
Redistributed Manufacturing for the Resilient, Sustainable City

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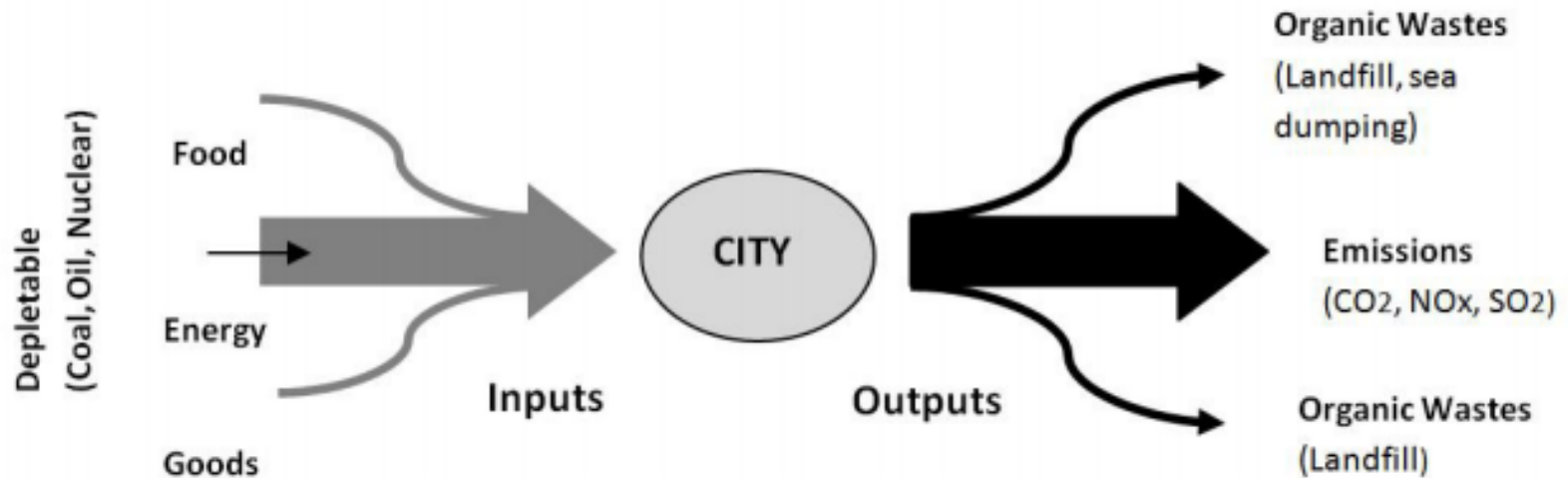


A Systems View of Cities

- Cities can be seen as a “system of systems” – communities, districts, infrastructure, buildings, political, natural systems, etc.
- There is structural complexity *and* behavioural complexity
- Problem solving for a part of the system needs to consider possible side effects on other parts (unintended consequences)
- A whole system view can support planning for resilience by providing understanding about:
 - Responsibility and accountability for a problem for different stakeholder groups (power structures)
 - Motivation, control, knowledge, legitimacy towards a plan/vision for different stakeholder groups
 - Potential impacts on stakeholders not involved in planning/decision making
 - Problem ownership, problematisation - who is it a problem for?

Sustainable

- “Sustainable”: system can function over an indefinite period of time
- Urban sustainability indicators cover a range of environmental, social, and ethical concerns - informed by urban metabolism studies
- Urban regions have high metabolic rates
- “Sustainable city”: a city-region has healthy ecosystems, high social well-being, and a low urban metabolism that is decoupled from economic growth



