-reaching impact (e.g. rising atmospheric CO2 lowering nutrient content of staple food crops).
- Extreme weather events, worsened by climate change (droughts, floods, sea-level rise etc.) requiring an increase in disaster risk response.
- Climate tipping points lead to extreme disasters e.g. melting of Greenland ice sheet triggers 7m sea-level rise over time, swamping key coastal cities; or large amounts of methane trapped in thawing permafrost released, driving an unstoppable cycle of higher temperatures and more melting, leading to food system collapse and displacing billions.
- Pollution linked to roughly 9 million deaths per year.
- Chemical avalanche. Around 250 billion tonnes of chemicals produced globally every year, many of which have not been properly researched, impact on life on earth unknown (e.g. endocrine-disrupting chemicals causing fertility crisis).
- Superbug epidemics, spurred by antimicrobial resistance.
- Non-communicable disease (NCD) epidemic.
- Mental health epidemic linked, amongst others, to multiple crises (see example 1, 2, 3 and 4).
- Cross-species viral transmission risk increased by climate change and our food system (e.g. high densities of poultry seen in commercial farming and risk of bird flu outbreak spill-over to humans).
- Climate-forced migration and displacement (e.g. climate change will force up to 113 million people to relocate within Africa by 2050).
- Food insecurity.
- Global energy crisis.
- Data-driven behavioural manipulation (e.g. commercial social media companies manipulating elections). Algorithms used to sow distrust in public information and government machinery (e.g. elections)
- Tech disrupting labour markets (e.g. the 4th Industrial Revolution and a jobless future).
- Cyber-security risks and threats.
- Ineffective regulation and governance of frontier tech (e.g. geo-engineering, gene editing, generative AI) – by definition innovation often ahead of regulation.
- AI discrimination. AI responsible for perpetuating discrimination in delivery of services and unfavourably profiling segments of the population.
- Dependence on international data infrastructure leaves countries vulnerable.
- Epidemic of misinformation.
- Digital inequality and feudalism.

Potential enablers

"To change our relationship to the physical world – to end an era of profligate consumption by the few that has consequences for the many – means changing how we think about pretty much everything: wealth, power, joy, time, space, nature, value, what constitutes a good life, what matters, how change itself happens" – Rebecca Solnit for The Guardian.

Reconfiguring our societal or civilisational stack is a big job. For example, consider the implications of changing the focus of the global economy from growth to degrowth. Research and science can help by:

Coming up with alternative ideas. Professor of Collective Intelligence, Public Policy and Social Innovation Geoff Mulgan notes that "the world is something we shape. It isn't a given, it doesn't come from nature. It's not fixed. And it's often much less rigid than we expect it to be". In a similar vein, Rebecca Solnit argues that "what drives our machines won't change until we change what drives our ideas", noting that every crisis – including the climate crisis – is in part a storytelling crisis. The authors agree that, while there is a role for technological innovations, there currently exists an imbalance in the way we favour technological innovations over social ones. In the words of Mohammad Yunus (winner of the Nobel Peace Prize for founding the Grameen Bank): "We have science fiction, and science follows it. We imagine it, and it comes true. Yet we don't have social fiction, so nothing changes". Mary Hegler adds that for too long, the climate fight has been limited to scientists and policy experts and that what we desperately need more of is artists. Ideas can come from interesting places. For example, Kaelan Doyle Myerscough discusses the creativity and rigor with which indie game developers build believable worlds.

Operationalising ideas. Reconfiguring a different society also requires a lot of figuring out. For example, in a world of degrowth, we need to reshape our provisioning systems: How do we fund public services or retirement/pensions? How would work time reductions work? Or universal basic income? Part of this may require developing new economic models that remove the dependencies on growth. Already there are examples (e.g. LowGrow SFC, EUROGREEN and MEDEAS) which are being used to project the impacts of policies like redistributive taxes, universal public services and reductions in working time.

In addition to new ideas, there is a need to simply make sense of what *is*. An event titled "Modelling an Evolving Economy" found that policymakers are thirsty for relevant and timeline insights about the state and evolution of the economy to inform policies and help them respond to shocks faster and more effectively. There are also new cutting-edge data sources and methods based on data science, machine learning, AI and complexity science that can help address these needs.

