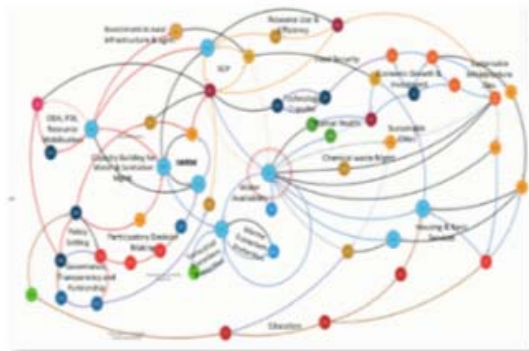


Introduction to Systems Thinking
Principles and Analytical Tools

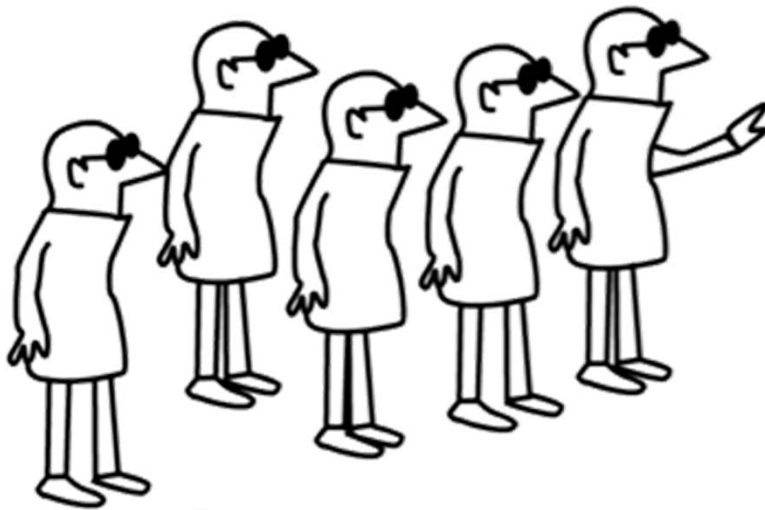




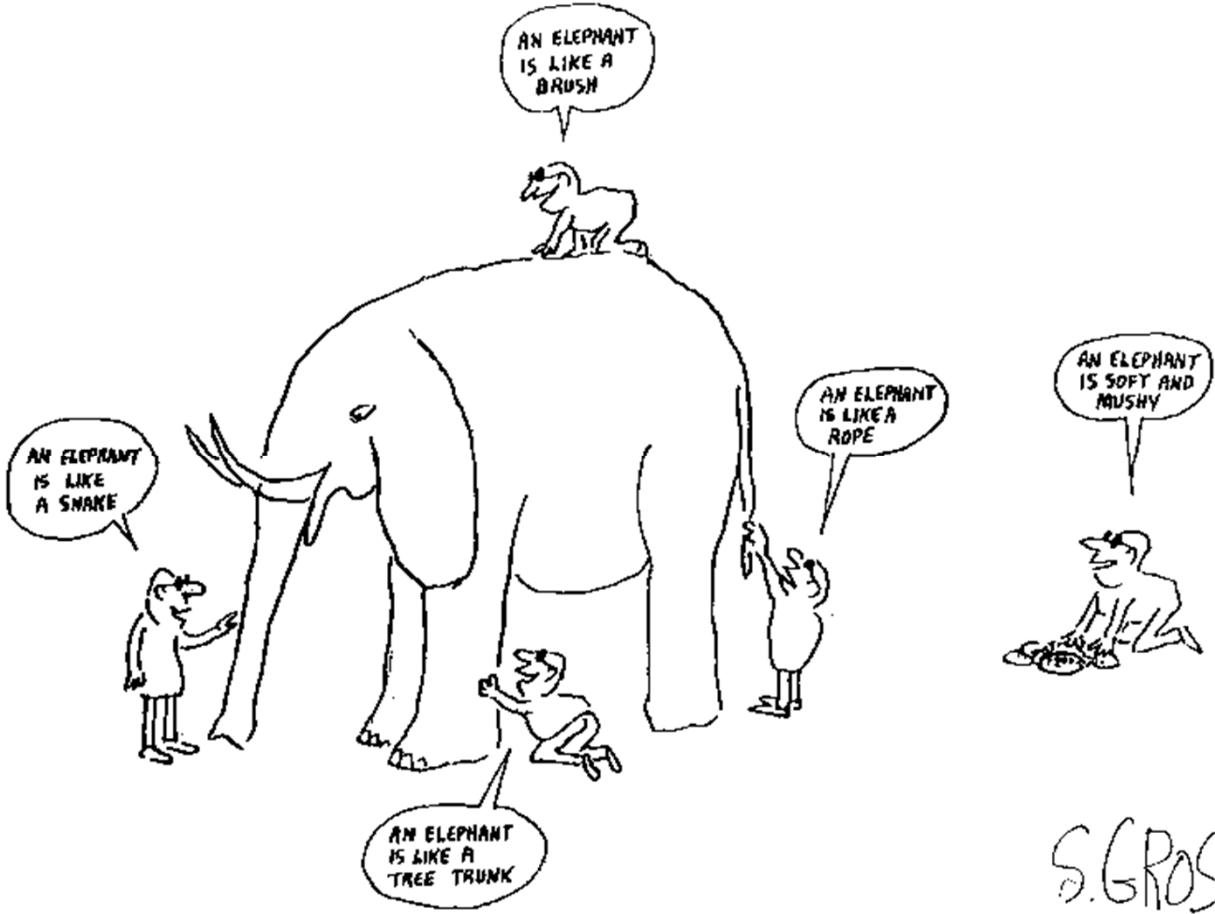
“ Any intelligent fool can make things bigger, more complex, and more violent. It takes a touch of genius — and a lot of courage to move in the opposite direction. ”