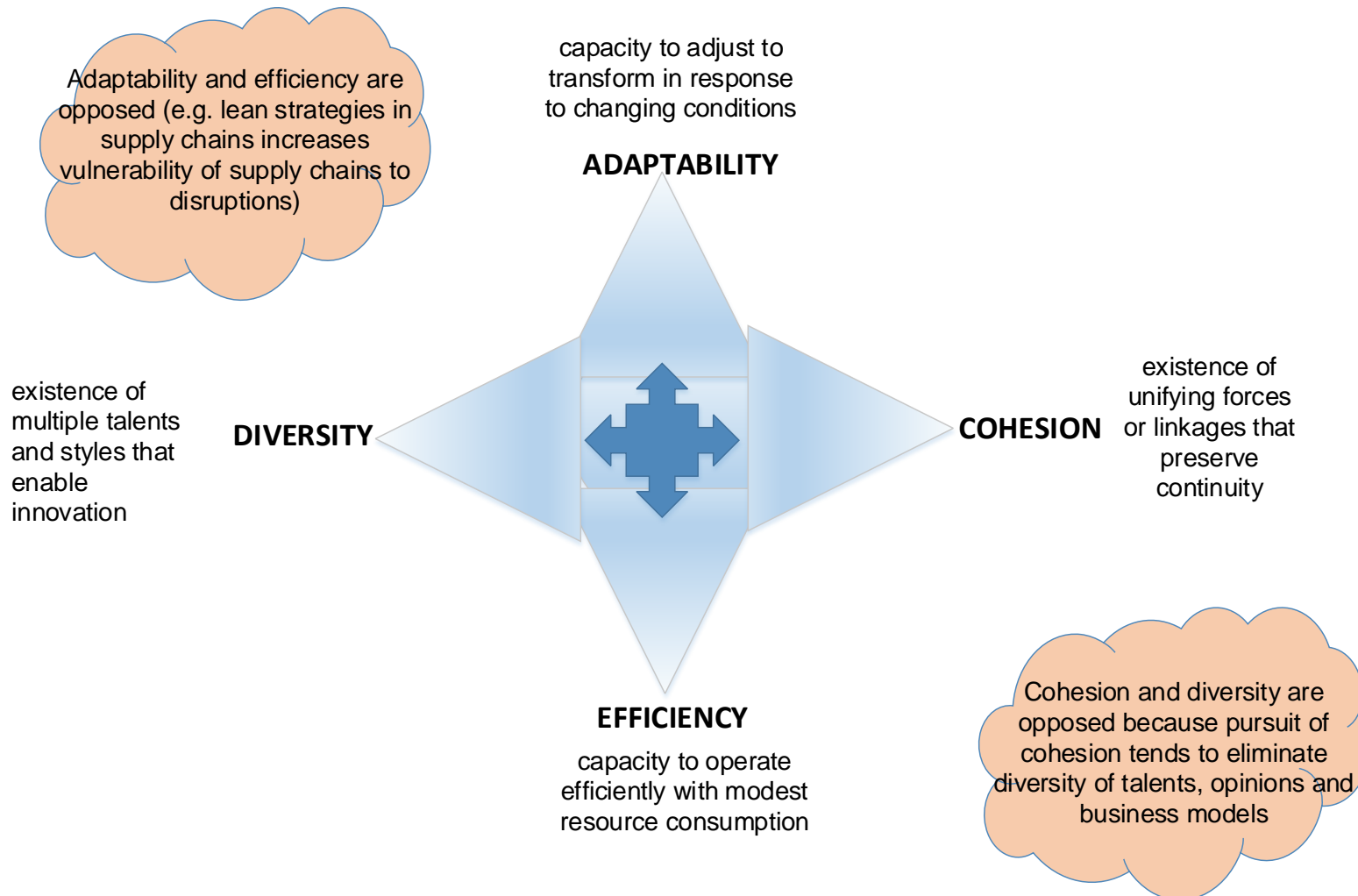
Bancheva (Integrating the concept of urban metabolism into planning of sustainable cities)

