Evaluating complex population health interventions across multiple urban development systems

10th Systems Evaluation Network (SEN) Meeting – Online Webinar
20th March 2024

Geoff Bates: University of Bath, Institute for Policy Research
Daniel Black: University of Bristol, Population Health (Bristol Medical School) & Daniel Black + Associates (db+a)
Neil Carhart: University of Bristol, Faculty of Engineering
Judi Kidger: University of Bristol, Population Health (Bristol Medical School)
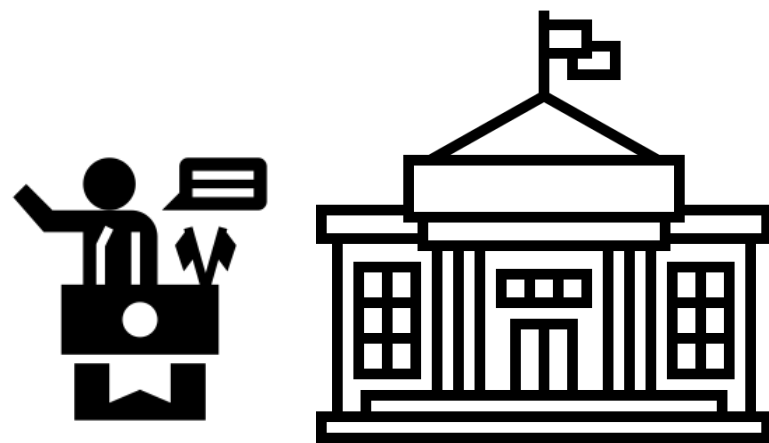
Talk 1:

Introduction to urban development systems
and the TRUUD research programme

Urban 'systems' (vs **sectors** vs **infrastructures**)

i.e. the (hard) 'built environment' is the tangible outcome, but results from (soft) social systems of decision-making
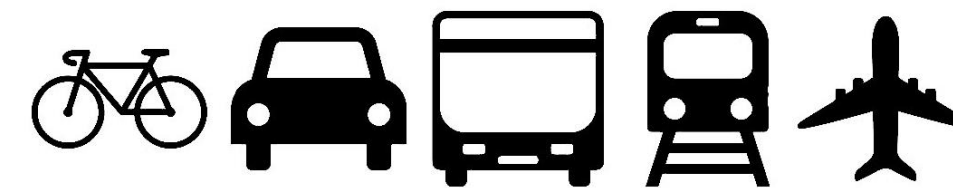
**MULTI-SECTOR
PLANNING**

ADMINISTRATIVE

BUILDINGS

TRANSPORT

WATER & WASTE

DIGITAL

EDUCATIONAL

SCHOOL

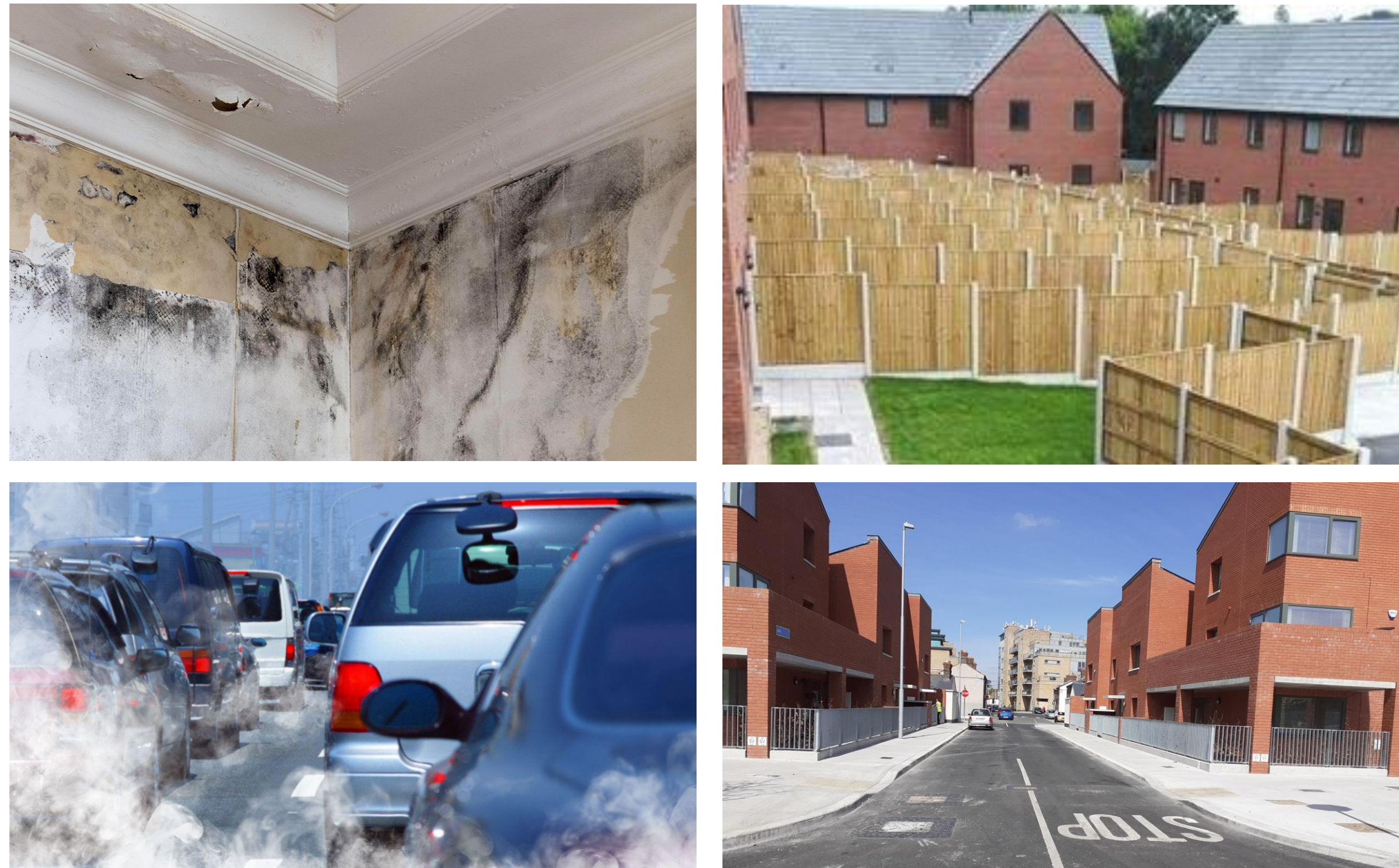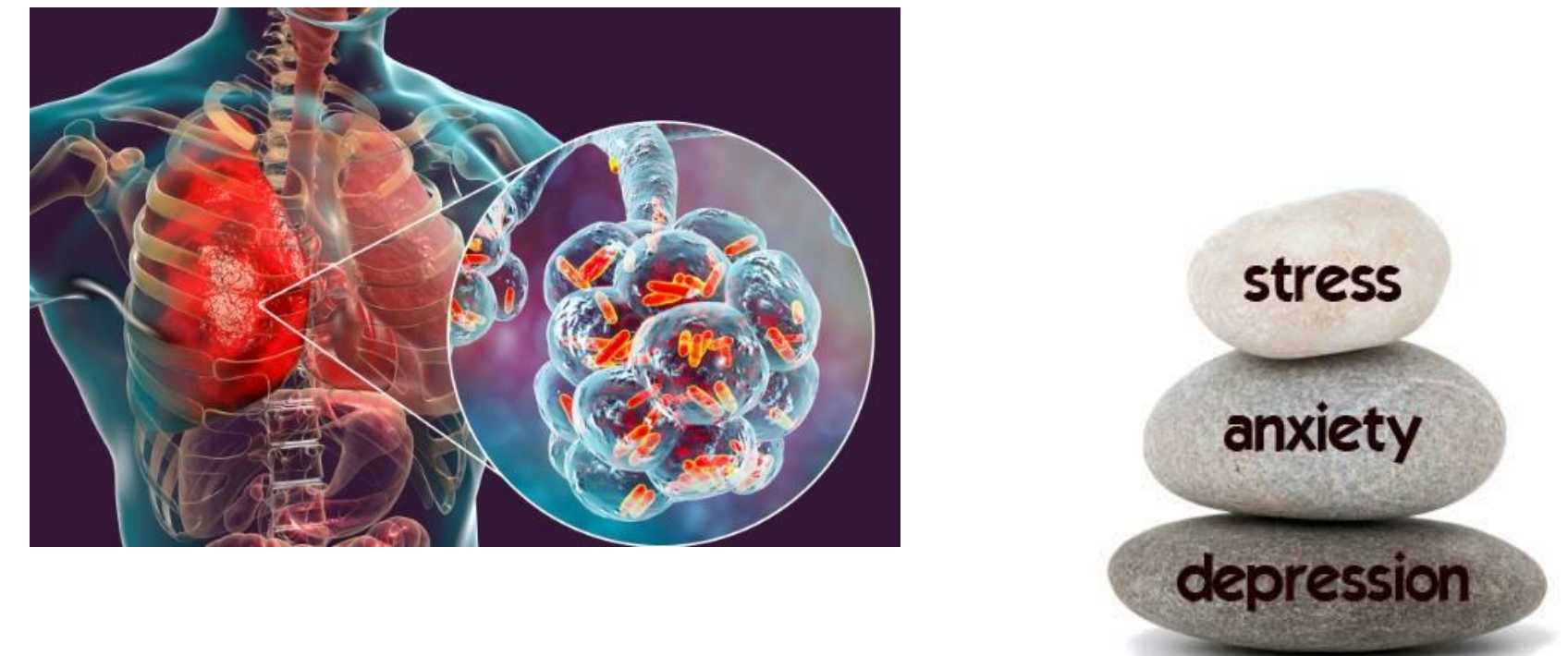HEALTHCARE

CULTURAL

Adapted from EIB 2023

Urban
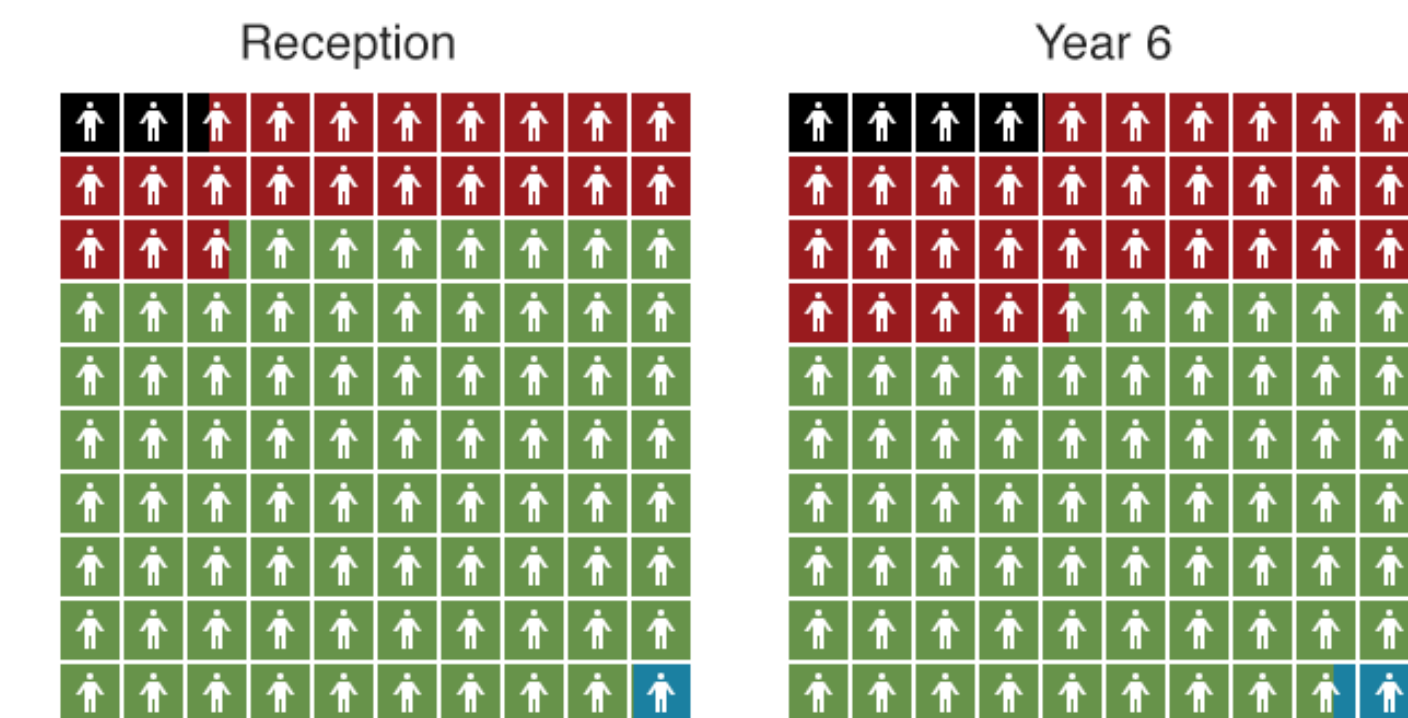
Health

Buildings, transport, outdoor space, streets, etc…

Ige et al. (2018, 2020), Eaton et al (2023)

Severely obese children in England

Severely obese | Overweight & obese | Healthy weight | Underweight

Reception
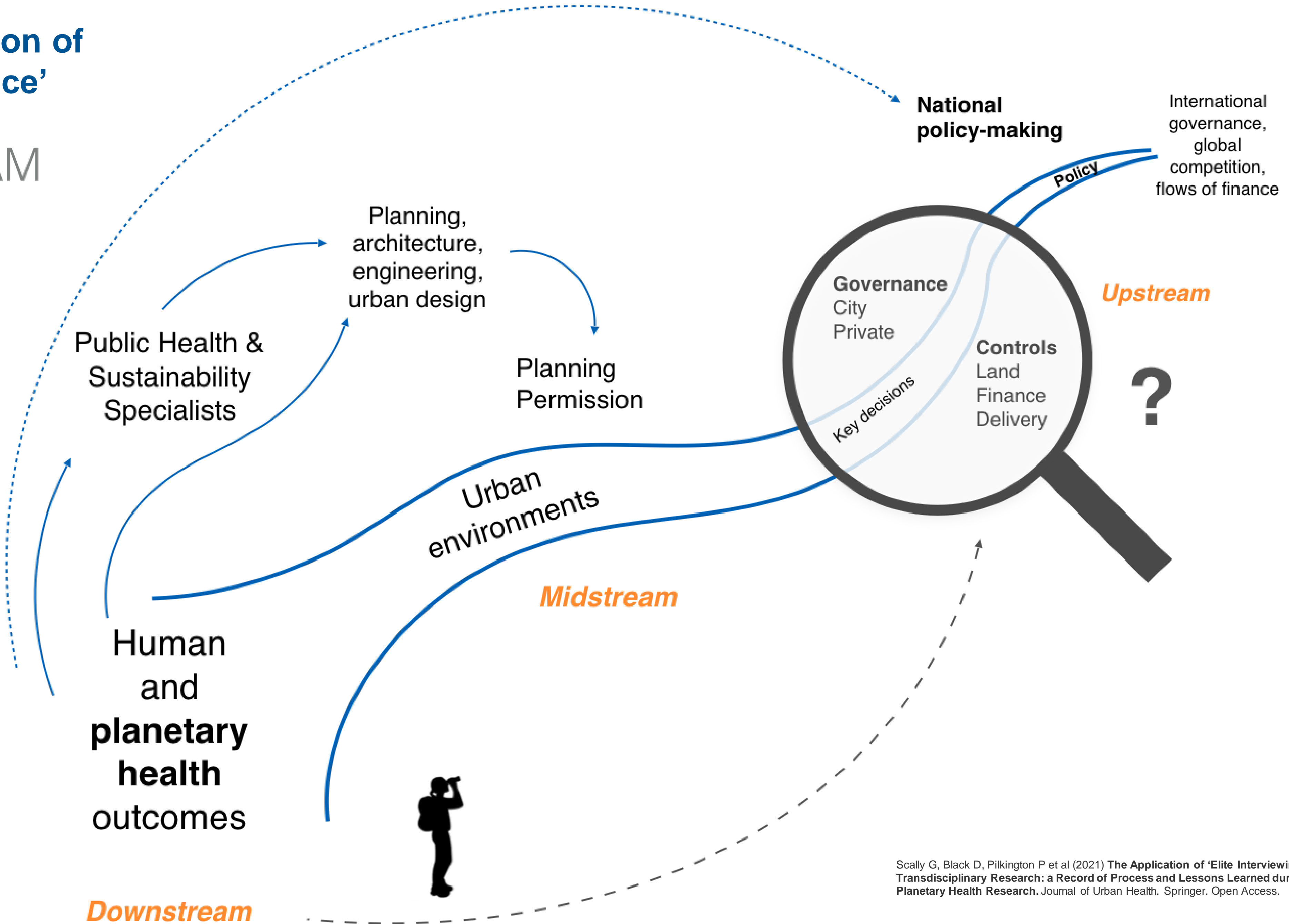
Year 6

stress
anxiety
depression

Source: Public Health England

BBC

Pilot illustration of 'problem space'

UPSTREAM

National policy-making

International governance, global competition, flows of finance

Policy

Upstream

Planning, architecture, engineering, urban design

Governance
City
Private

Controls
Land
Finance
Delivery

Public Health & Sustainability Specialists

Planning Permission

Key decisions

?