Ernst F. Schumacher, Development Economist & Statistician

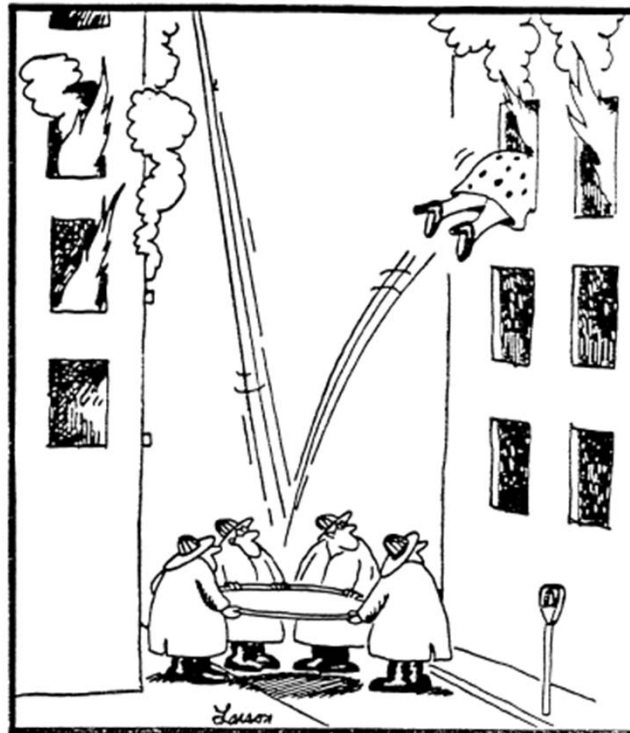
What is a Systems Perspective?



By fixating on the parts of a system, we miss understanding the whole



Lacking a Systems Perspective... the solution to one problem can easily lead to a new and bigger problem later on or somewhere else in the system

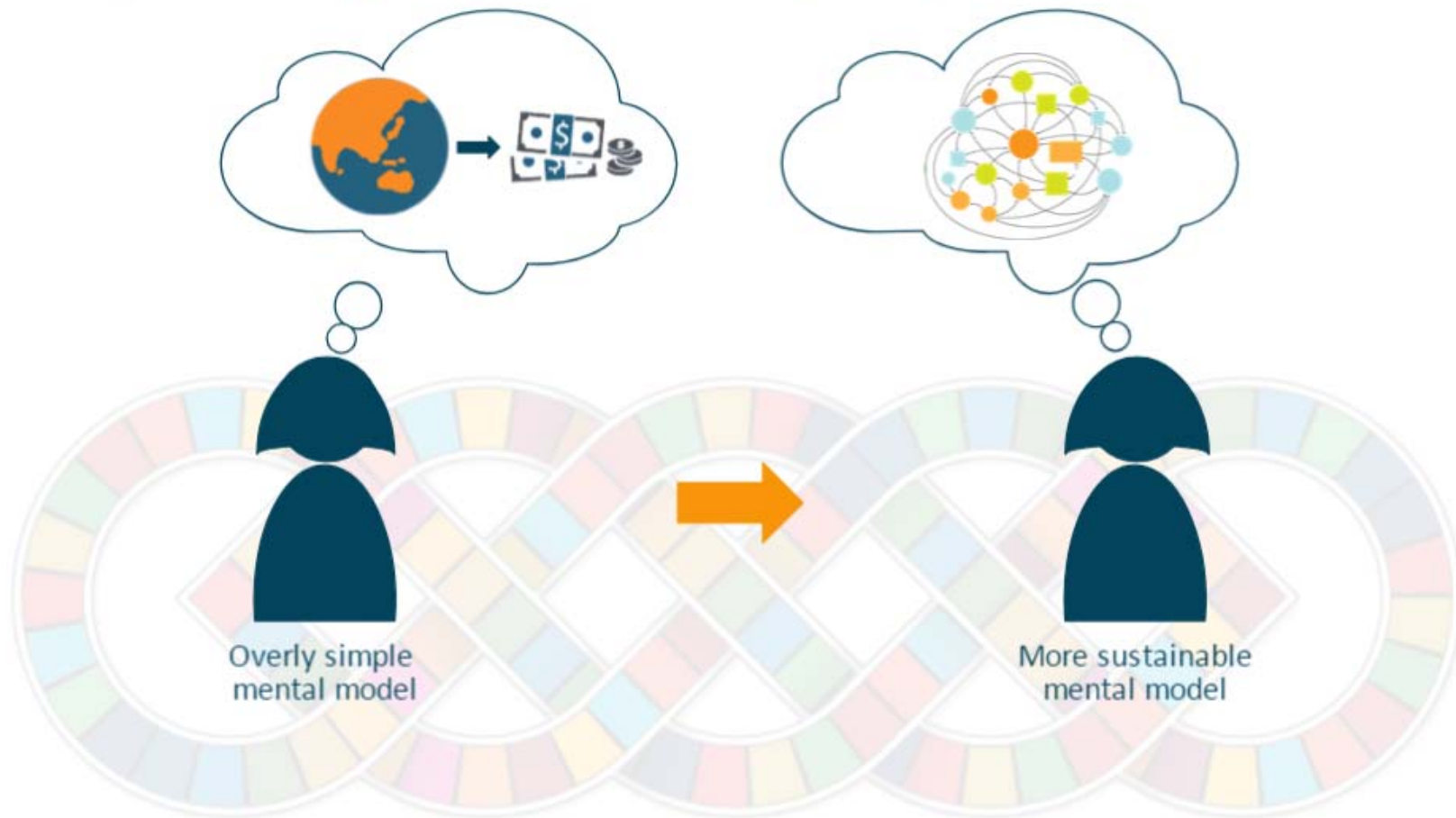


Artist:
Gary Larson

“unintended consequences”