Smart

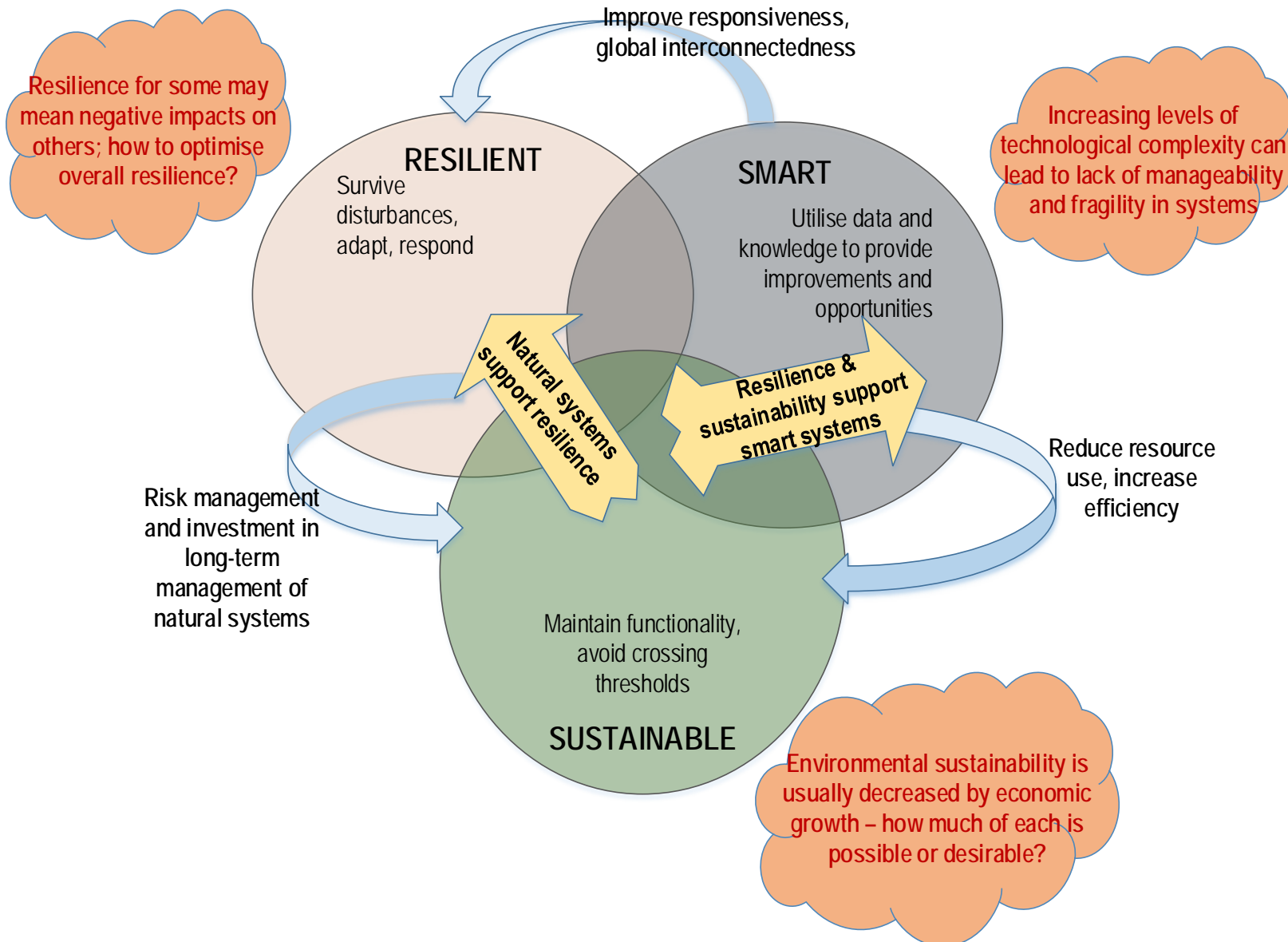
- Concept of “smart” is poorly defined and understood - at risk of joining other well-used but undefined notions like ‘liveability’ and ‘sustainability’
- A process in which increased citizen engagement, hard infrastructure, social capital and digital technologies make cities more liveable, resilient and better able to respond to challenges
- Making optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources
- UK citizens: smart city is clean, friendly and has good transport connections; also, “technology”, “connected”, “internet” and “modern” (taken from **Centre for Cities** report)

Resilient (Fiksel)

“Resilient”: city is able to thrive environmentally, economically and socially in the face of a range of short-term and long-term disturbances



Conceptual Framework



Bristol - A Somewhat Unequal City

- Bristol's labour market performs well in economic activity and employment rates, occupational mix, qualification levels, but...
- "Pockets" of unemployment and persistent worklessness affect some city areas, young people (9% of Bristol 16-18 years olds are NEETs), and those without adequate qualifications
- Worklessness has detrimental impacts upon residents' health and mortality, levels of crime, educational attainment and childhood poverty
- Difference in life expectancy between the most and least deprived wards is 9.4 years for men and 5.8 years for women