Urban environments

Midstream

Human and **planetary health** outcomes
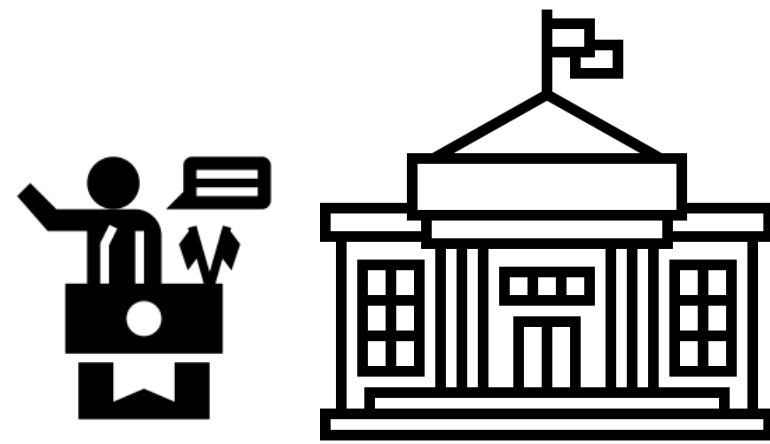
Downstream

Scally G, Black D, Pilkington P et al (2021) **The Application of 'Elite Interviewing' Methodology in Transdisciplinary Research: a Record of Process and Lessons Learned during a 3-Year Pilot in Urban Planetary Health Research.** Journal of Urban Health. Springer. Open Access.

Each system complex...

Let's take buildings as example...

ADMINISTRATIVE

BUILDINGS

TRANSPORT

WATER & WASTE
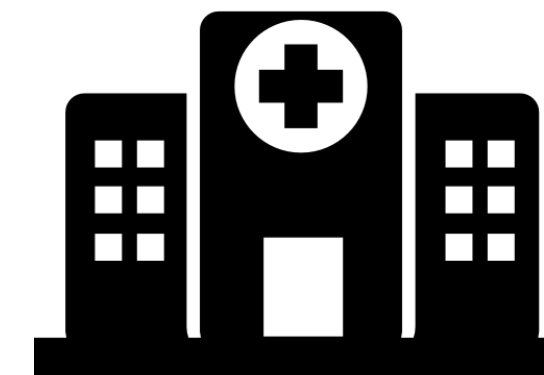
DIGITAL

EDUCATIONAL

SCHOOL

HEALTHCARE

CULTURAL

Adapted from EIB 2023
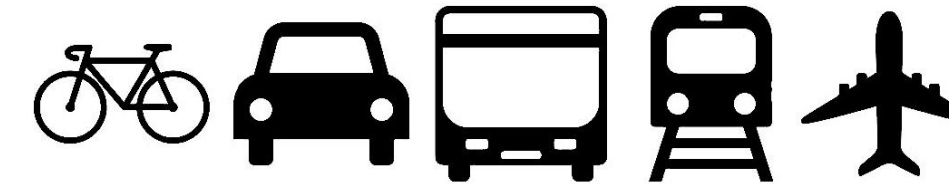
UK Property (private sector delivery)

Residential

Volume

Social

Commercial

Office

Retail

A GLANCE AT THE UK BUILD-TO-RENT MARKET INFOGRAPHIC
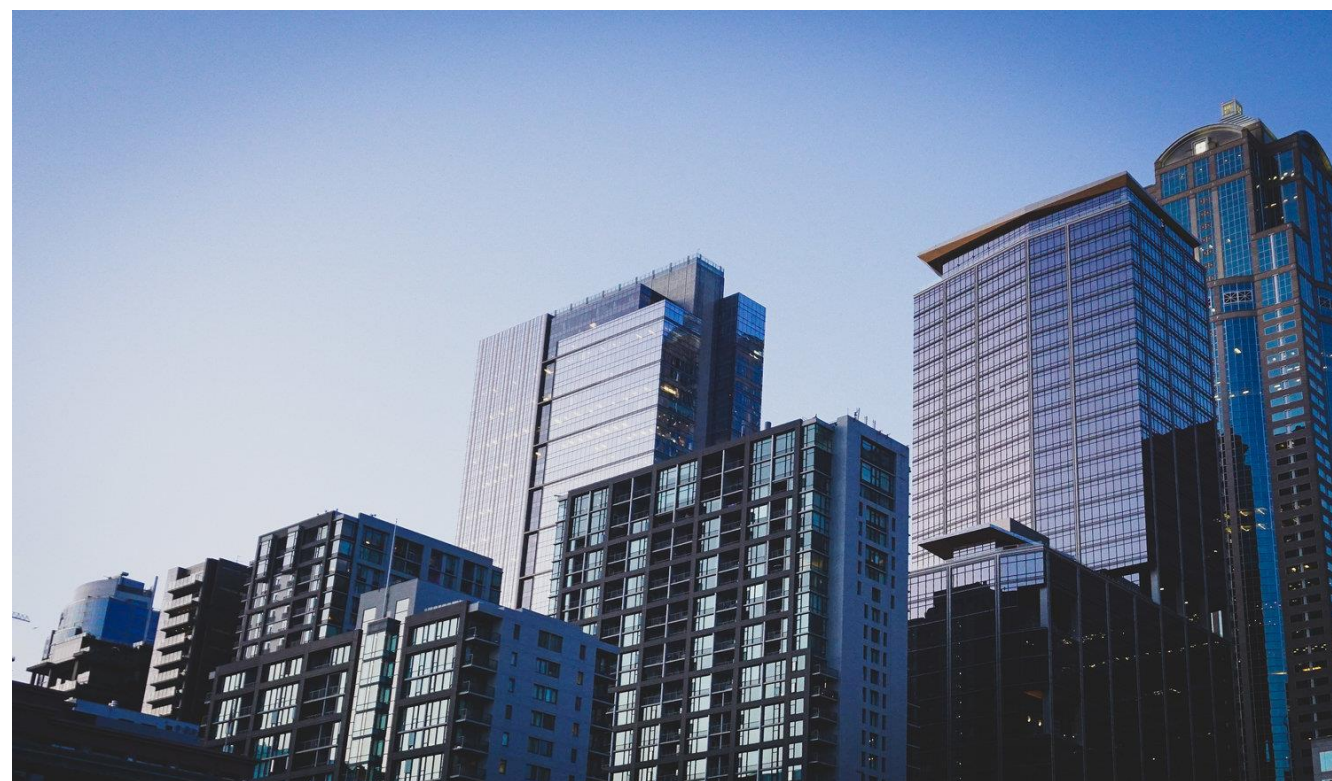
Low quality sprawl vs…   …unaffordable city centres

Building Design.
Intelligence for Architects

NEWS

Housebuilders lambasted for producing overwhelmingly bad designs

By Joey Gardiner | 21 January 2020

"The design quality of homes built by "greedy" volume housebuilders are overwhelmingly poor or mediocre…

…three-quarters of new homes constructed by large builders are of mediocre or poor design quality, with one in five so bad they should never have been given planning permission."

House prices and income - affordability

"…only the top quarter of earners in the capital can afford even London's cheapest homes (bottom 10% of house prices)"

- Erhart K (2018)

UK Prevention Research Partnership

is a £50 million multi-funder initiative that supports novel research into the primary prevention of **non-communicable diseases to improve population health and reduce health inequalities.**

Funders

Call Criteria

- "*New approaches* to population health research" (going beyond '*traditional*')
- *Whole* systems
- *Interdisciplinary*

- Multiple '*upstream*' actions
- *Co-creation* with *end users*
- '*Knowledge brokers*' key
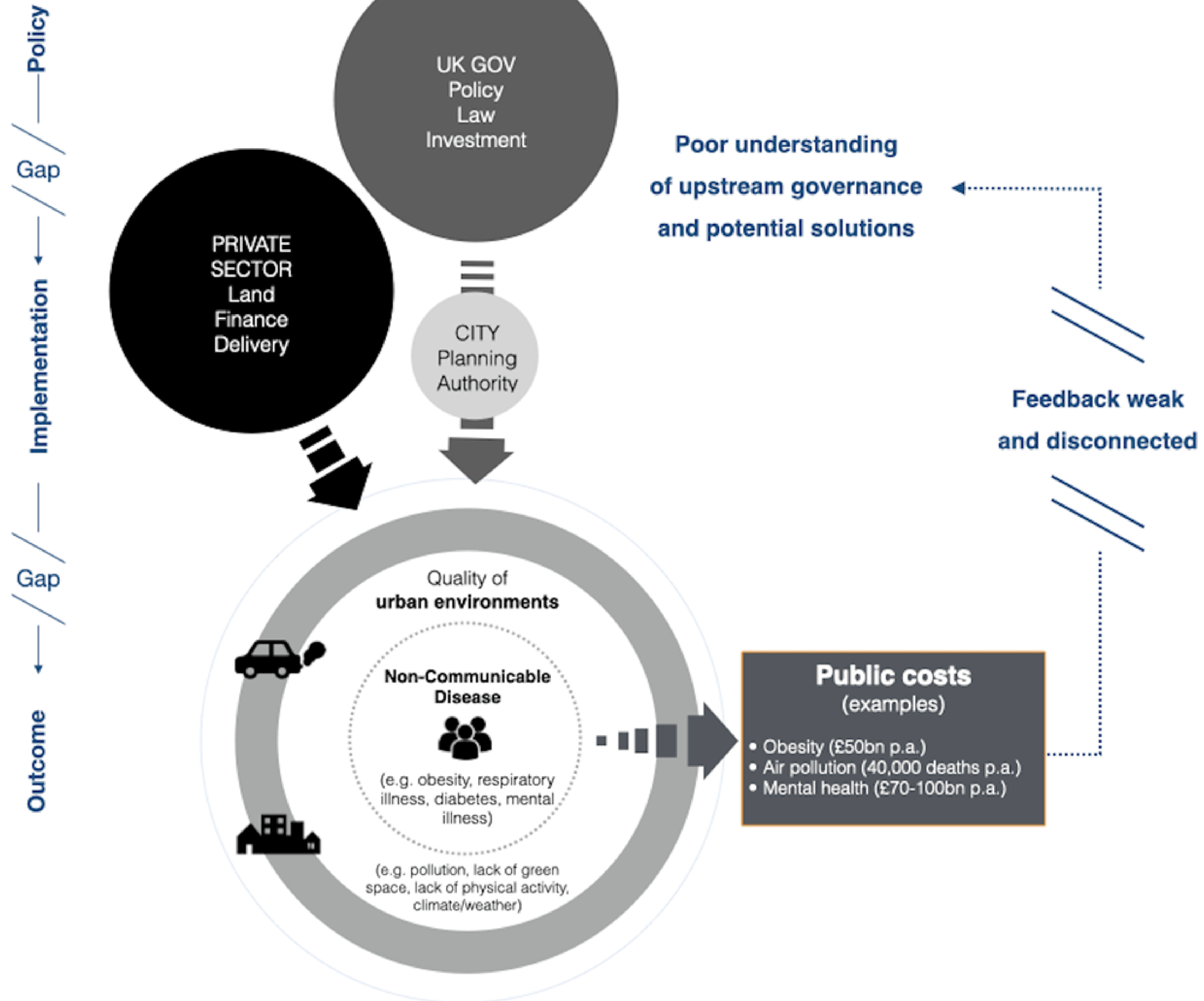- Solutions/societal impact (changes in *policy and practice*)

NCDs, health inequalities, and…

"*Our definition of planetary health is the achievement of the highest attainable standard of health, wellbeing, and equity worldwide…*

Put simply, planetary health is the health of human civilisation and the state of the natural systems on which it depends."

Rockefeller Foundation-Lancet Commission (2015) report

Policy

Gap

Implementation

Gap

Outcome

UK GOV
Policy
Law
Investment

PRIVATE
SECTOR
Land
Finance
Delivery

CITY
Planning
Authority

Poor understanding
of upstream governance
and potential solutions

Feedback weak
and disconnected

Quality of
urban environments

**Non-Communicable
Disease**

(e.g. obesity, respiratory
illness, diabetes, mental
illness)

(e.g. pollution, lack of green
space, lack of physical activity,
climate/weather)

Public costs
(examples)

- Obesity (£50bn p.a.)
- Air pollution (40,000 deaths p.a.)
- Mental health (£70-100bn p.a.)

6 universities, 40+ people, many areas of expertise:

public health, policy, economics, engineering, law, management, spatial planning, real estate investment…

TRUUD

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Senior Research Associate
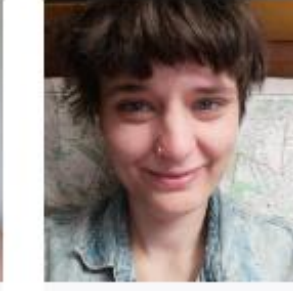Department of Civil Engineering
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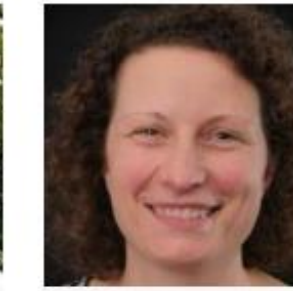University of Bath

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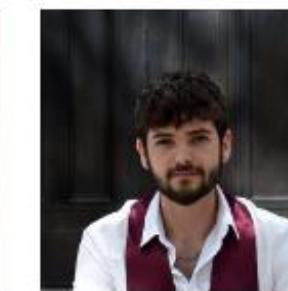
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Mariam Jamilah (IA3- Spatial Planning)
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Methods

Interviews
- 30 pilot interviews
- 123 interviews (132 interviewees)
- Purposive, snow-ball sampling (Phase 1)
- Large-group TD design and analysis

Workshops (x4 in Phase 1)
- Participatory mapping
- Causal loop diagrams

Economic valuation (environmental, health)
- Systematic reviews (urban-health evidence)
- Agent-based modelling
- GIS/Quality Outcomes Framework
- Database/tool development
- Testing and refining on case study projects

Intervention identification
- MRC Complex Intervention Framework
- Bespoke TRUUD Template
- Iterative, participatory selection

Phase II
- Emergent (participatory co-design)

Identified problem areas

National Govt: e.g.
Lack of: integration (health compartmentalised), comparable evidence, funding/long-term thinking/investment

Local Govt: e.g.
Resource, agency, lack of evidence

Private sector: e.g.
Dominant property delivery models, investment risk appetite, lack of incentives, short-termism

Third: e.g.
Land control/value, 'hope value', tax arrangements

Law: e.g.
Power asymmetry, resultant risk aversion, siloed legislation, systemic inertia

50 Areas of potential intervention identified

7 INTERVENTION AREAS TAKEN FORWARD

1. Corporate decision-making
2. Real estate investment
3. National government policy
4. City-region transport KPIs
5. Large-scale property – spatial plans
6. Law (legal capacity – local govt)
7. Public engagement (digital tools)