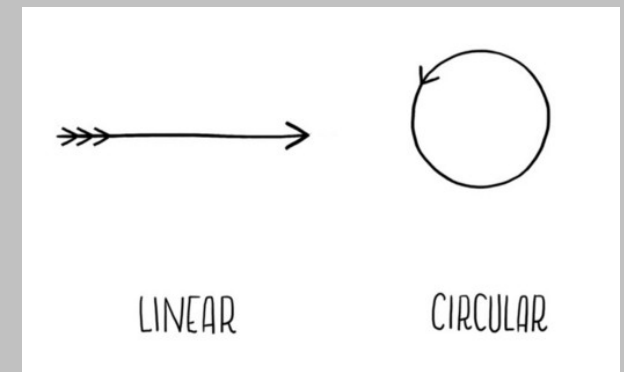
Systems Thinking in a Nut-Shell

Systems thinking is the practice of examining, and improving, our mental models



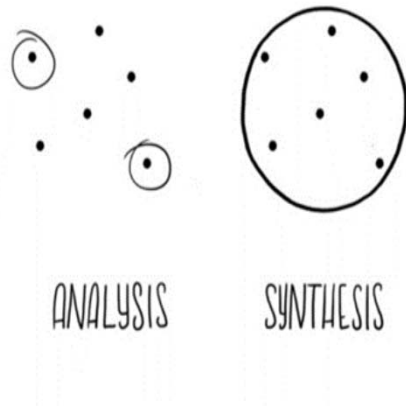
Systems Thinking

- System mindsets are needed for dealing with complex problem solving
- 4 fundamental concepts:
 - INTERCONNECTEDNESS
 - SYNTHESIS
 - FEEDBACK LOOPS
 - CAUSALITY



Analysis

Is about dissection of complexity into manageable components. Analysis fits into the mechanical and reductionist worldview, where the world is broken down into parts



Synthesis

sees the interconnectedness

Synthesis

Is about understanding the whole and the parts at the same time, along with the relationships and the connections that make up the dynamics of the whole.

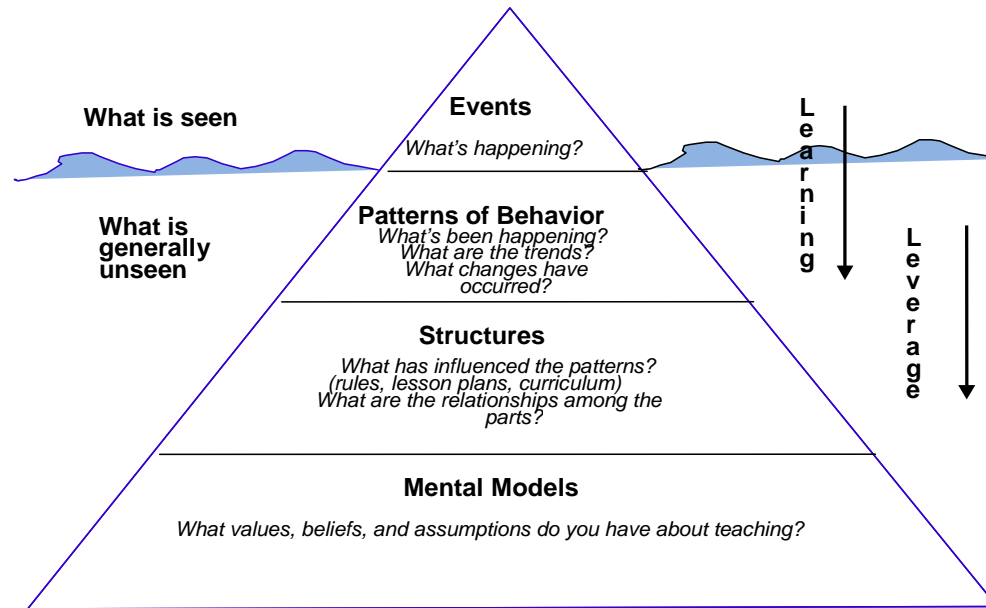


What is Systems Thinking?

- Systems thinking is a vantage point from which you see a whole, a web of relationships, rather than focusing only on the detail of any particular piece. Events are seen in the larger context of a pattern that is unfolding over time. - *isee systems, inc.*
- Systems thinking is a perspective of seeing and understanding systems as wholes rather than as collections of parts. A whole is a web of interconnections that creates emerging patterns. – Peter Senge

Systems Thinking helps us to . . .