Bristol - Smart/Innovative City Activities



Bristol is Open



Bristol Approach to Citizen Sensing



Engine Shed as Innovation Hub



WEBSTART

BRISTOL+BATH
THE BEST CITY REGION



Bristol - Sustainable/Resilient City Activities

- European Green Capital 2015
- Green Capital Partnership (> 700 organisations)
- City GHG emissions reduction goal of 40% by 2020 over 1995
- One of Rockefeller's 100 resilient cities
- Open Green Doors (and digital Green Doors)
- Bristol City Council Initiatives:
 1. Healthy and caring Bristol
 2. Keep Bristol working and learning
 3. Keep Bristol moving
 4. Building successful places
 5. Global green capital
 6. Vibrant Bristol
 7. Empowered city
 8. Active citizens



Bristol's Manufacturing History

- Manufacturing has provided up to 1/3 of employment through Bristol's 800 year history
- During 1800's: specialist glass products, shot and bullets, shoes, motorcycles, chocolate, and tobacco were made in Bristol
- Manufacturing growth was supported through new infrastructure such as the floating harbour and an airstrip to the north of the city
- Most mass manufacturing gone by 1980's due to mergers and acquisitions, rising salaries, low-cost production in other countries, and the declining cost of consumer goods
- Recent growth in high-value manufacturing in aerospace and electronics – industries provide less than 10% of Bristol employment
- Some companies have sent production overseas but retain product design and corporate headquarters locally (Dyson) – loss of semi-skilled jobs
- A few small manufacturing companies still manufacture locally (e.g. hot air balloons, Bristol blue glass, Bart's Spices)

Re-distributed Manufacturing

*The **localisation** of the design and production of manufactured artefacts, especially through the use of **small-scale** and innovative production methods and associated business models, which has the potential to benefit a region's **economy, society and environment**, and to improve its **resilience** to future megatrends such as climate change and globalisation of supply networks*

1. Making shapes that cannot otherwise be made - e.g. Blagdon, aerospace, Hieta, bikes
2. Making shapes that can be made in other ways but that need expensive tooling, and/or to allow small quantities to be made
3. Making mass customised, personalised products – teeth, drones
4. Niche local products (strong localism) – hot air balloons, caravans
5. More/better repair and remanufacture – contribution to the circular economy
6. Potential for more “local for local” – food and drink, clothes, etc.

Measuring City Performance

Economic Sustainability	Income from local taxes and central government are sufficient to maintain a good quality of civic life; citizens can be economically self-reliant; businesses can attract investment
Environmental Sustainability	The region's ecosystems remain healthy; the city's urban metabolism is low in relation to the prosperity it generates
Short-term Resilience	Public and private agencies are able to establish normal services, supply chains, and economic activity soon after short-term economic, social, political, or environmental shocks
Long-term Resilience	The regional economy, and society as a whole is able to evolve and adapt in response to a range of long-term stressors
Manufacturing Sector Resilience	Local manufacturing sectors use changes in supply chains and markets as opportunities to transform and grow, whilst decreasing environmental impacts and providing local employment

Disturbances (identified)

	Short-term (hours to months)	Long-term (years to decades)
City Level	<p>Pandemics/changes in workforce</p> <p>Social unrest</p> <p>Fast economic downturns or upturns</p> <p>Extreme climatic events</p> <p>Sudden changes in political landscape</p>	<p>The role of global NGOs</p> <p>Changing societal ethical stances</p> <p>Changing demographics</p> <p>Climate change</p> <p>Availability of investment capital</p>
Business Level	<p>Changes in supply chain legislation</p> <p>Changes in business ownership</p> <p>Changes in availability and/or cost of materials or parts</p> <p>Technology disruption</p>	<p>Automation</p> <p>Globalisation and future markets</p> <p>Scarcity of resources</p> <p>Mass customisation</p> <p>Dynamic technology and innovation</p> <p>Global knowledge society</p>

System Model

- A way to think about how the city has grown and changed, in relation to the city performance indicators
- Combines stocks (collections of things), flows (movement of things), causation, feedback loops
- The model represents our understanding of historical trends – model is not saying “this is how the world is”
- Different parts of the model have been more or less active at different times in the past
- Can be used to think about what the future might look like – depending on the size, range and frequency of disturbances
- Model could be further developed to be simulatable with more time/budget