7 Intervention Areas
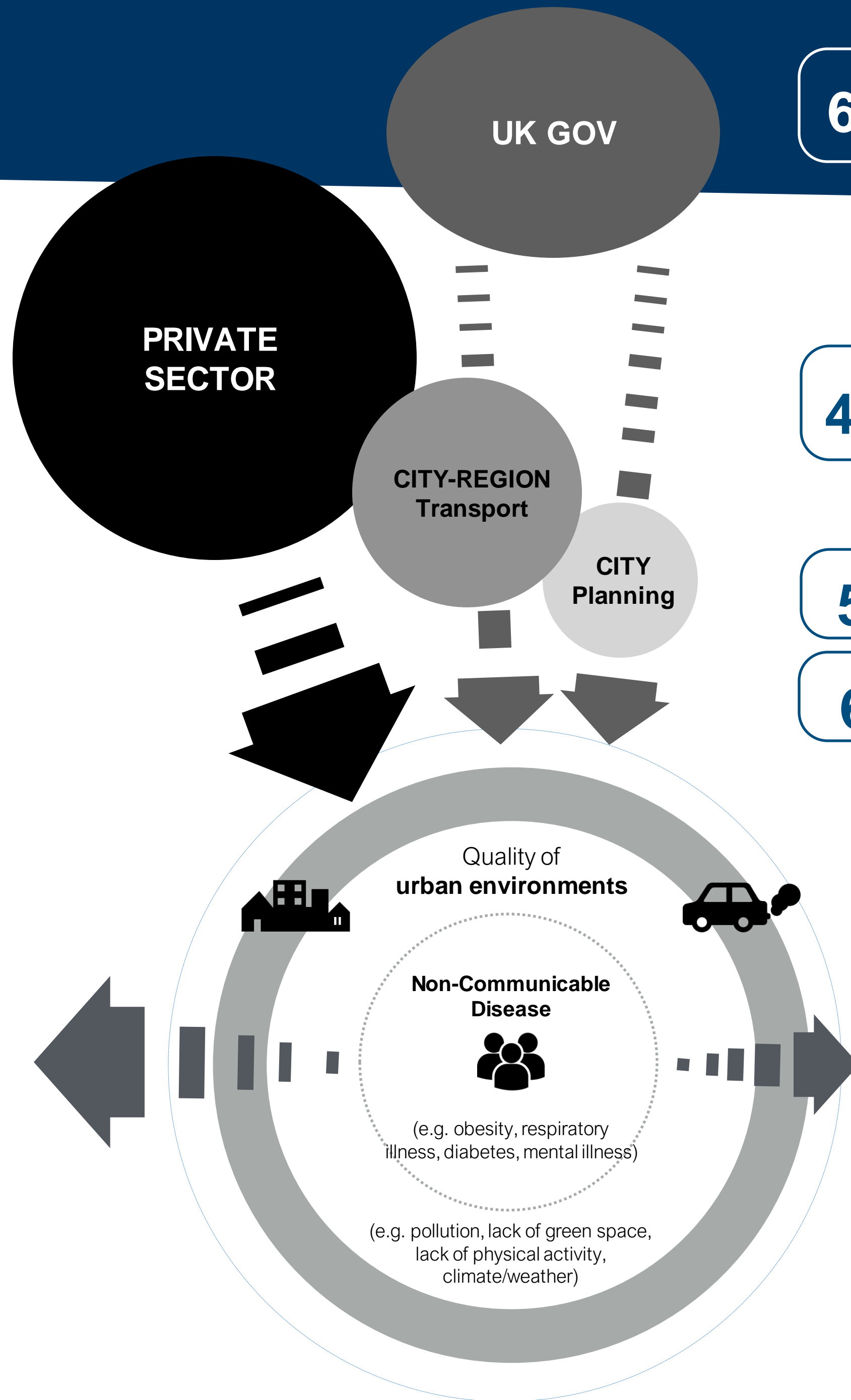
1 Government Valuation Tools

2 Corporate Decision-Making

3 Real Estate Investment

6a Legal Understanding

UK GOV

PRIVATE SECTOR

CITY-REGION Transport

CITY Planning

Combined Authority

4 Health Data in KPIs + Spatial Mapping

City Government

5 Valuation + HIA

6 Legal Understanding

Quality of **urban environments**

Non-Communicable Disease

(e.g. obesity, respiratory illness, diabetes, mental illness)

(e.g. pollution, lack of green space, lack of physical activity, climate/weather)

'External' Costs

Medical treatment

Sick leave / productivity

Pain & suffering'

Climate impacts

Biodiversity impacts

7 Amplifying citizen 'voice'

Talk 2:

An overview of TRUUD's use of systems approaches
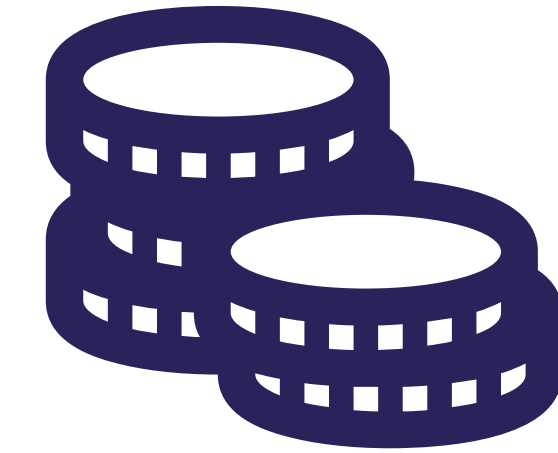to map the problem space and how this can support impact evaluation

Systems Maps

Interview transcript extract

"We were very careful about the design because we didn't want people to be stuck in a little flat with no ability to talk to neighbours or see what's going on outside (Level of Isolation Influenced by Design), so our actual design ended up a lot more expensive than it should have been (Expense of Design) because we were taking a lot of these factors into account (Design Considerations) and we may have to do some compromises (Potential Need for Compromise in Design), but at the beginning, that was our aim, to make sure that everybody didn't feel trapped in a little box (Need to Reduce Isolation of Residents)."
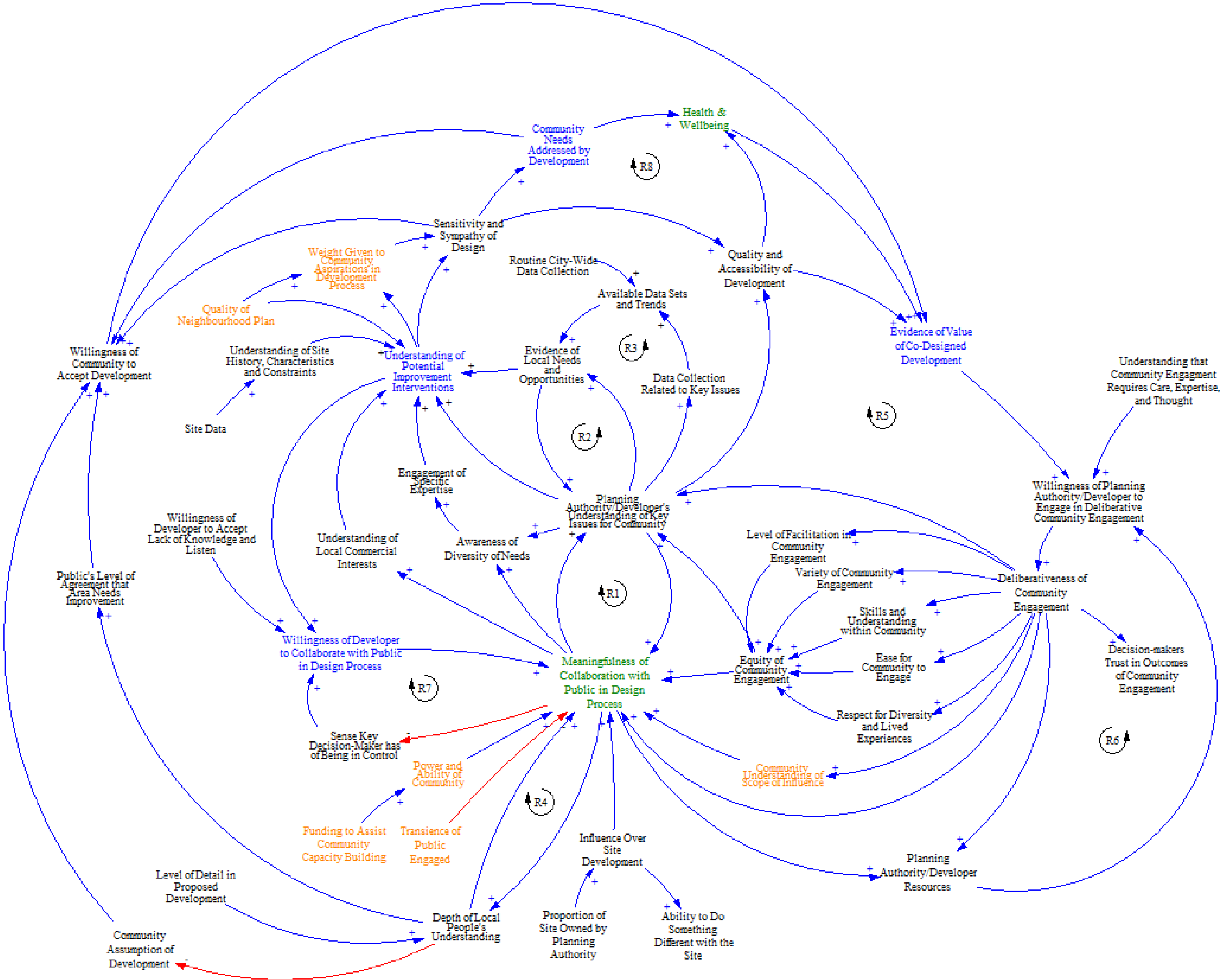
Causal loop diagram
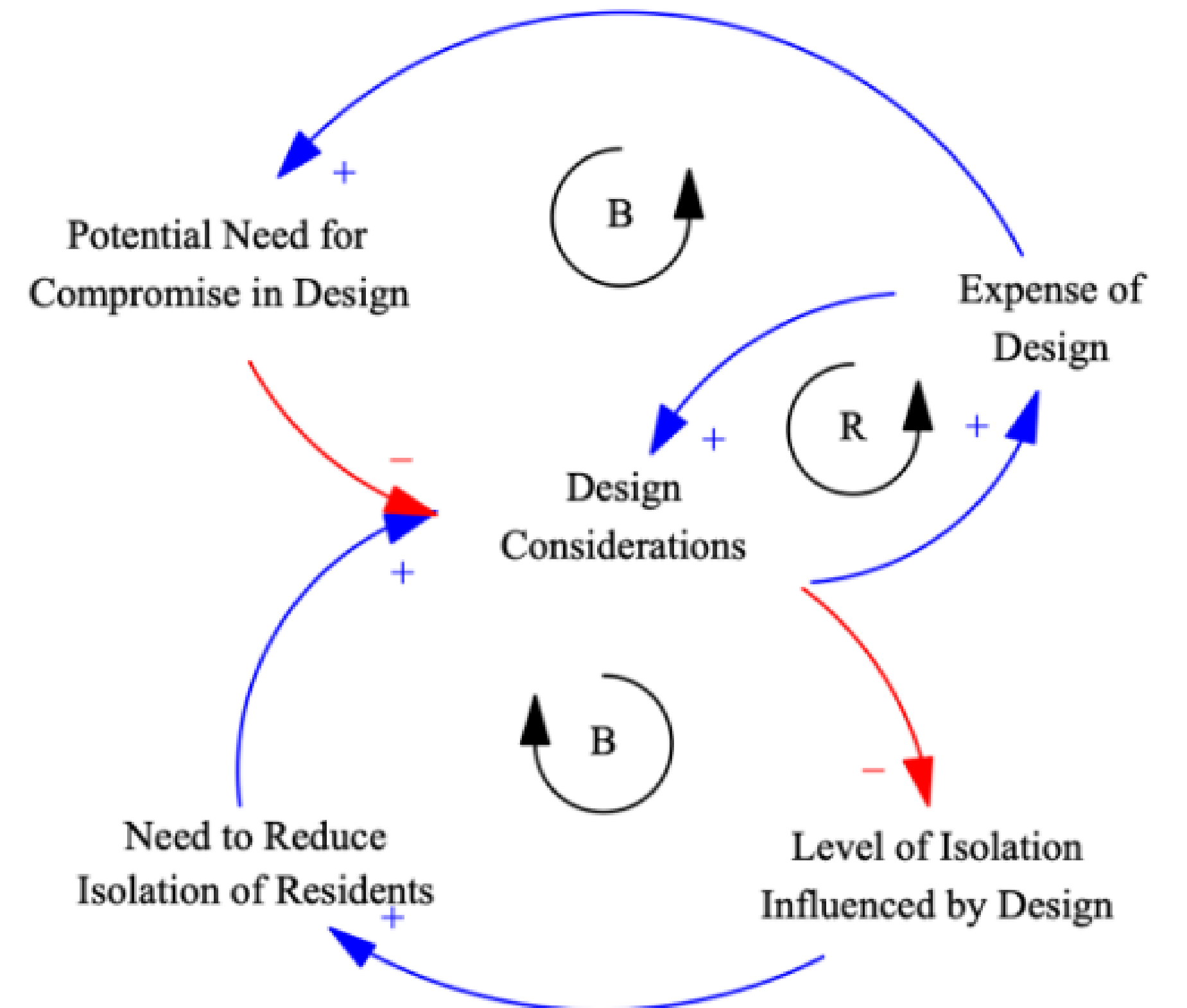
Once thematic analysis of interview transcripts complete:

All causal statements from interview transcript elements coded with '**Co-Design-Production-Delivery**' *extracted and used to create this model.*

This was then taken to a workshop for discussion and 'validation'.
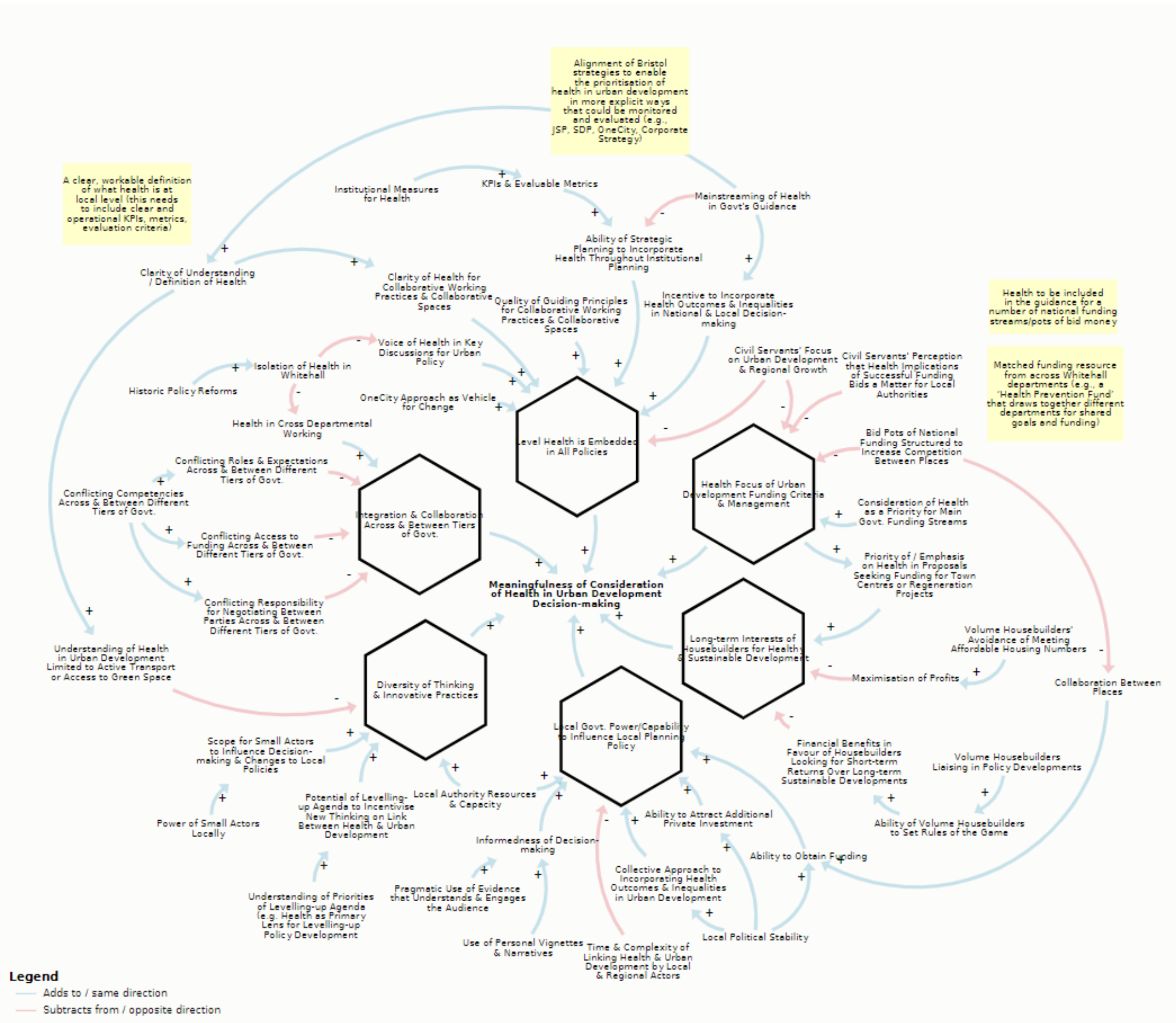
Semi-automated Process of Constructing CLDs

- Using the following query developed from inventories of causal expressions used in automated text analysis research…

so OR therefore OR thus OR as OR consequently OR consequence OR hence OR result OR accordingly OR account OR because OR cause OR ground OR owing OR reason OR due OR sake OR since OR why OR conclusion OR conclude OR "give rise" OR induce OR produce OR generate OR effect OR bring OR provoke OR arouse OR elicit OR lead OR trigger OR derive OR associate OR relate OR link OR stem OR originate OR "stir up" OR entail OR contribute OR "set up" OR "set in motion" OR conduce OR educe OR spark OR evoke OR implicate OR activate OR actuate OR kindle OR "fire up" OR stimulate OR "call forth" OR unleash OR effectuate OR "kick up" OR "give birth" OR "call down" OR "put forward" OR allow OR arise OR assure OR attribute OR avert OR avoid OR bar OR blame OR block OR "come after" OR "come from" OR compel OR create OR "depend on" OR deter OR discourage OR drive OR ease OR eliminate OR enable OR encourage OR engender OR facilitate OR feed OR foils OR follow OR force OR foster OR "get to" OR "got to" OR hamper OR "help to" OR hinder OR impede OR incite OR inhibit OR inspire OR "keep from" OR launch OR "lead to" OR mean OR necessitate OR oblige OR permit OR precipitate OR "predicate on" OR prevent OR prohibit OR promote OR prompt OR provoke OR require OR "restrain from" OR spur OR thwart

…approximately **17,000** potential causal phrases were identified in the corpus of interview transcripts

- On the thematic sub-category of 'Co-production-design-delivery', **51% of 145 potential causal phrases identified are actually causal**, others are non-causal uses of common words like "so" and "for" (i.e., false positives).