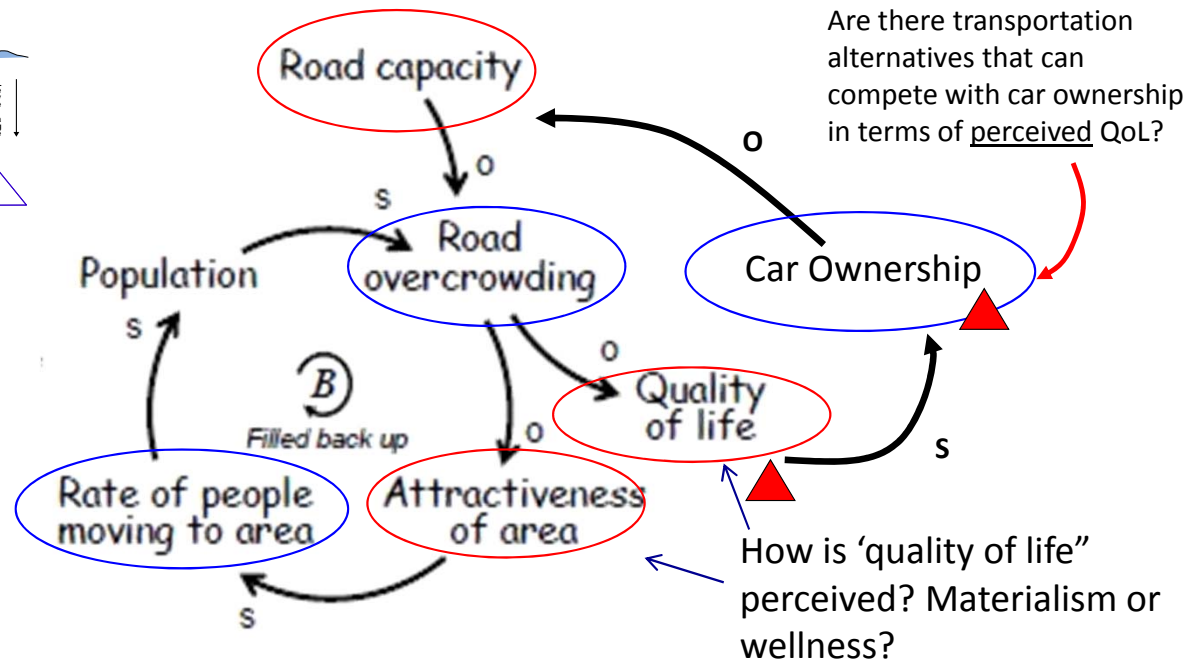
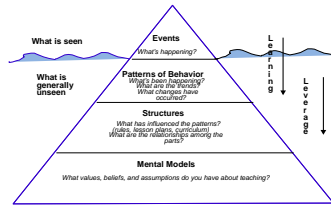
- . . . move the focus away from **events** and **patterns of behavior** (which are symptoms of problems) and toward **systemic structure** and the underlying **mental models**



Source: Senge, Peter, *The Fifth Discipline*, 1996.

Systems Thinking helps us to . . .

- . . . To find the most important places for intervention to change the long-term behaviour of a system.



Source: Senge, Peter, The Fifth Discipline, 1996.

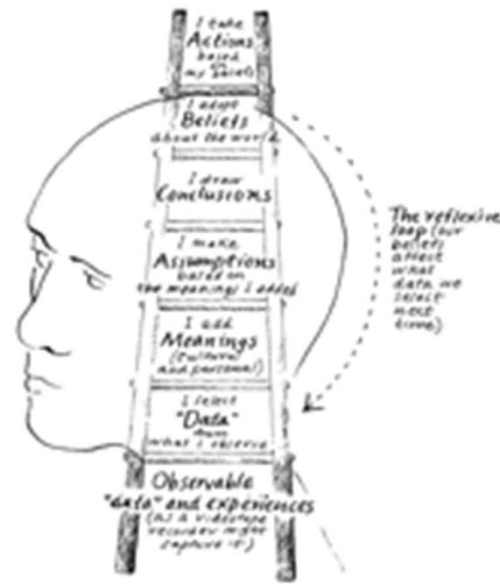
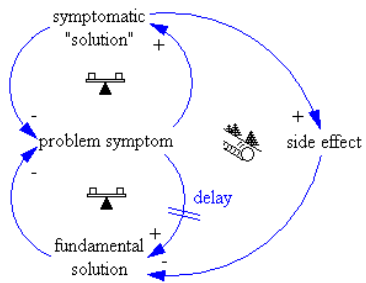
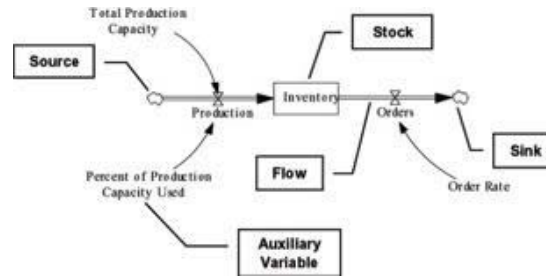
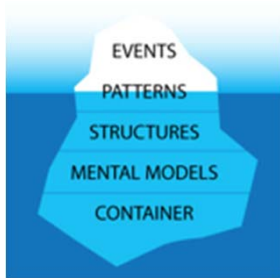
A systems approach is to . . .

1. **Identify a system** - After all, not all things are systems. Some systems are simple and predictable, while others are complex and dynamic. Most human social systems are the latter.
2. **Explain the behavior or properties of the whole system** - This focus on the whole is the process of synthesis. Analysis looks into things while synthesis looks out of things.
3. **Explain the behavior or properties** of the question to be explained in terms of the role(s) or function(s) of the whole.