Modelling Disturbances

- Model considers disturbances as exogenous impacts on the city
- Can occur singularly or in combination, may be larger or smaller in impact, and may last for a short or long time
- Eventually cease (e.g. high rainfalls stop), or become the new normal (e.g. mass manufacturing is lost and buildings repurposed)
- Rate of arrival of disturbances impacts ability of the city to cope or adapt
- Even a medium sized disturbance over a long time can have a large impact (e.g. winter of 2013)
- Impacts from disturbances affect environment, infrastructure, economy, and manufacturing – but impact is lessened by resilience
- Assume disturbances will be damaging, but some businesses may be able to create opportunities out of disturbances such as technology change (may gain market share)

RDM Key Findings

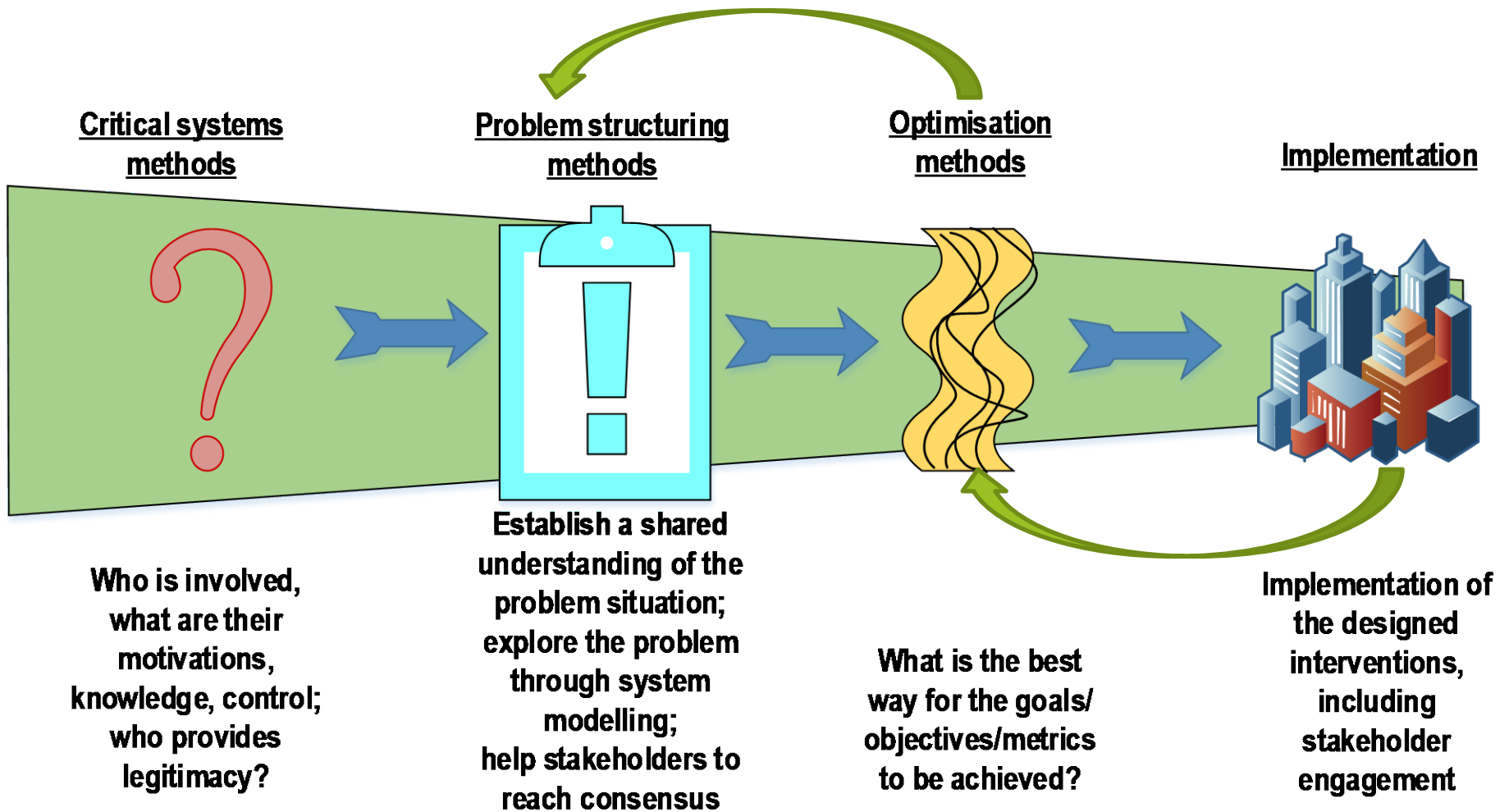
- **Resilience through Adaptability:** RDM *should* be more agile and able to respond positively to disturbances, but need investment in R&D
- **Environmental Impacts could be reduced:**
 - Benefits from repair, remanufacturing, recycling in combination with RDM
 - Could increase “local for local” and reduce imports
- **But....**
 - Need appropriate environmental regulation for small-scale production
 - RDM energy and material efficiency depends on the product design, its material construction, and its lifetime use
 - RDM technologies can produce non-recyclable or non-repairable products
- RDM **could** bring back some semi-skilled jobs, but...
 - Most RDM seems to create highly skilled or niche jobs - need different business models and/or public support to create semi-skilled jobs
 - Large companies could use RDM to make their own parts, leading to a loss of jobs in their supply chain