Newberry, P. and Carhart, N. (2024), Constructing causal loop diagrams from large interview data sets.
System Dynamics Review., 40: e1745. https://doi.org/10.1002/sdr.1745

Seven Causal Loop Diagrams were built from the main interview findings, each representing the collected views of a particular stakeholder perspective, on the extent and quality of the consideration of health in urban development decision-making
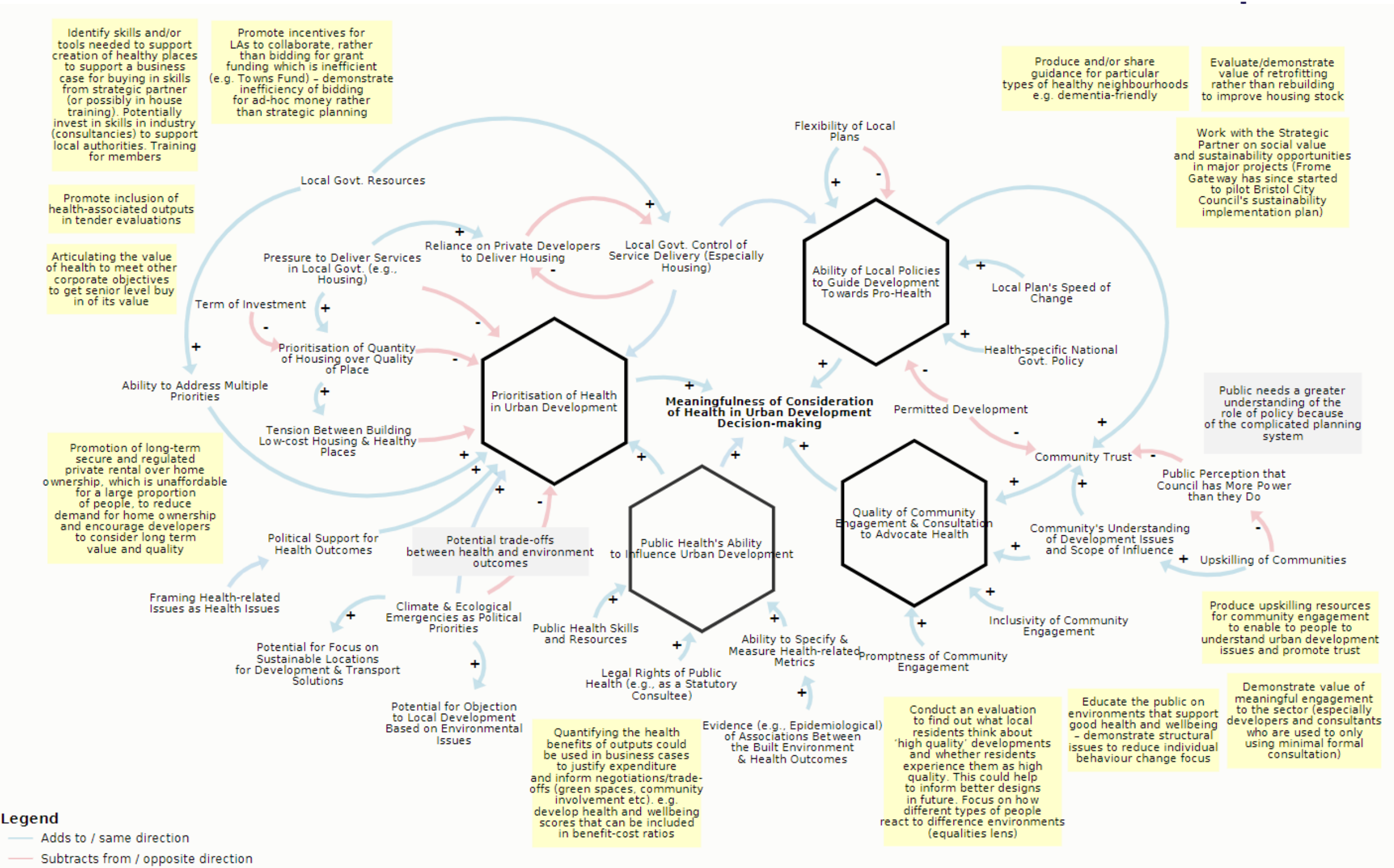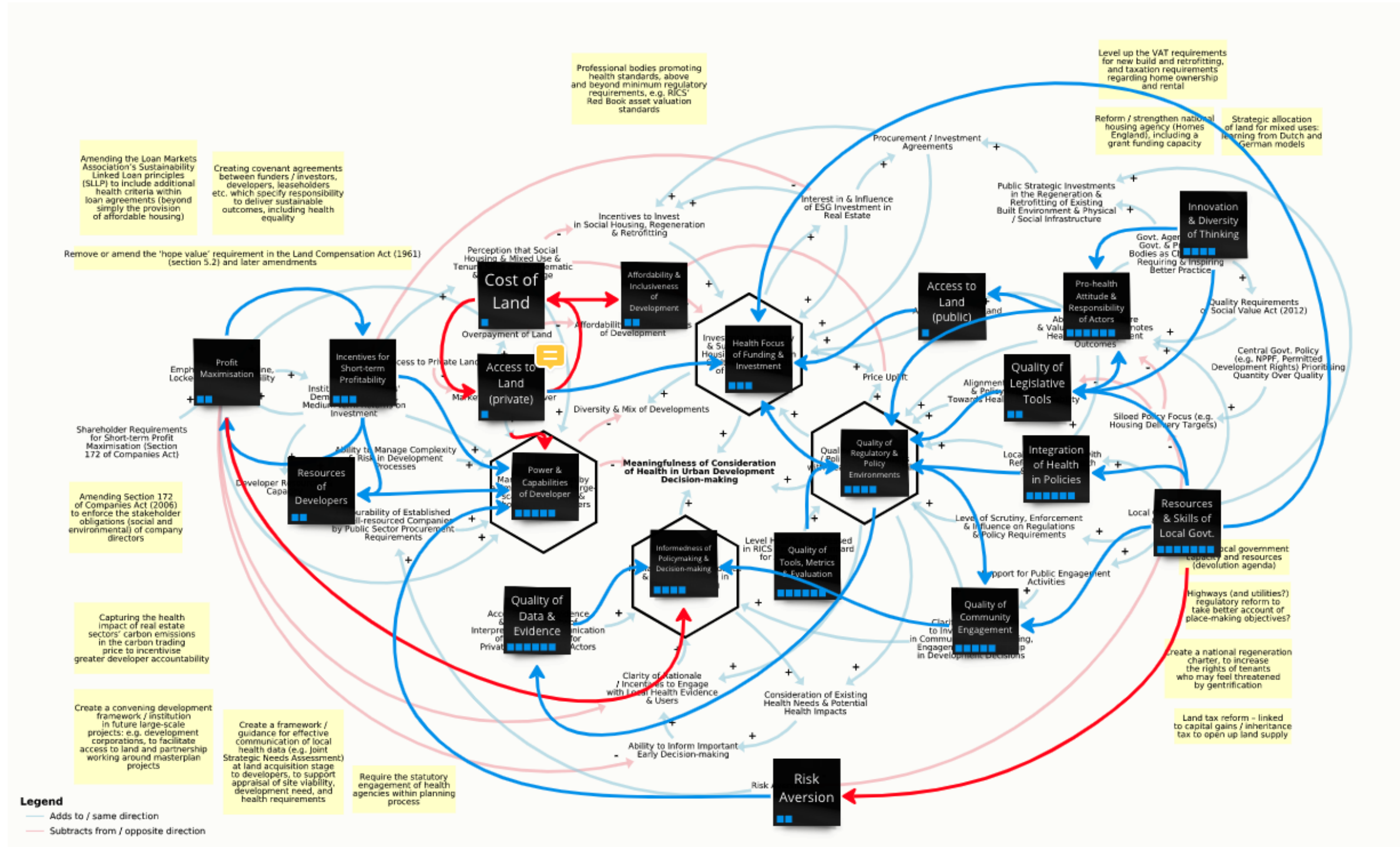
1 – Local & National Government

2 – Local Government

3 – National Government

4 – Private Sector (Corporate Governance)

5 – Private Sector (Real Estate)

6 – Private, Third and Hybrid Sector Orgs

7 – Spatial Planning

Legend
Adds to / same direction
Subtracts from / opposite direction

Variables grouped and new variables established
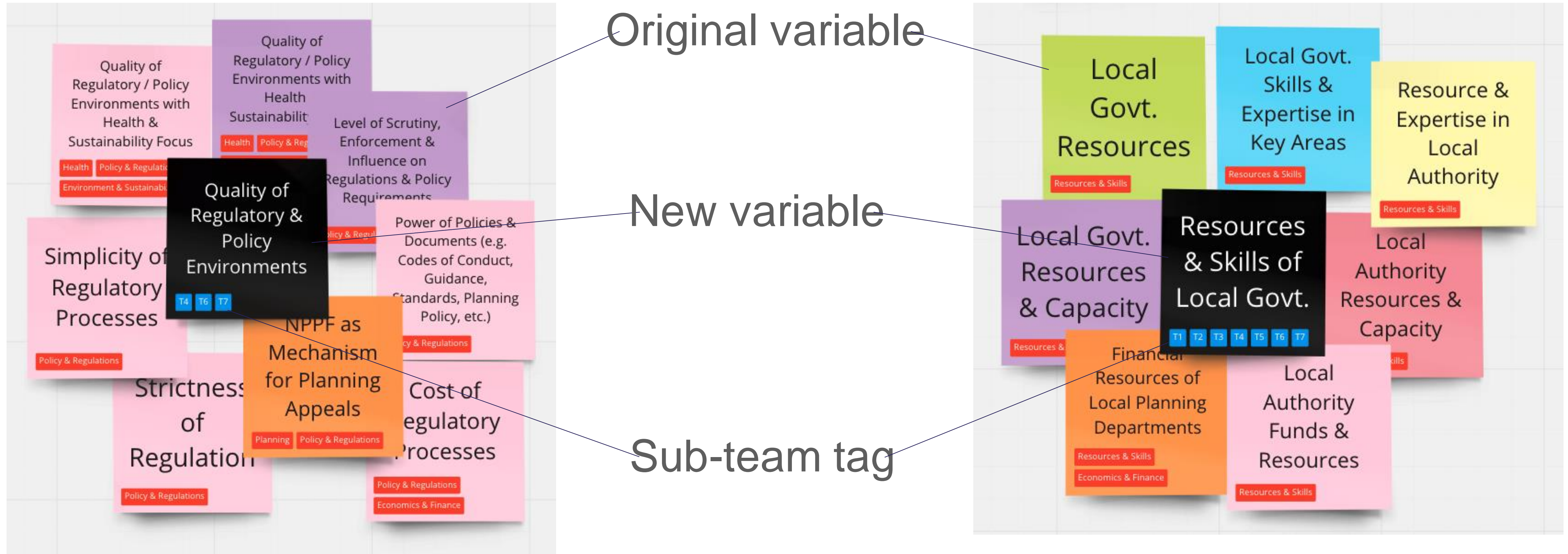
New variables overlaid on CLDs…

…and integrate them together.
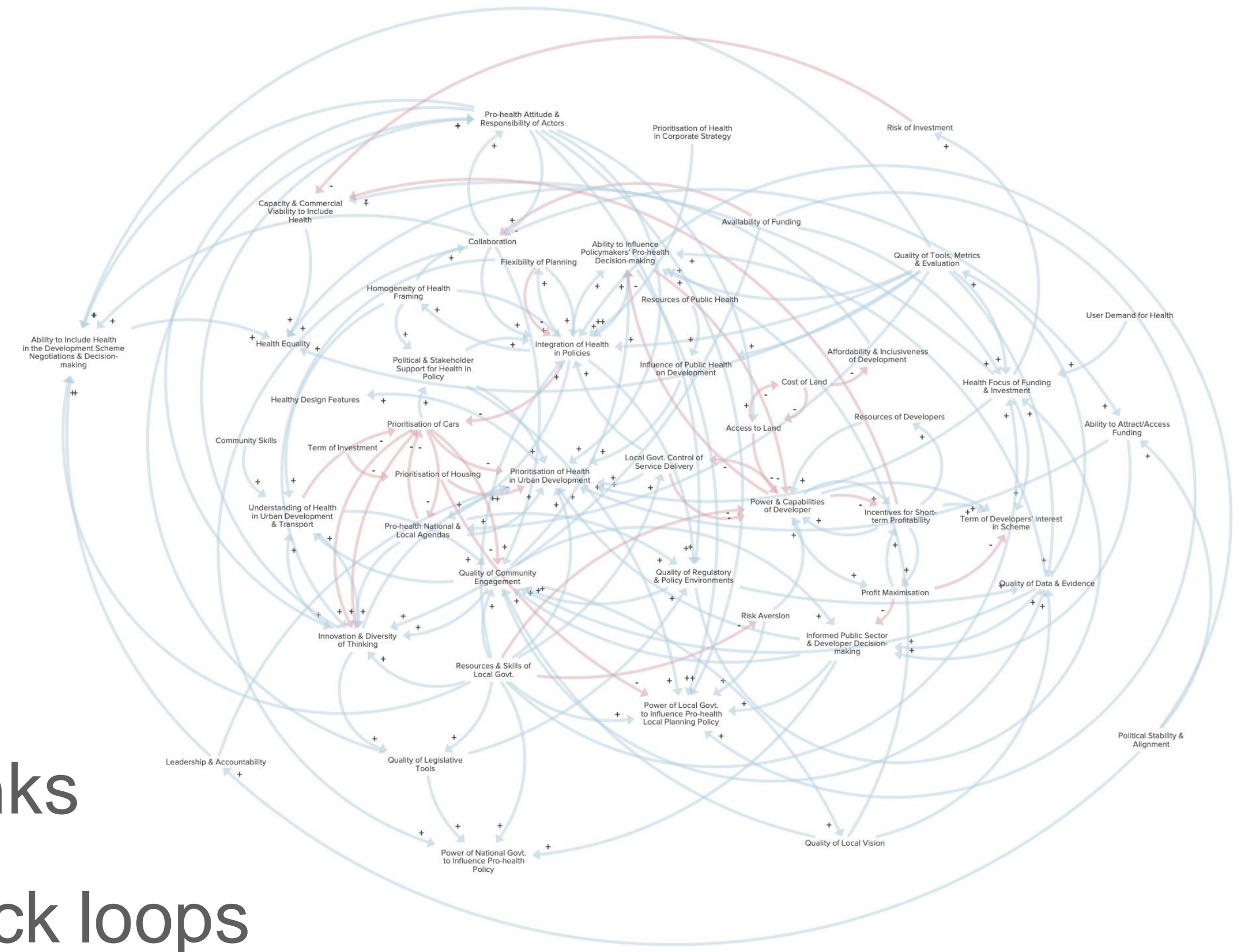
- **49** variables
- **144** causal links
- **3,341** feedback loops

systems

MDPI

Article

A Method for Simplification of Complex Group Causal Loop Diagrams Based on Endogenisation, Encapsulation and Order-Oriented Reduction

Vladimír Bureš iD

Faculty of Informatics and Management, University of Hradec Králové, Rokitanského 62, 50003 Hradec Králové, Czech Republic; vladimir.bures@uhk.cz; Tel.: +420-4-9333-2259
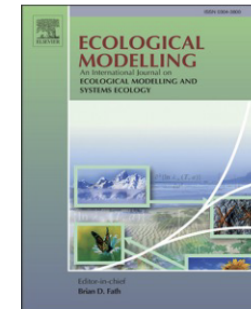
Development of methods for the simplification of complex group built causal loop diagrams: A case study of the Rechna doab

Muhammad Asif [a], Azhar Inam [a,*], Jan Adamowski [b], Muhammad Shoaib [a], Hisham Tariq [c], Shakil Ahmad [d], Mohammad Reza Alizadeh [b], Aftab Nazeer [a]

Summarised EEOR Method Steps:

1. Define required complexity
2. **Endogenisation**: Label then remove all exogenous variables
3. **Encapsulation**: Label then remove single-input single-output (SISO) variables and replace the links
4. If there are new exogenous variables, perform step 2 again.
5. If there are new SISO variables, perform step 3 again.
6. Repeat steps 4 and 5 until all exogenous and SISO variables disappear.
7. **Order-Oriented Reduction**: Label then remove SIDO or DISO variables
8. If required complexity is still not obtained, label then remove DIDO, TISO, SITO and TITO variables

Simplification of aggregated CLD
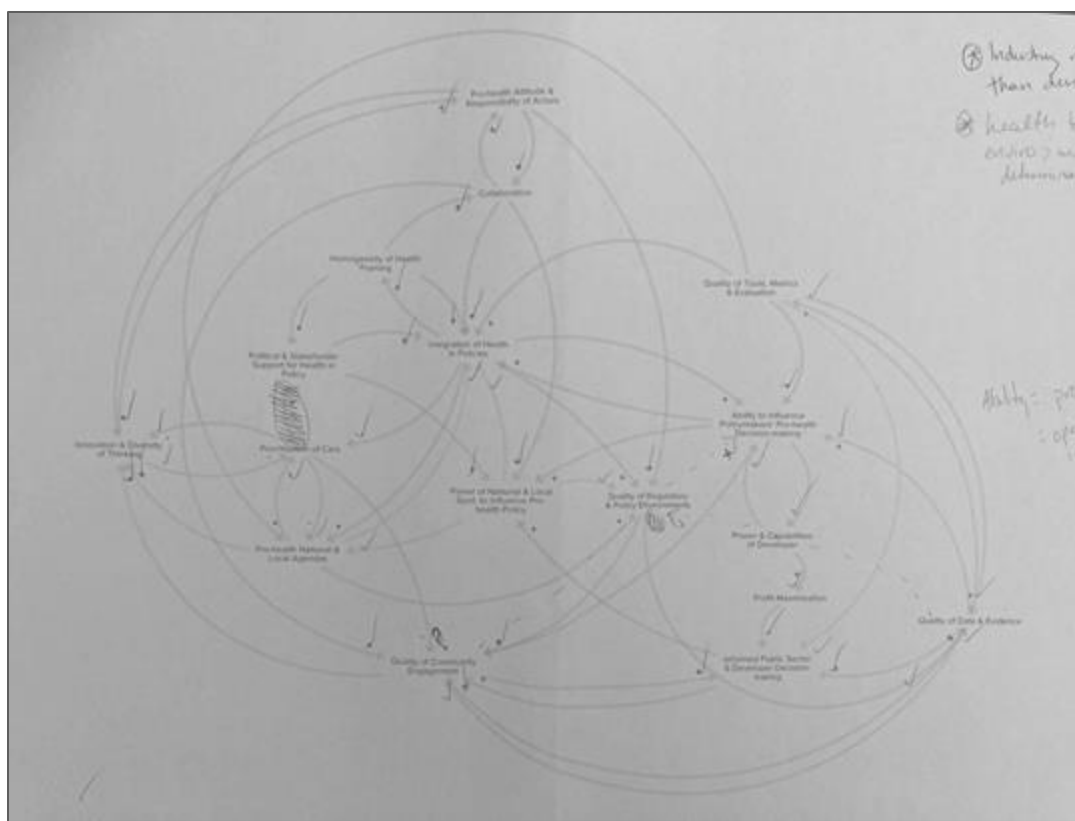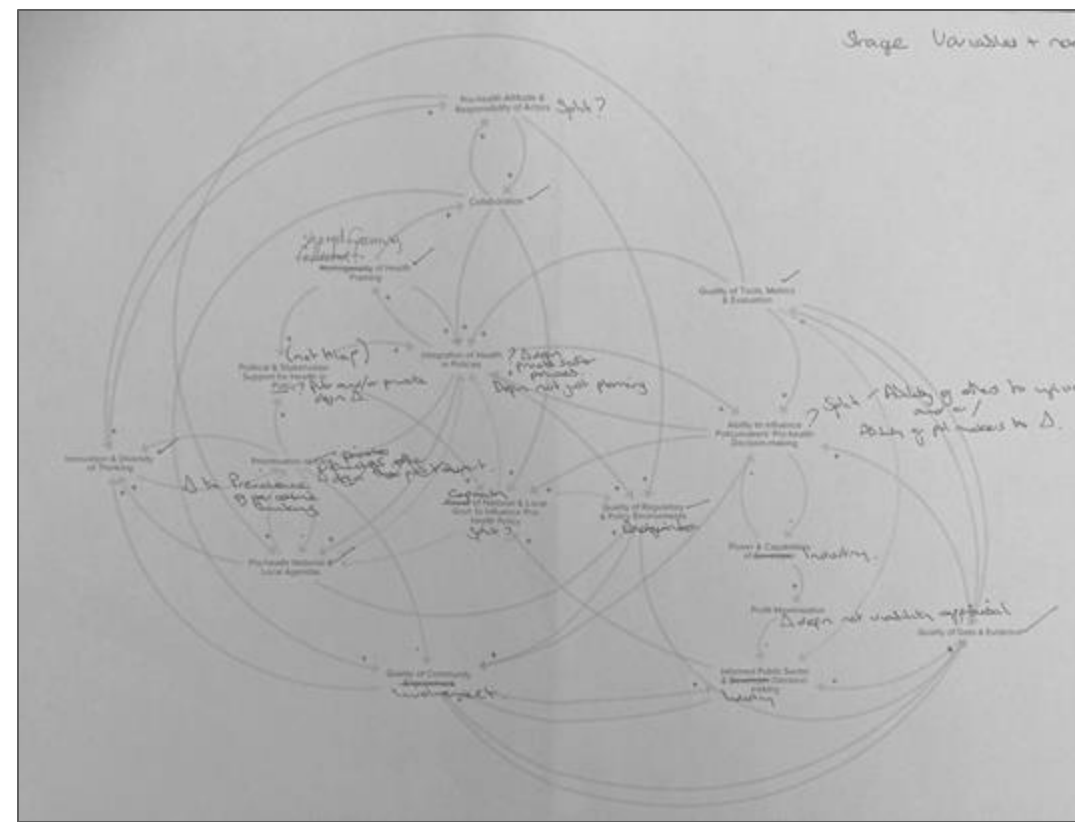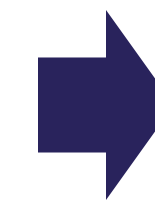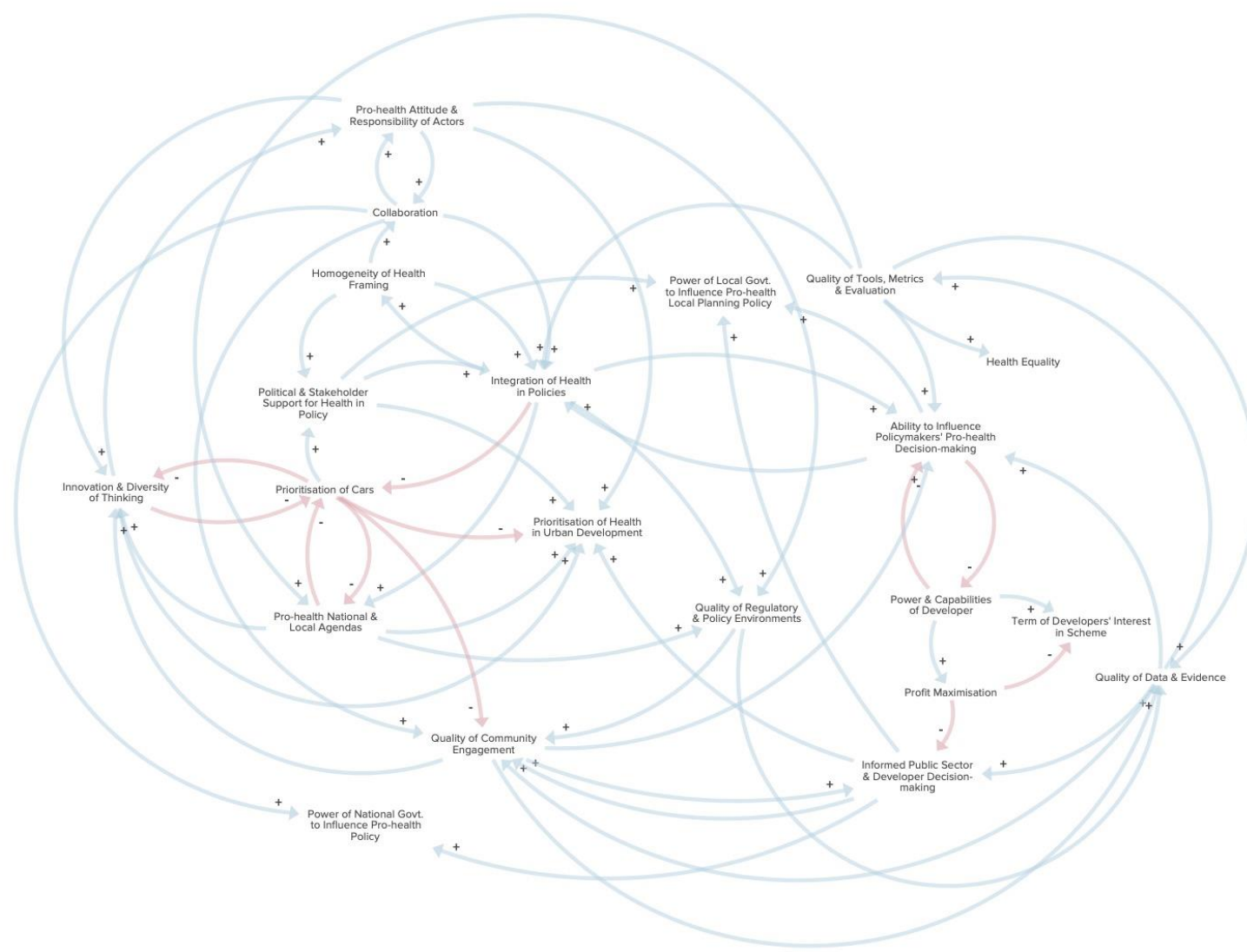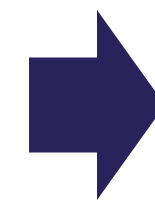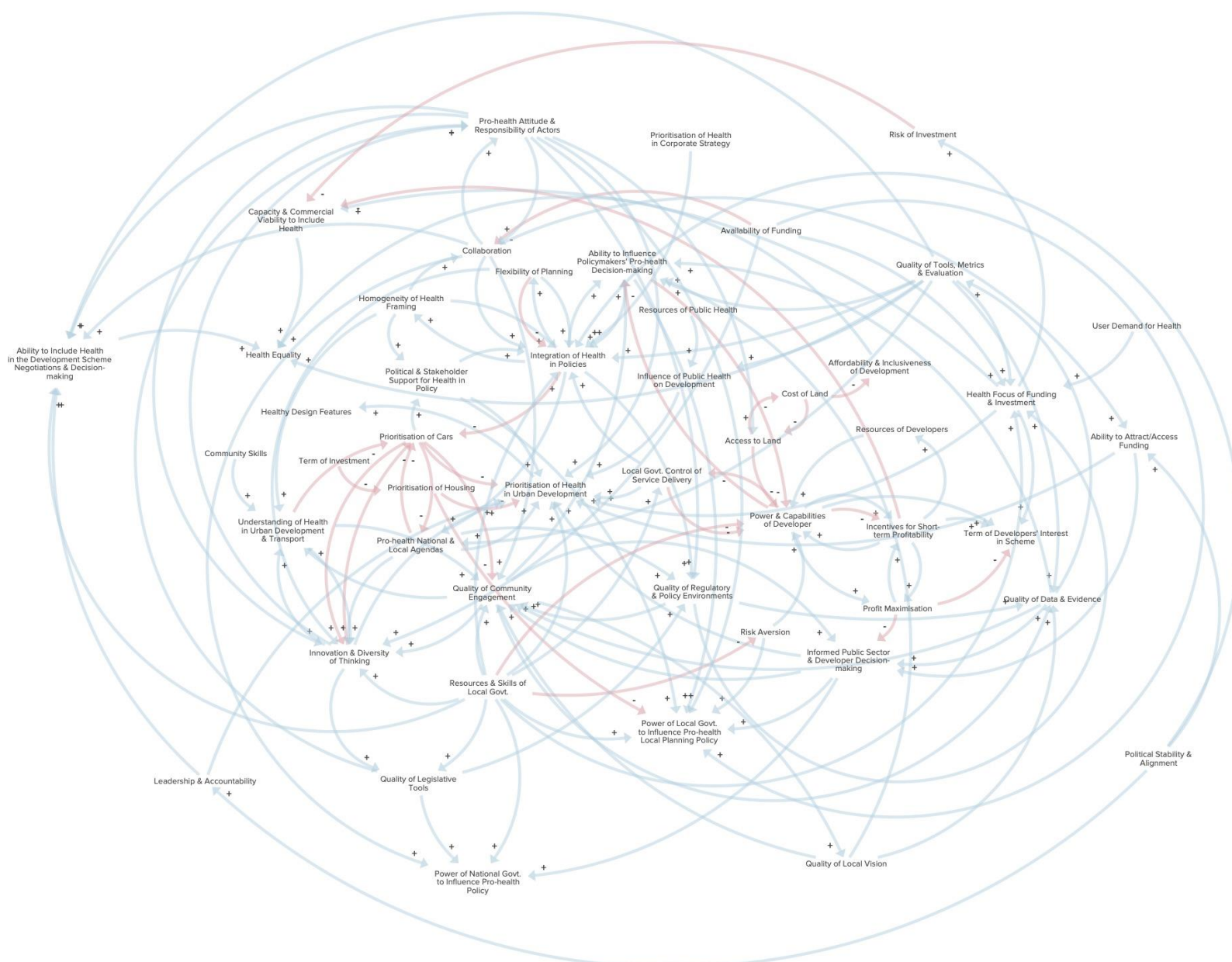
Maximum Complexity
49 variables
144 causal links

Simplification
21 variables
59 causal links

Refinement & Validation
10 project participants

https://bit.ly/TRUUD_System

Legend

→ Adds to / same direction

→ Subtracts from / opposite direction

1 Land & Development – Changing Mindsets

2 Real Estate – Investment Decision-making

3 National Government – Urban Policy

4 Health Advocacy – Legal Determinants

5 City-Region Government – Transport Planning

6 Local Government – Spatial Planning

7 Local Government – Legal Capacity

8 Local Community – Public Engagement

Pro-health Attitude & Responsibility of Actors

Collaboration

Collective Understanding of Health

Pro-health Funding & Investment

Quality of Evaluation Tools

Political & Stakeholder Support for Health in Policies

Integration of Health in Policies

Ability of Individuals/Groups to Influence Pro-health Decision-making

Innovation & Diversity of Thinking

Prevalence of Car-centric Thinking

Capacity of National & Local Govt. to Influence Pro-health Policy

Quality of Regulatory & Policy Environments

Power & Capabilities of Developer

Pro-health National & Local Agendas

Return on Investment

Capacity & Commercial Viability to Include Health

Realisation of ESG Financial Value

Quality of Community Involvement

Health-informed Decision-making

Quality of Data & Evidence

Pro-Health Attitude of Actors

Power & Capability of Developer
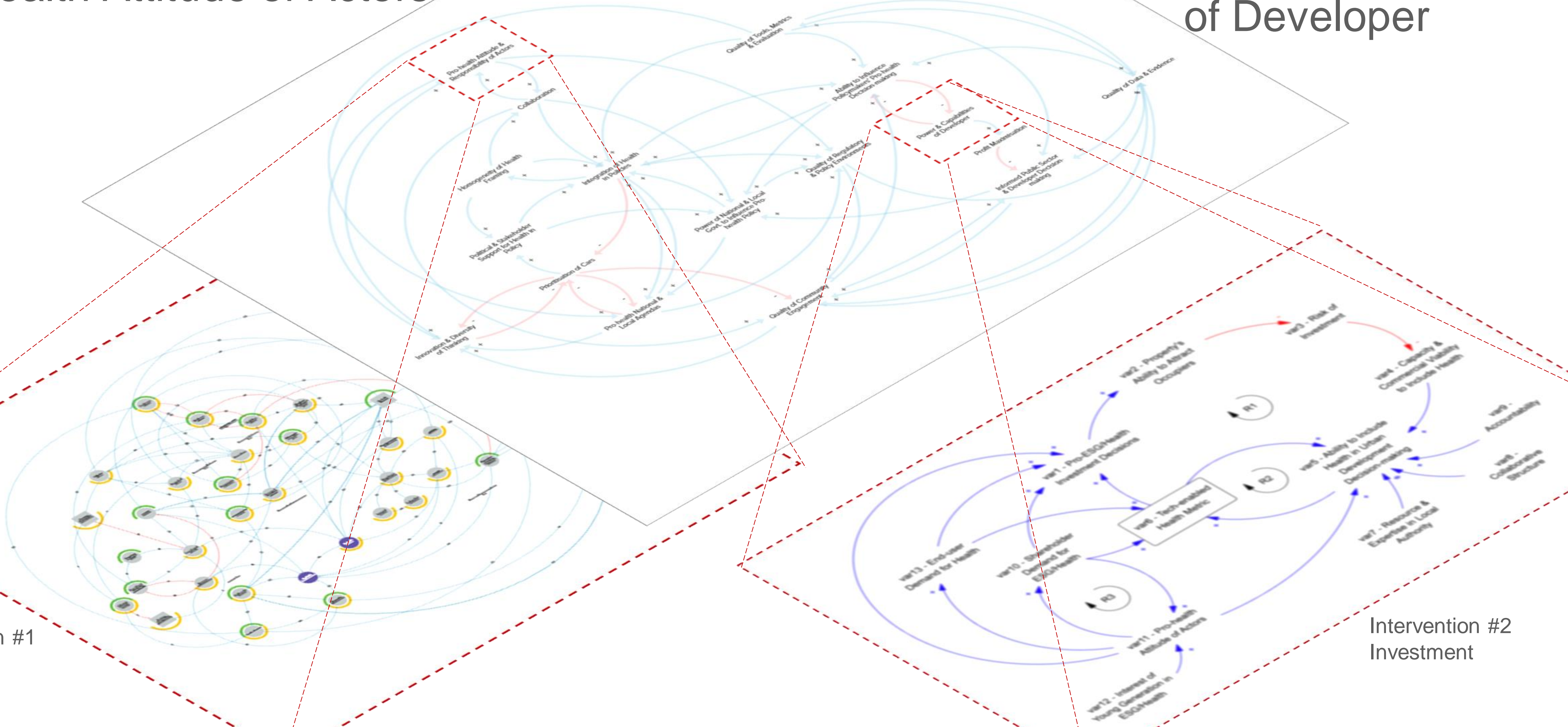
Intervention #1
Mindsets