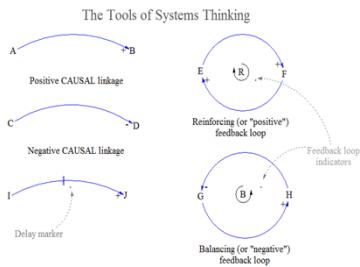
“Systems Thinking is seeking to understand the connections among elements in a system”

- ✓ what depends on what,
- ✓ what is causing what,
- ✓ where are information flows,
- ✓ where control decisions are made,
- ✓ what information flows are critical,
- ✓ how to best engage stakeholders,
- ✓ And how best to manage or intervene in the system for desired results.





The Tools of Systems Thinking



Systems Thinking includes a Set of Tools



brainstorming
tools



dynamic thinking
tools



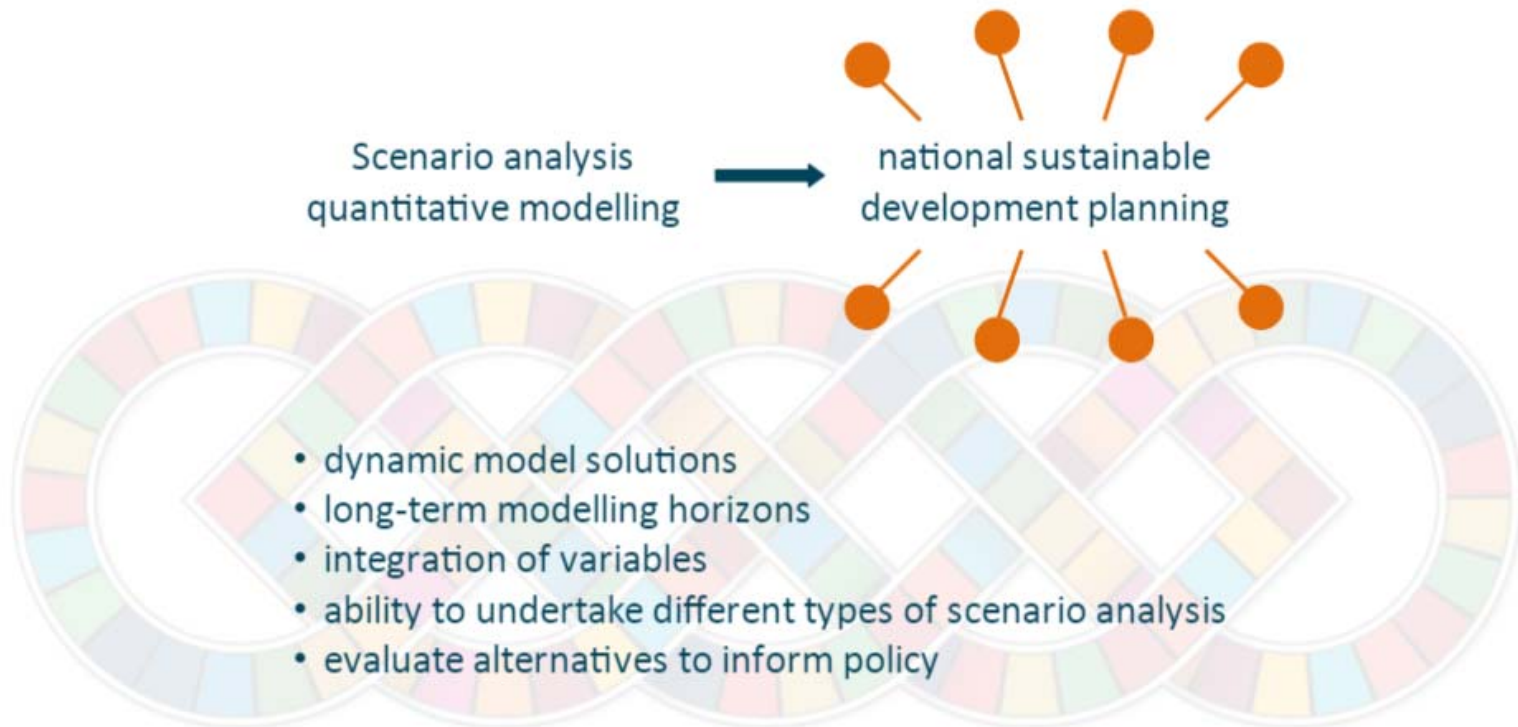
structural
thinking tools



computer-based
tools

Application of the Systems Thinking and System Dynamics at the National level - System Dynamic Modelling Description

The long-run processes and systems perspective that are inherent in the SDGs present complex analytical problems for policymakers and analysts.



Key Messages

- Policymaking at the national and local level is a difficult, complex challenge.
- It is necessary to understand and appreciate the systemic factors and relationships that ultimately impact the processes used by decision-makers.
- Systems thinking requires a local, multi-perspective, participatory and iterative approach to be effective.
- A systemic approach provides a suitable environment for good policy / decision making.
- Having good visual, dynamic and responsive tools is also necessary to strengthen effective policy decisions.
- *Systems thinking can therefore strengthen policy making for long-term sustainable development.*

Systems Thinking Recap

- Systems thinking is the practice of examining and improving our mental models for complex scenarios
- Systems thinking is conducive to strengthening and enhancing the capacity for adaptive governance to better address the 2030 Agenda and the SDGs

It helps in

- reviewing existing institutional architecture and mandates to determine their relationship with the 17 SDGs;
- assessing the impacts of policies and identifying effective policy interventions (leverage points) for impactful investment and use of scarce resources; and
- stakeholder mapping and engagement in collectively developing the aspirational qualitative vision for societal change.

QUIZ

Which of the below options best describe systems thinking approach?