Potential RDM in Sectors in Bristol

Table filled in with some very rough and subjective guesses at values!

Type of enterprise	Where and to whom they sell	Drivers	Susceptible to technology disruption	Need for R&D support from public sector	Estimate of % of existing regional manuf. jobs	RDM potential - new products and growth	RDM potential - new jobs	RDM potential - sustainability and resilience	Examples
Sole trader makers	direct to customers, in the area and export	steady stream of work	1	1	5%	2	1	2	violin makers, tailors
Product based SMEs	direct to customers/retailers, in the area and export	localism, local production	1	1	5%	2	1	2	bristol balloons, truki
SME high tech makers/designers	mostly B2B, in the area and export	competition, staying in cluster	3	2	15%	3	2	3	GKN Aerospace
Low tech makers	mostly B2B, mostly in the area	steady stream of work	1	1	20%	1	2	3	print shops, steel fabrication, building facades, joinery
Product based LEs	mostly to retailers, in the area and export	competition with global manuf.	2	3	5%	2	1	2	very limited (Indesit Yate)
Product based LEs - customised	direct to customers and to retailers, mostly export	new markets, added value	2	3	0%	3	2	2	none. Potential
SME food production	mostly in the area, some UK and international distribution	local branding, exports	2	2	20%	1	2	3	Bart Spices, Natural Beverage Company
Large high tech	almost all export, international	global competition	3	3	30%	2	2	1	Airbus
					100%				
	1 low								
	2 medium								
	3 high								

Intervening for City-Scale Resilience



Final Thoughts

1. Definition of sustainability, resilience, smart – innovation, growth, and resilience for whom? Who has agency and interest?
2. Need suitable frames for thinking about systems of systems, e.g. panarchy, complex adaptive systems, socio-technical systems
3. Need suitable methodology for working with systems of systems, e.g. systems architecting, problem structuring methods
4. Currently a lack of data on physical things – e.g. material flows, lifecycle impacts of city activities
5. Will the future have a mixture of old and new technologies, high-tech and low-tech, makers and hackers?
6. Jobs now and in the future – automation, global competition, jobs for different types of skills, manufacturing locally
7. Sustainability goal vs. competition between cities for investment
8. Power, knowledge, and legitimacy for change are growing; do our cities have “transformability”?

Stakeholder Roles in Low-Carbon Development

- Some findings on stakeholder roles, from a project called STEEP (Systems Thinking for Energy Efficient Planning) done in collaboration with Bristol City Council
- Those most strongly proposing the low-carbon vision did not have direct agency to enact it
- Even within local government there was varying commitment to low-carbon development between departments
- Those with the highest agency had limited interest, and not enough interest to change business models
- Competition between cities for investment meant that setting very high environmental standards would have risked losing development money
- Some of those affected by the development - future generations and natural systems – were not represented