Intervention #2
Investment

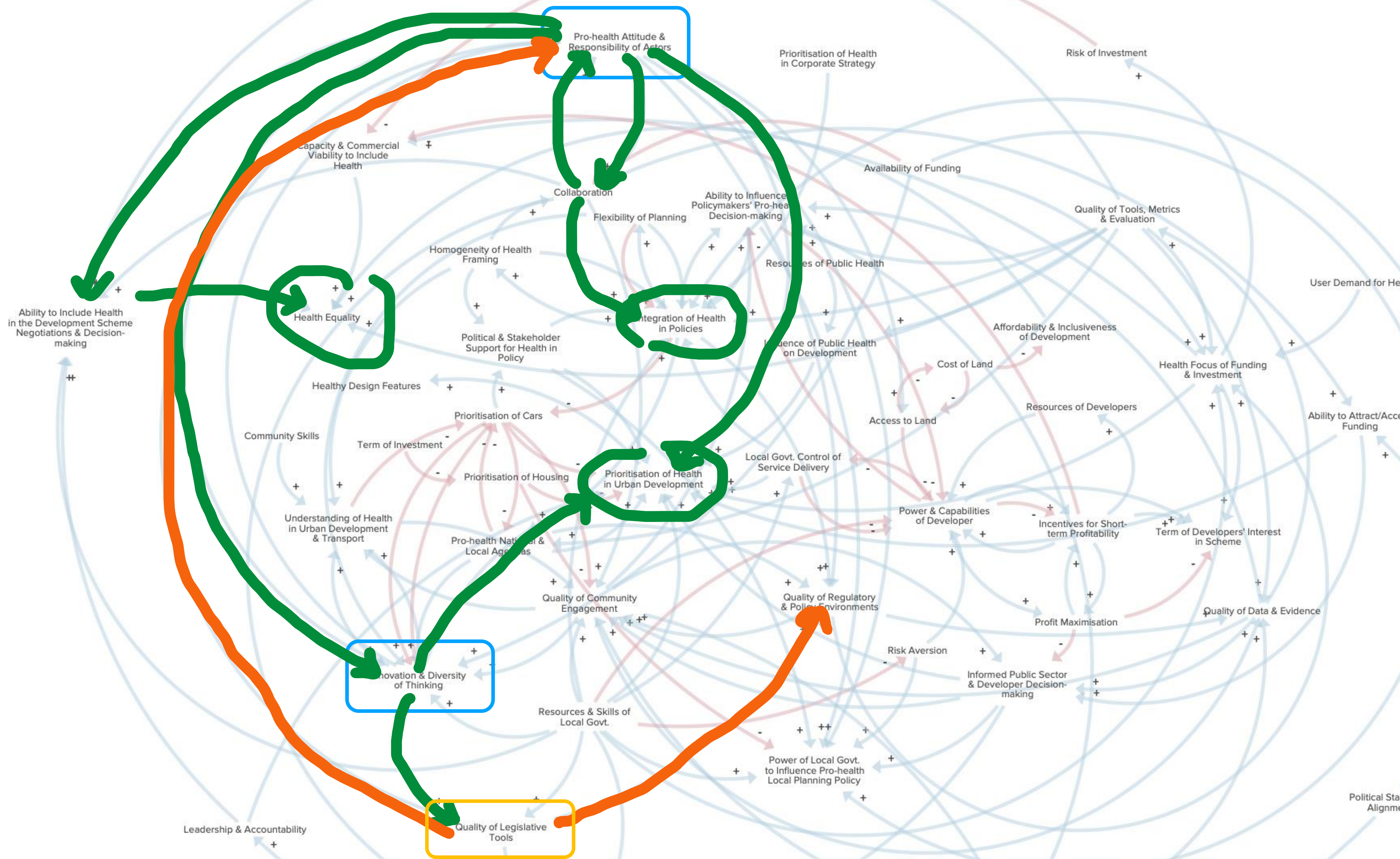# How does this inform evaluation?

Prioritisation of Health in Corporate Strategy

Risk of Investment

Pro-health Attitude & Responsibility of Actors

Capacity & Commercial Viability to Include Health

Availability of Funding

Collaboration

Ability to Influence Policymakers' Pro-health Decision-making

Quality of Tools, Metrics & Evaluation

Flexibility of Planning

Homogeneity of Health Framing

Resources of Public Health

User Demand for He

Ability to Include Health in the Development Scheme Negotiations & Decision-making

Health Equality

Integration of Health in Policies

Affordability & Inclusiveness of Development

Health Focus of Funding & Investment

Political & Stakeholder Support for Health in Policy

Influence of Public Health on Development

Cost of Land

Healthy Design Features

Prioritisation of Cars

Access to Land

Resources of Developers

Ability to Attract/Acce Funding

Community Skills

Term of Investment

Local Govt. Control of Service Delivery

Understanding of Health in Urban Development & Transport

Prioritisation of Housing

Prioritisation of Health in Urban Development

Power & Capabilities of Developer

Incentives for Short-term Profitability

Term of Developers' Interest in Scheme

Pro-health National & Local Agendas

Quality of Community Engagement

Quality of Regulatory & Policy Environments

Profit Maximisation

Quality of Data & Evidence

Innovation & Diversity of Thinking

Risk Aversion

Informed Public Sector & Developer Decision-making

Resources & Skills of Local Govt.

Power of Local Govt. to Influence Pro-health Local Planning Policy

Political Sta Alignme

Leadership & Accountability

Quality of Legislative Tools

Talk 3:

How does a systems approach relate to
the MRC/NIHR Complex Intervention Guidance?

Skivington et al., BMJ, 2021 'An new framework for developing and evaluating complex interventions: update of Medical Research Council guidance' https://pubmed.ncbi.nlm.nih.gov/34593508/

"Complex intervention research can take an efficacy, effectiveness, theory based and/or systems perspective"
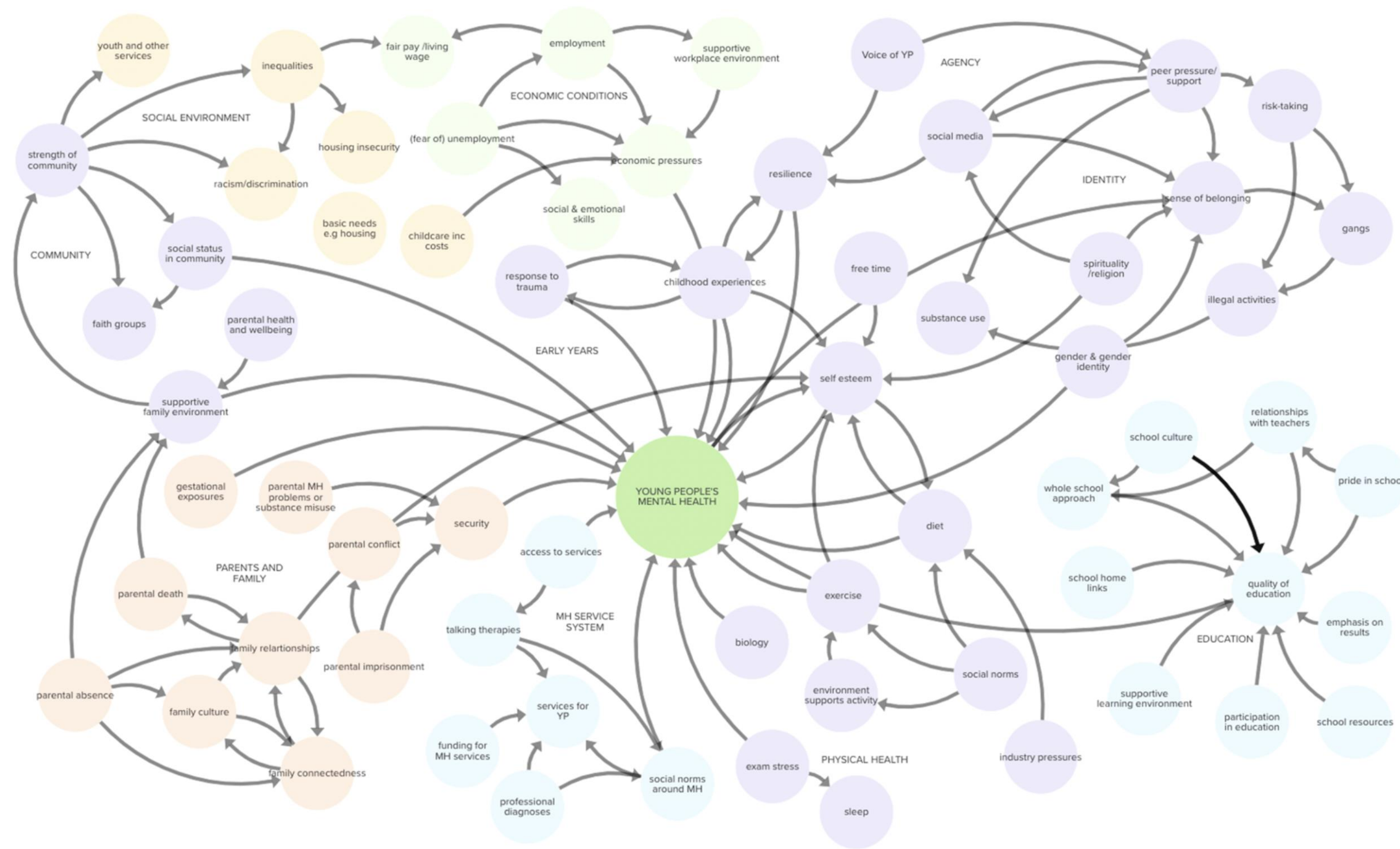
Why a systems approach for evaluation of public health interventions?

Health Foundation, 2019

- Health outcomes and inequities have multiple, wider (systemic?) determinants
- These determinants interact and work together
- We are intervening in real world, complex, *changing* contexts
- Disrupting the system more effective / sustainable change: events in systems

Wellbeing in Secondary Education (WISE) Study to Improve the Mental Health and Wellbeing of Teachers: A Complex System Approach to Understanding Intervention Acceptability

Rhiannon Evans,✉1 Sarah Bell,2 Rowan Brockman,2 Rona Campbell,3 Lauren Copeland,1 Harriet Fisher,2 Tamsin Ford,4 Sarah Harding,5 Jillian Powell,5 Nicholas Turner,2 and Judi Kidger2

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"Yes, it's much better to offer support, but the context, That's the challenge, it's trying to think oh yes, I'm trying to get the best out of people's performance and everything else. You understand, but whether your line manager will understand. So it needs empathy throughout the system really, to give you a bit of space."

Context is key

A school based intervention to improve teacher mental health through training and peer support is undermined by the working culture, where staff feel overworked, and unable to admit that they are struggling to cope

"How do the system and intervention adapt to one another?"

Different questions?
Change / impact versus outcome / effectiveness
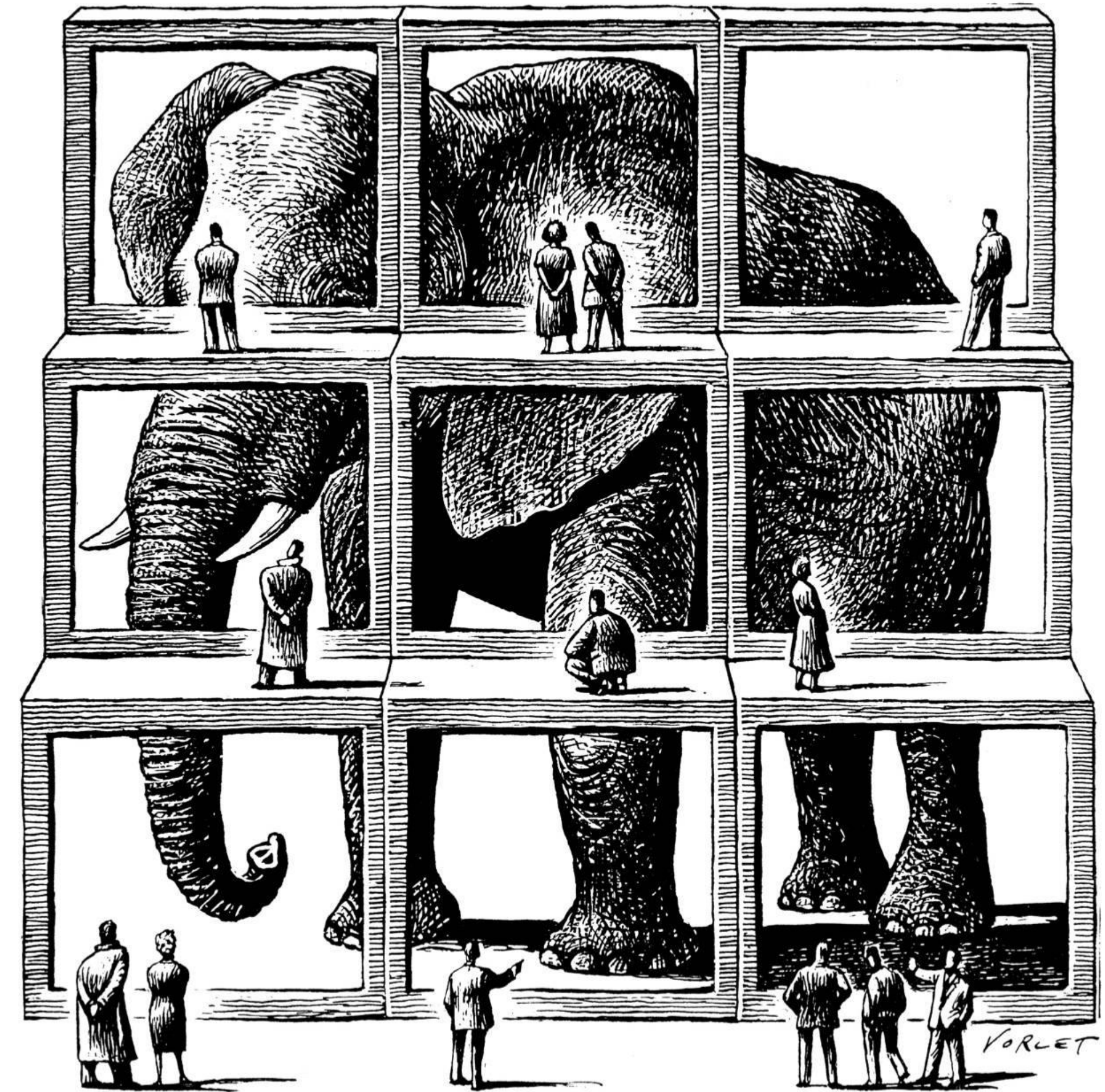Wider range of impacts than we might consider in more traditional designs