- It focuses on how the problem being analyzed interacts with other elements of a bounded system
- It emphasizes wholes rather than parts, and stresses the role of interconnections as well as of circular feedback
- It allows dealing with complex issues in an effective way
- All of the above



CAUSALITY

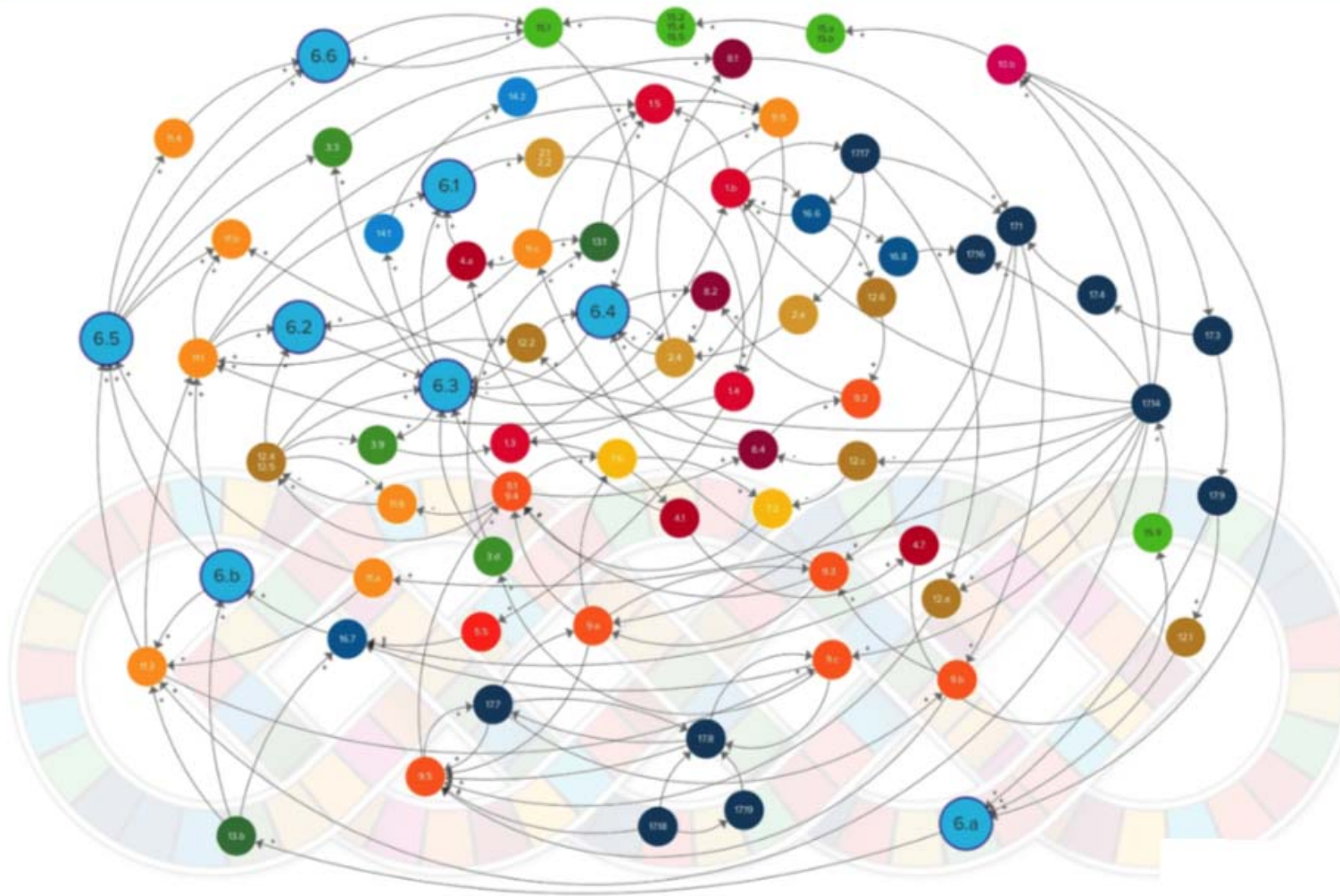


To understand the feedback loops we need to gain perspective of causality: how one thing results in another thing in a dynamic and constantly evolving system.



The cause and effect concept in system thinking is about being able to understand the way things influence each other in a system (on agency, feedback loops, connections, and relationships)