Other methods and schools of thought that could help with sense-making in the midst of complexity, change and uncertainty include complexity science (including computational complexity mentioned above, but also critical complexity), systems thinking and foresight (a field that straddles what *is* and what *could be*). Whether it is figuring out what is, or shaping what comes next, it is increasingly hard if not impossible for lone individuals to do. A diversity of perspectives is not just preferable but often crucial. Many of the techniques and methods of these fields are therefore participatory. Even when it comes to AI, there is a case to be made for participatory AI, which can assist with concerns about representation in these systems. Though we can be smarter together, it is also not a foregone conclusion, as anyone who has had to endure decisions via committee can attest. Figuring out how to be smarter together is therefore a worthwhile pursuit. This is exactly what Nesta's Centre for Collective Intelligence Design is looking at, i.e. how we can be smarter together, as humans, and in collaboration with machines (i.e. human plus machine intelligence).

Any attempts to understand or shape the world must consider power relations. This is always the case, but even more so when one considers big changes and shifts. There will always be vested interests, winners and losers. It pays being astute about power in all the systems we mentioned. This has implications across the research and scientific domain, from initiatives that aim to address inequities in research (for example, Figure 8 on the data AI sees, or initiatives to increase African content on Wikipedia), and the challenges of science communication in a world of low trust and misinformation, to the role for science diplomacy in a divided world. There are interesting initiatives seeking to address excessive concentrations of power in different sectors, including the anti-monopoly movement, the way in which the decentralised web/Web3 plans to distribute power, plans to replace platforms with protocols, or new ideas about the commons (including the digital commons).

And even as some lament a slowing down of globalisation, the reconfiguration of value chains and production networks by decentralising, localising or onshoring is also an attempt to address fragility in global chains. In terms of solutions to complex problems, Nathan Gardels argues that "maximizing reliance on the large systems with complex interrelated links invites all manner of vulnerabilities" He argues that a kind of distributed simplicity or "thinking big but acting in many small ways" creates a diverse equilibrium that is more resilient to shocks.

There is value and richness in alternative ways of knowing. This includes, for instance indigenous knowledge (e.g. this article on combining indigenous knowledge and synthetic biology for a sustainable future in Hawaii), or somatic intelligence/embodied knowledge in the time of machines. Several scientific breakthroughs in the past were made by citizen scientists. It is worth considering the role of citizen science today and into the future. There are also arguments that neurodiversity contributes new ways of knowing and being to the world.

In a world where paradoxical forces towards conformity and contrarianism exist, it is important to keep space for contrarians (coupled with ways to ensure legitimacy).

4. Taking this work forward

The foresight framing and horizon scanning work featured in this report needs to be translated into practical inputs for the next phase – the foresight phase – of this project, consisting largely of two virtual and two in-person workshops with R4D stakeholders, and the resulting output of those workshops. The workshops will involve collective engagement using futures/foresight tools as follows:

- Generating R4D futures scenarios using the morphological method that produces stories resulting from divergent outcomes of critical themes.
- Producing *futures wheels* that encompass impact cascades of imagined mature disruptors and enablers.
- Populating *three horizons frameworks* involving preferred futures, weak signals (pockets of the future in the present), back-casting and systemic change.

In addition to the workshops, a foresight questionnaire will be distributed to stakeholders unable to attend a workshop, and these responses plus insights will be incorporated into the foresight phase output. Employing foresight methods for the participative workshops entails reconfiguring the content of foresight framing and horizon scanning in the following manner:

- The long list of disruptors and potential enablers will be ranked and prioritised so that they can be used for futures wheels, which is essentially a participative implications analysis.
- Five to seven divergent themes with multiple potential future outcomes will be extracted from the foresight framing to serve as building blocks for the inductive *morphological scenarios* building process.
- A selected deck of (~50) horizon scanning 'cards' will be chosen from the database to be shared with participants as part of their workshop preparation. Some of these cards will be curated to depict the major driving forces as per the horizon scanning analysis presented above.

A final *Research for Development Disruptors and Enablers* report containing the overall findings and a synthesis of the workshop write-ups is expected to be submitted in mid to late November 2023. After that a range of knowledge sharing communication material for different channels and publications e.g., blogs, conference papers, videos, short- and longer articles in different publications, including open access targeted peer-reviewed journal article(s) will be released.