Outcomes measured in public health evaluations can be system level changes, e.g. new policies, changes in culture, normalisation of a new practice
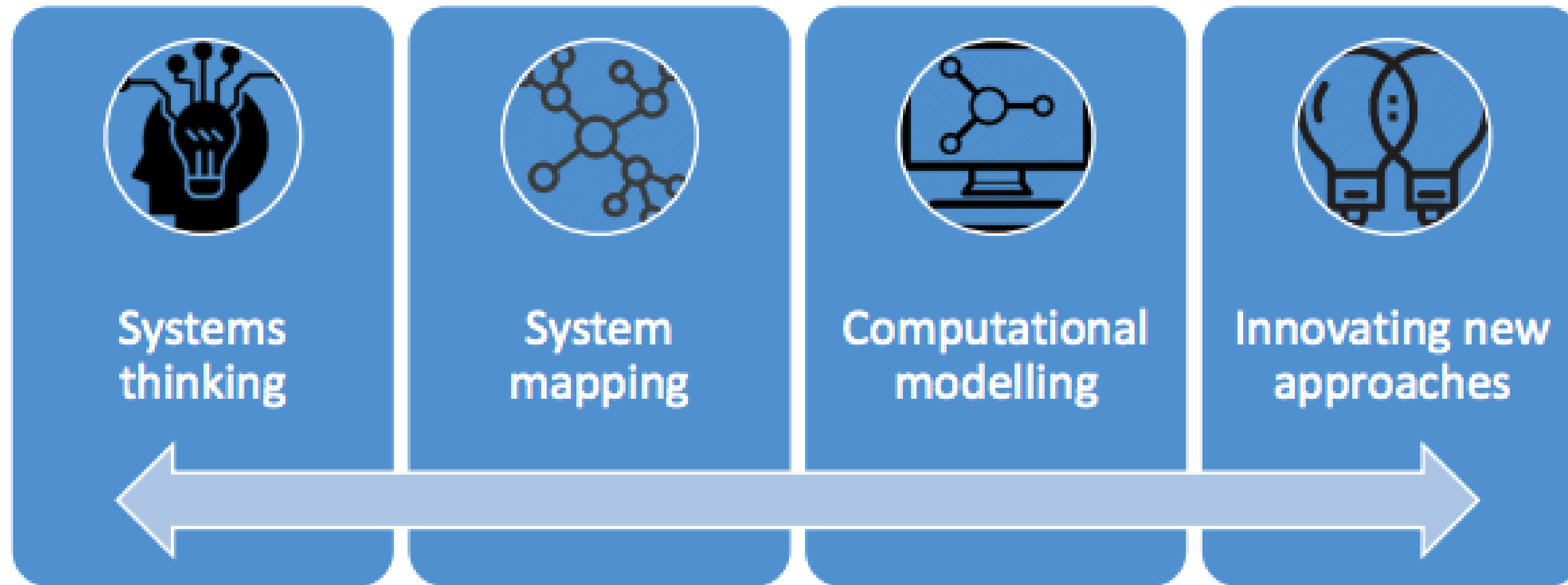
Can answer similar questions to more traditional process evaluations

- Why did the intervention have the effect or not that was intended?

- What unintended effects did it have (good or bad)?

- How might the changes impact on inequalities?

- How sustainable are the changes?

- Could this be implemented in other parts of the system, or in other systems?

Systems mapping to guide research/practice

- Supports development of programme theory

- Helps identify priorities to focus on

- Highlights gaps in knowledge

- Identifies data sources

- Identifies where context / other factors may facilitate or prevent change

- Big picture thinking enables a strategic response

Figure 1: Approaches to systems evaluation

NIHR SPHR Guidance for developing a systems perspective for the evaluation of local public health interventions

https://sphr.nihr.ac.uk/guidance-for-developing-a-systems-perspective-for-the-evaluation-of-local-public-health-interventions/
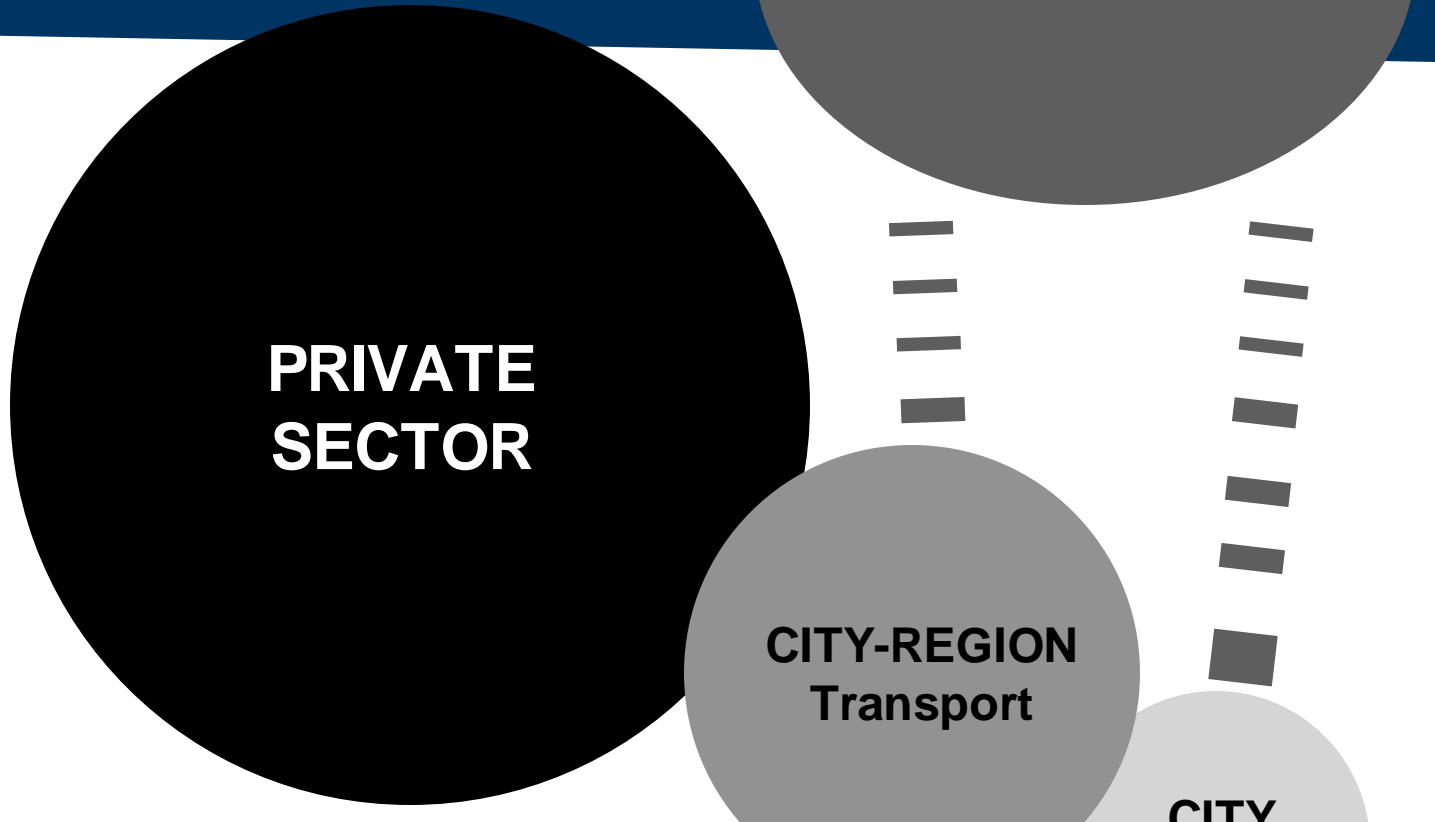
Talk 4:

TRUUD's approach to evaluation
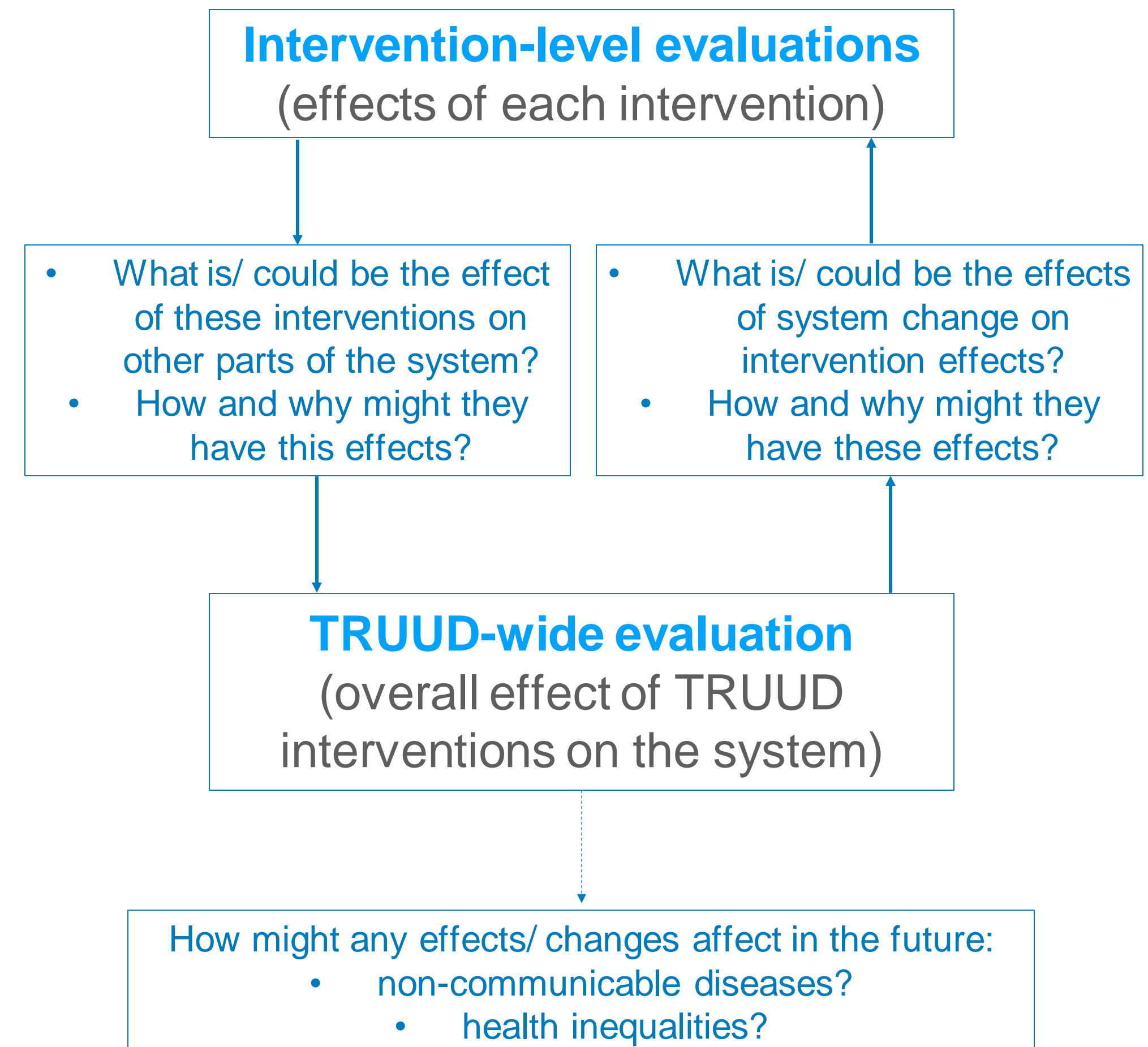
Intervention-level evaluation

7x evaluations carried out by the different intervention teams:

- What effects has their intervention had in their part of the system?

- How and why did the intervention work?

TRUUD-wide evaluation

1x 'system evaluation' carried out by TRUUD evaluation team:

- What are the cumulative effects of our interventions?

- How and why did we change the system?

- How might we change the system in the future?

Intervention-level evaluations
(effects of each intervention)

- What is/ could be the effect of these interventions on other parts of the system?
- How and why might they have this effects?

- What is/ could be the effects of system change on intervention effects?
- How and why might they have these effects?

TRUUD-wide evaluation
(overall effect of TRUUD interventions on the system)

How might any effects/ changes affect in the future:
- non-communicable diseases?
- health inequalities?

What impact did TRUUD have?

- What evidence is there that TRUUD has disrupted the system?
  - How did connections and relationships across the system change?
  - What new policies or new ways of working are there?

- What are the perceived impacts on future policy and practice?
  - What are the potential external risks and drivers for this?

- What are the perceived impacts on future population health?
  - What are the potential external risks and drivers for this?

How and why did we have these impacts?

- What were the facilitators and barriers to TRUUD having an impact on policy and practice?
  - What role did our co-production play?
  - What interdependencies across intervention areas were enacted?
  - How did the context impact what we did (e.g. political climate, economic factors)?

What more needs to happen?

- What changes still need to happen in the system to improve health outcomes?
- What future research is needed?

We asked TRUUD's intervention teams to think about:

How might changes in one TRUUD intervention area affect other intervention areas?

- What could happen in your intervention area because of other TRUUD interventions?

- What could happen in other intervention areas because of your TRUUD intervention(s)?

UK GOV

CITY-REGION Transport
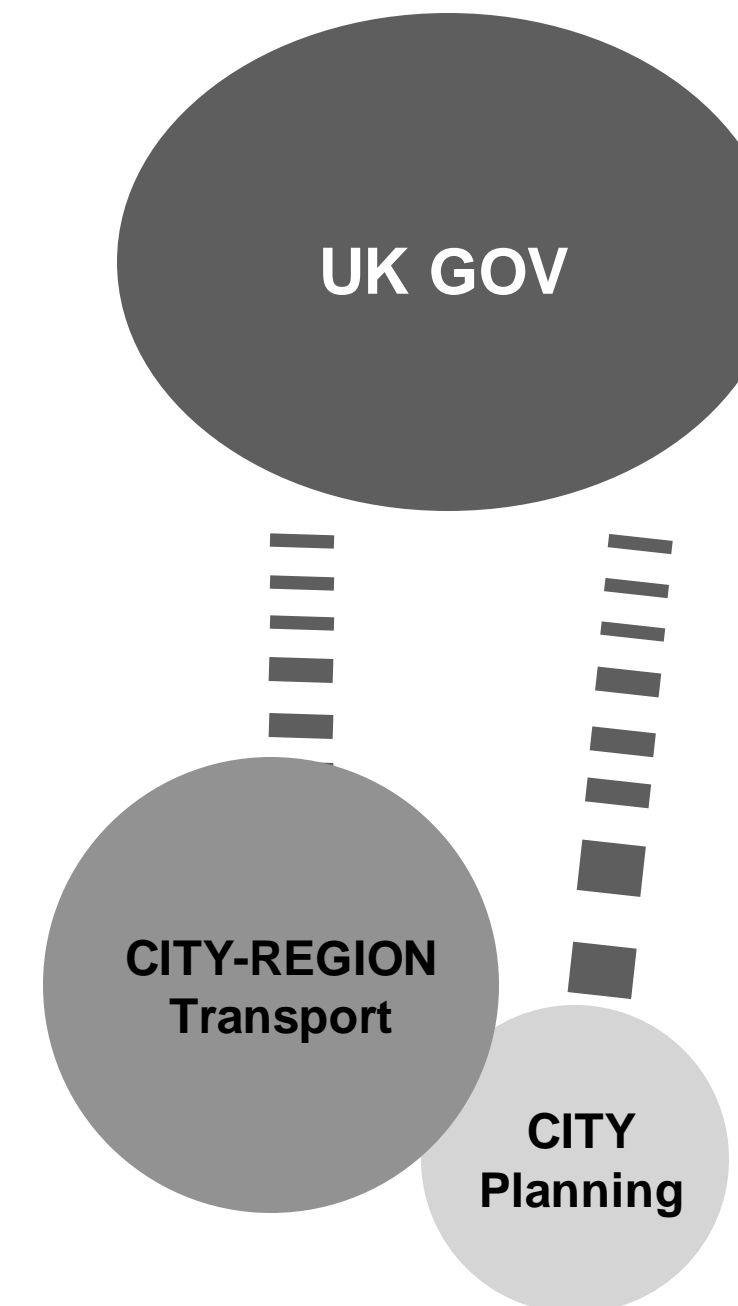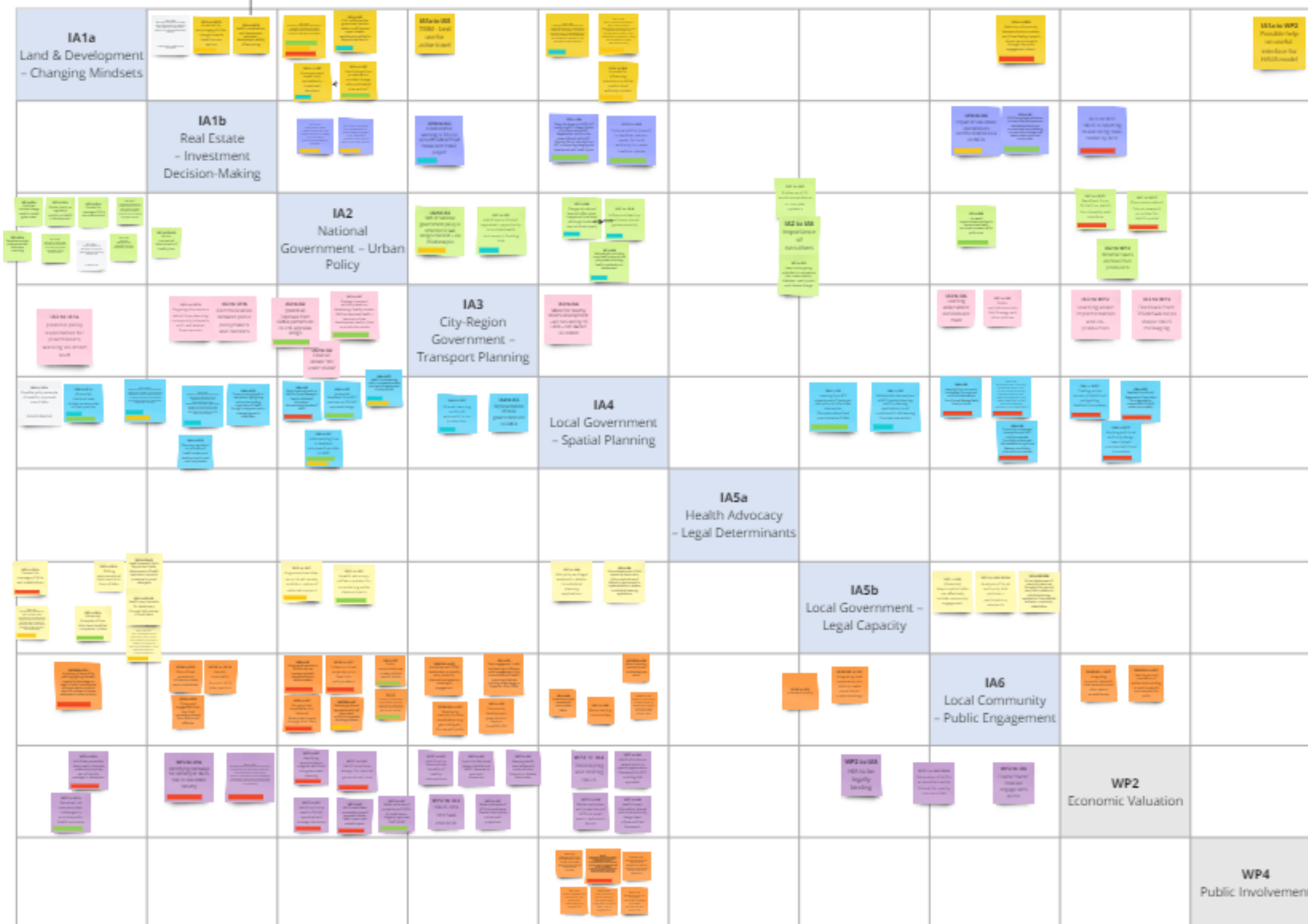
CITY Planning