Developing Causal Loop Diagrams



The Tools of Systems Thinking



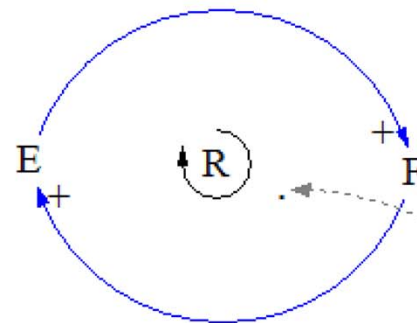
Positive CAUSAL linkage



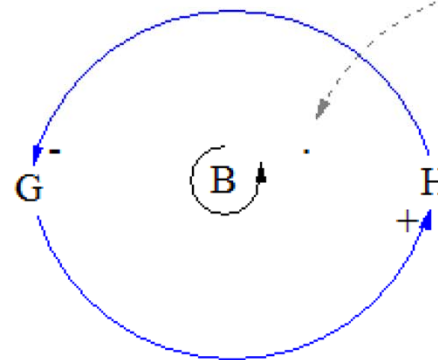
Negative CAUSAL linkage



Delay marker



Reinforcing (or "positive")
feedback loop



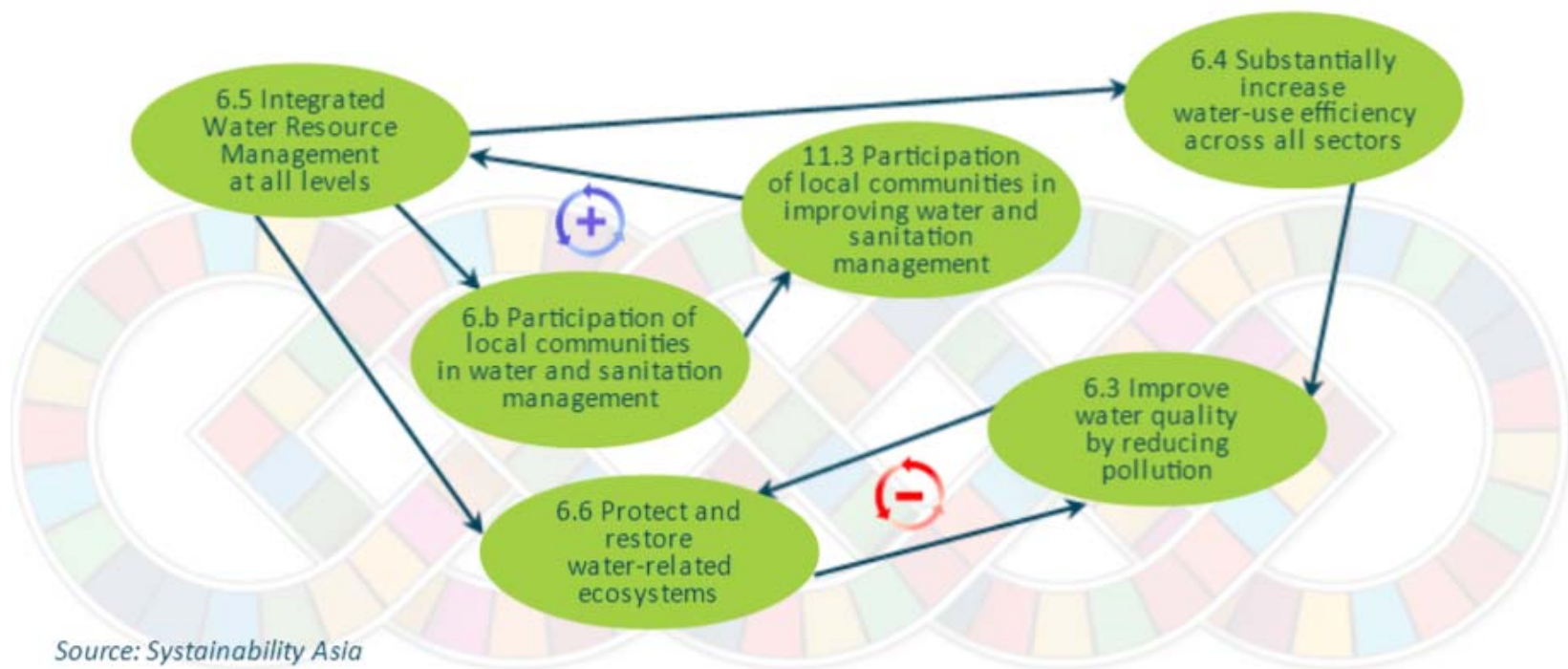
Balancing (or "negative")
feedback loop

Feedback loop
indicators

Basic Processes of Systemic Behavior

Reinforcing Feedback

Balancing Feedback



Source: Sustainability Asia

SDG 6 Interlinkages with other SDGs



Target 6.b – Support and strengthen the participation of local communities in improving water and sanitation management.

Fourth most inter-linked target;

Direct causal inter-linkages with 48 other targets from 14 SDGs;

Indirectly linked with another 28 targets;

Directly driven/influenced by 27 other targets and is a key driver / influencer of 21 other targets;

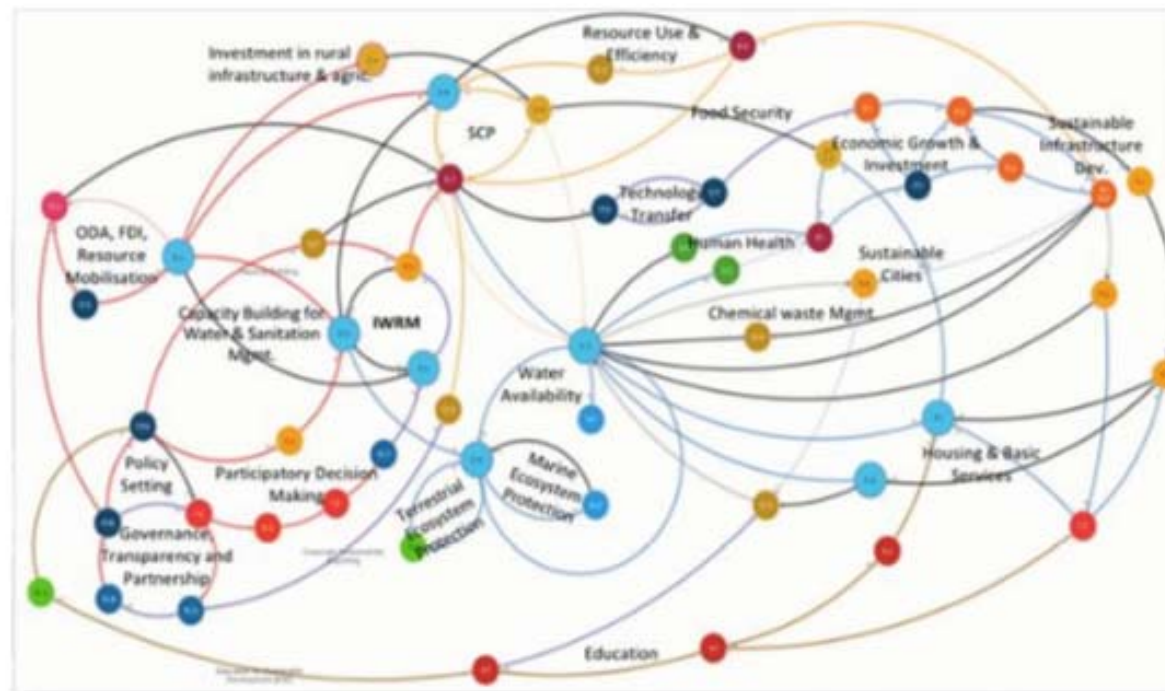
Most strongly influenced by SDG 5, 16, and 17