Example questions

How has a change created by TRUUD at national level affected policies and practice at City Planning level?

What changes need to happen at City Region Transport level to maximise the effectiveness of what TRUUD has delivered at national level?

What barriers at national level are there to the effective delivery of TRUUD's regional and city-level interventions?

How can we do this?
Our approach

TRUUD

Co-ordination and support for intervention-level evaluations

Intervention interdependencies mapping and facilitation

Development of 'evaluation templates' detailing evaluation plans in each intervention area

'Systems lens' input into intervention teams' data collection plans

TRUUD-wide evaluation: key activities

Review and **'systems lens' analysis** of intervention-level evaluation data

Additional data collection to understand cross-intervention area effects – where are the gaps?

Cross-sector stakeholder workshops to explore our impacts and pathways to future downstream health impacts beyond TRUUD

Refining/ updating TRUUD's systems maps – how have we changed what is happening?

**Review of TRUUD co-production activities** – who did we engage with? How effective was this?

Our research questions

What evidence is there that TRUUD has disrupted the system?

What are the perceived (future) impacts on policy and practice?

What were the facilitators and barriers to impact?

How might we impact on future population health outcomes? What needs to happen to maximise this impact? What might prevent it?
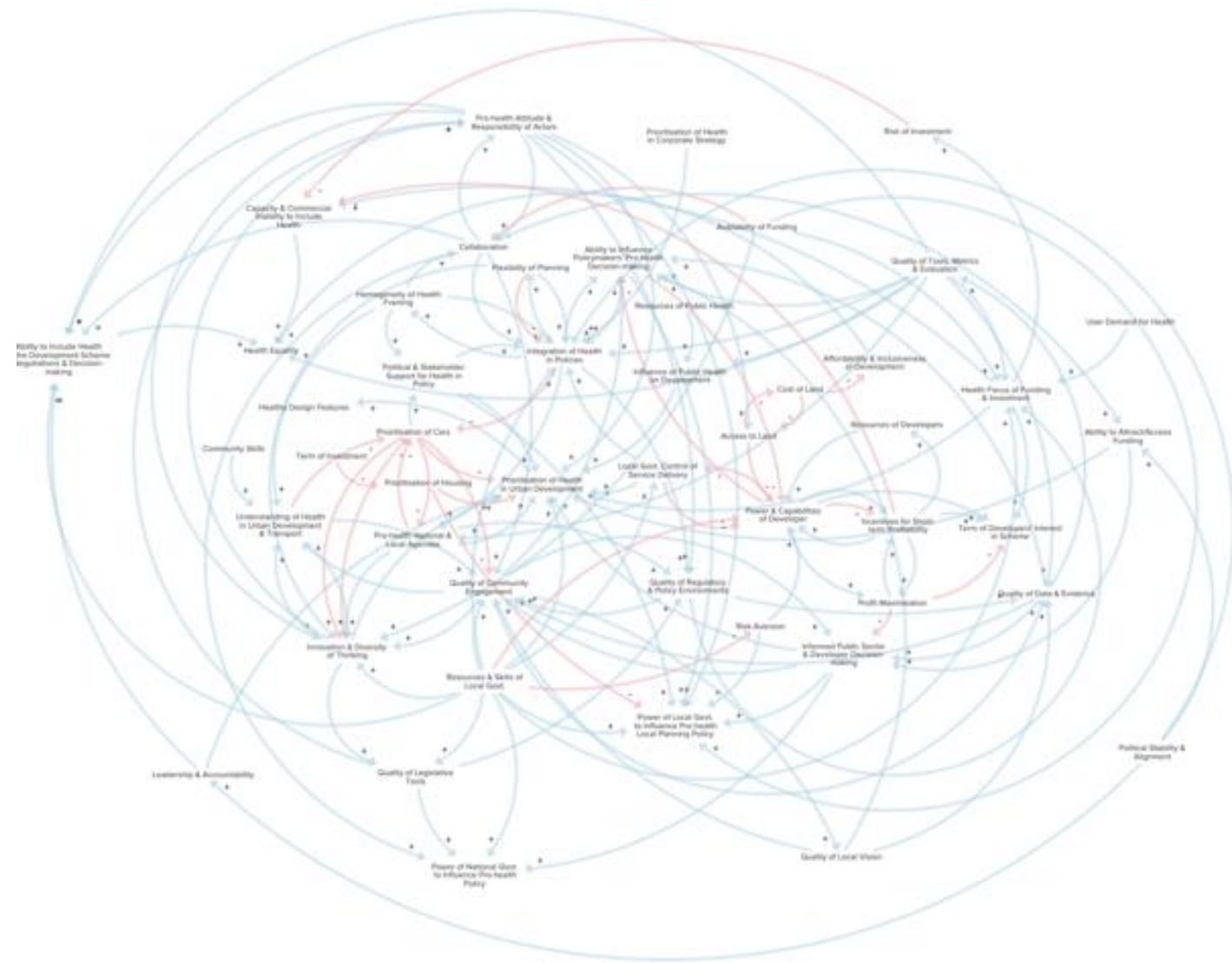
Which stakeholders to engage with to understand system change and long-term impacts?

- Who has sufficient understanding of the whole system?
- How to ensure fair representation across sectors?
- Challenges of stakeholder analysis in a large system

How can we project future downstream impacts of upstream policy interventions?

- How can we understand and demonstrate pathways from changes in policy and practice (now) to reductions in NCDs (in the future)?
- How can we manage uncertainty about these pathways?
- How can we consider the changing wider political climate and economic context?
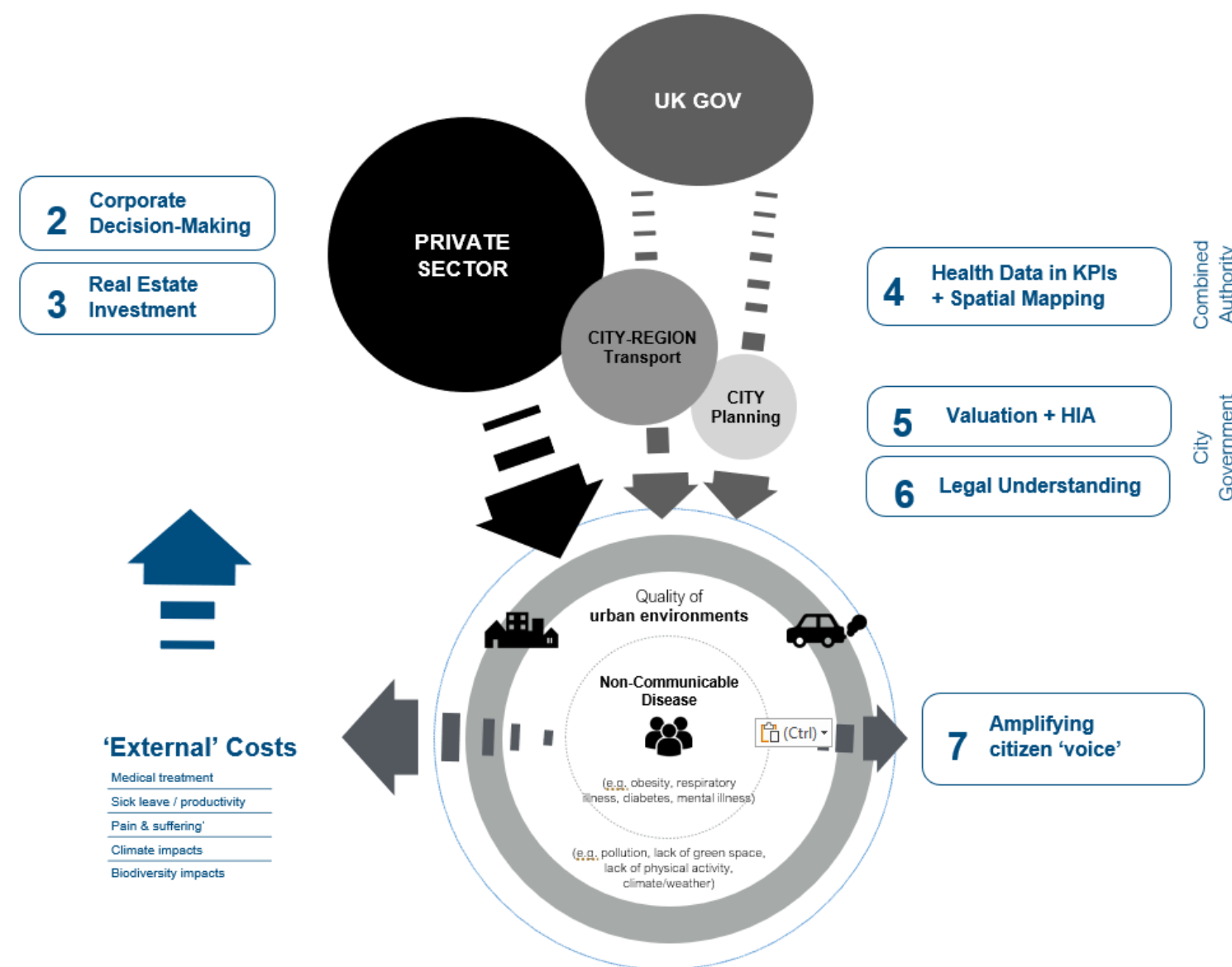
Diverse expertise and experience in the TRUUD team
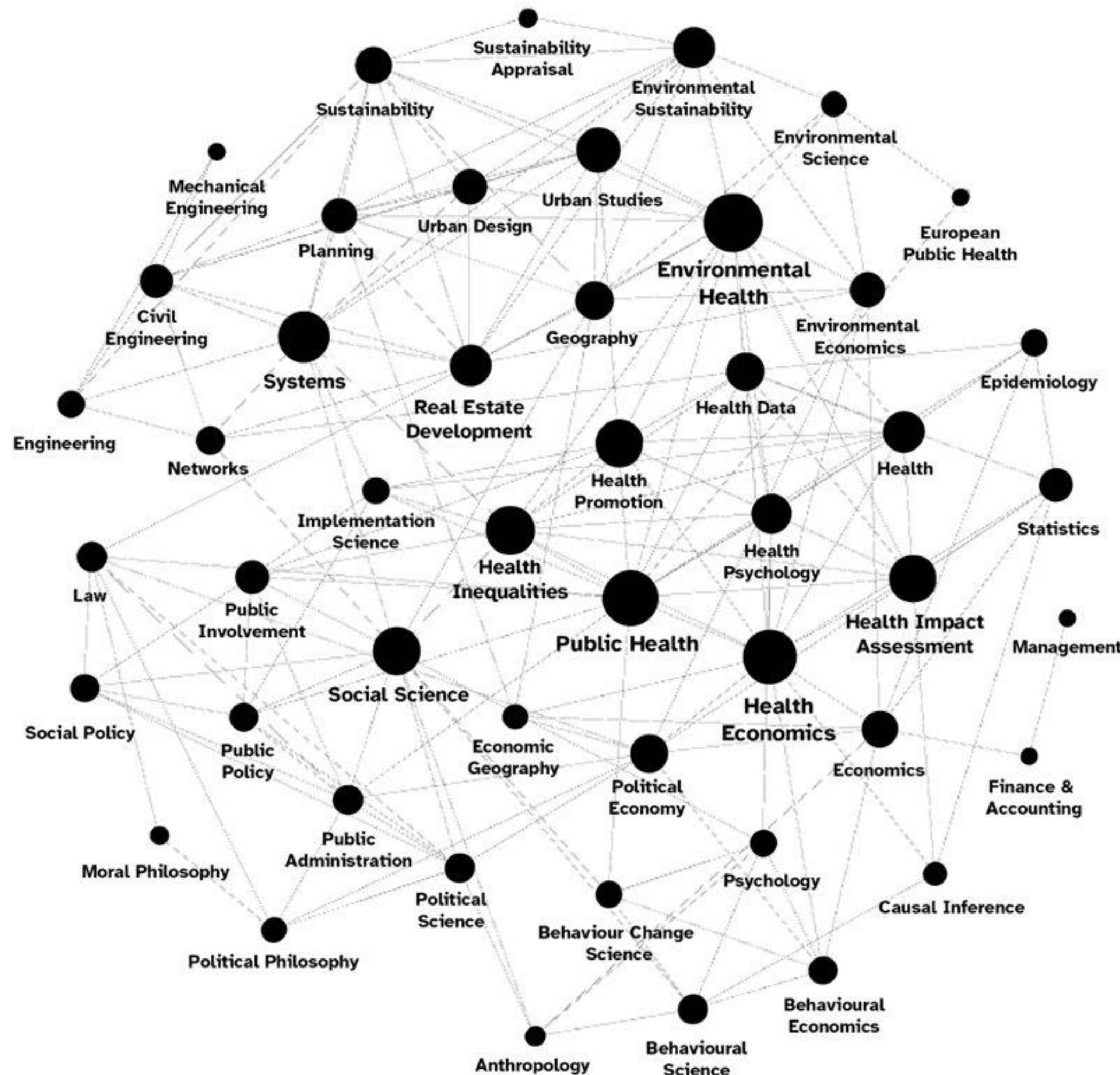
Some of the challenges for co-ordinating systems evaluation across a large and diverse research team:

- Varying methodological preferences and understandings about evaluating interventions and systems approaches.
- Limited capacity of intervention teams to work effectively across intervention areas.
- Teams are time and resource limited and work at difference paces.
- Teams prioritise understanding their own intervention effects over system change.

'Getting on with it' vs a complete and joined up approach?
Top-down decision-making vs allowing individual freedoms?

Questions for you!

TRUUD

☐ Is it possible to do a robust evaluation for this scale of complexity?

☐ Do you have to compromise on methods?

☐ Given the scale of complexity of the intervention spaces in TRUUD, do you think a whole programme evaluation is effectively impossible?

☐ That being so, how should we be approaching evaluation?

TRUUD

Acknowledgements