Has the most direct influence on SDG 1, 6, 11, 12, 13, and 14.

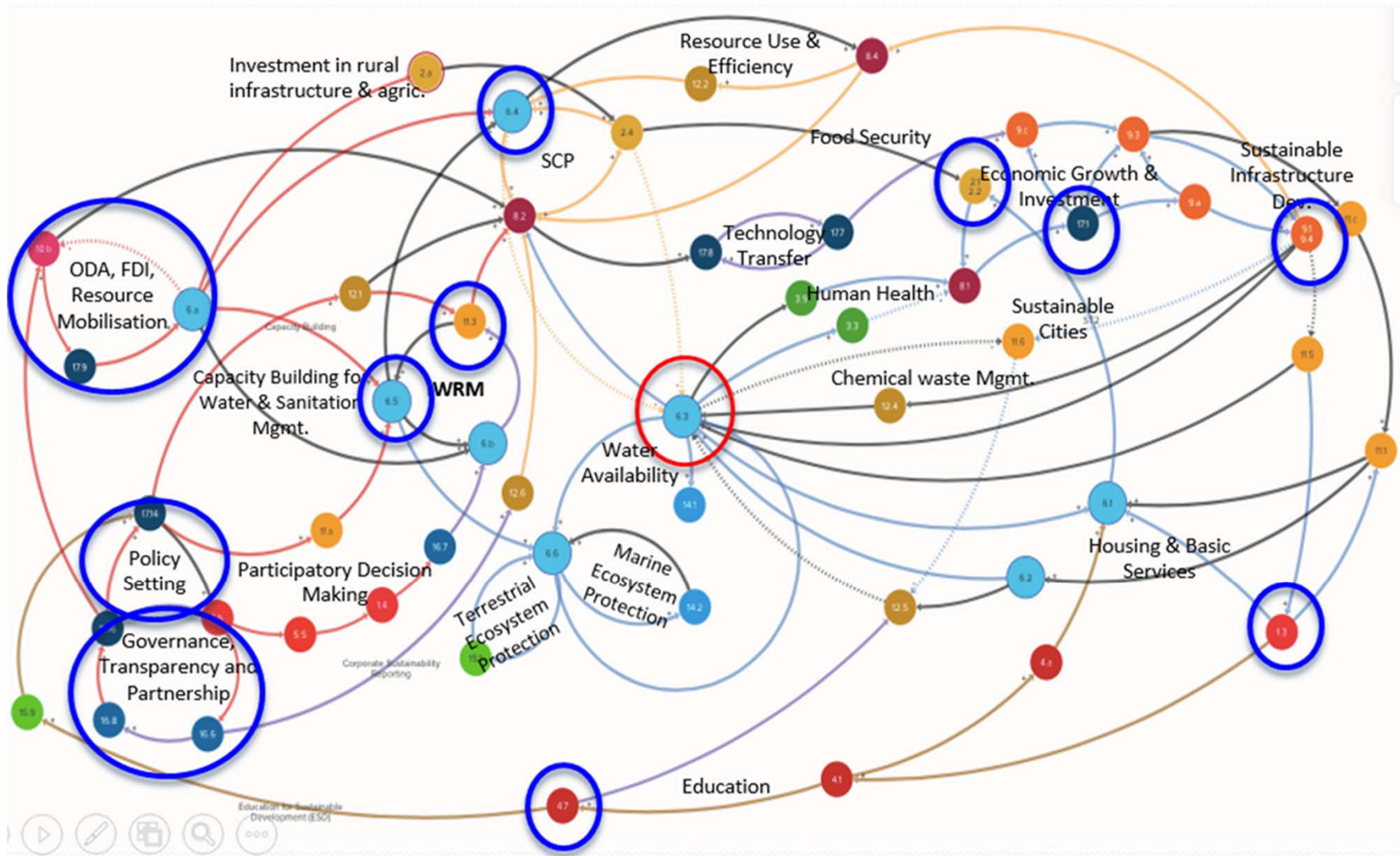


The Value of Causal Loop in Systems Diagrams

To describe and analyse the structure of complex problems, systems models often include Causal Loops, which support multi-level and inter-sectoral policy making processes with wider stakeholder engagement.



Developing Causal Loop Diagram focused on SDG 6 targets



Quiz 3: Feedback and Causal Loops

Why feedback loops are important elements of systems thinking approach?
Choose all correct answers.

- They determine the dynamics of the system
- They are used for analytical purposes, but irrelevant in practice
- They help in removing bottlenecks in the system
- They make the visual representation of causal dynamics look more appealing

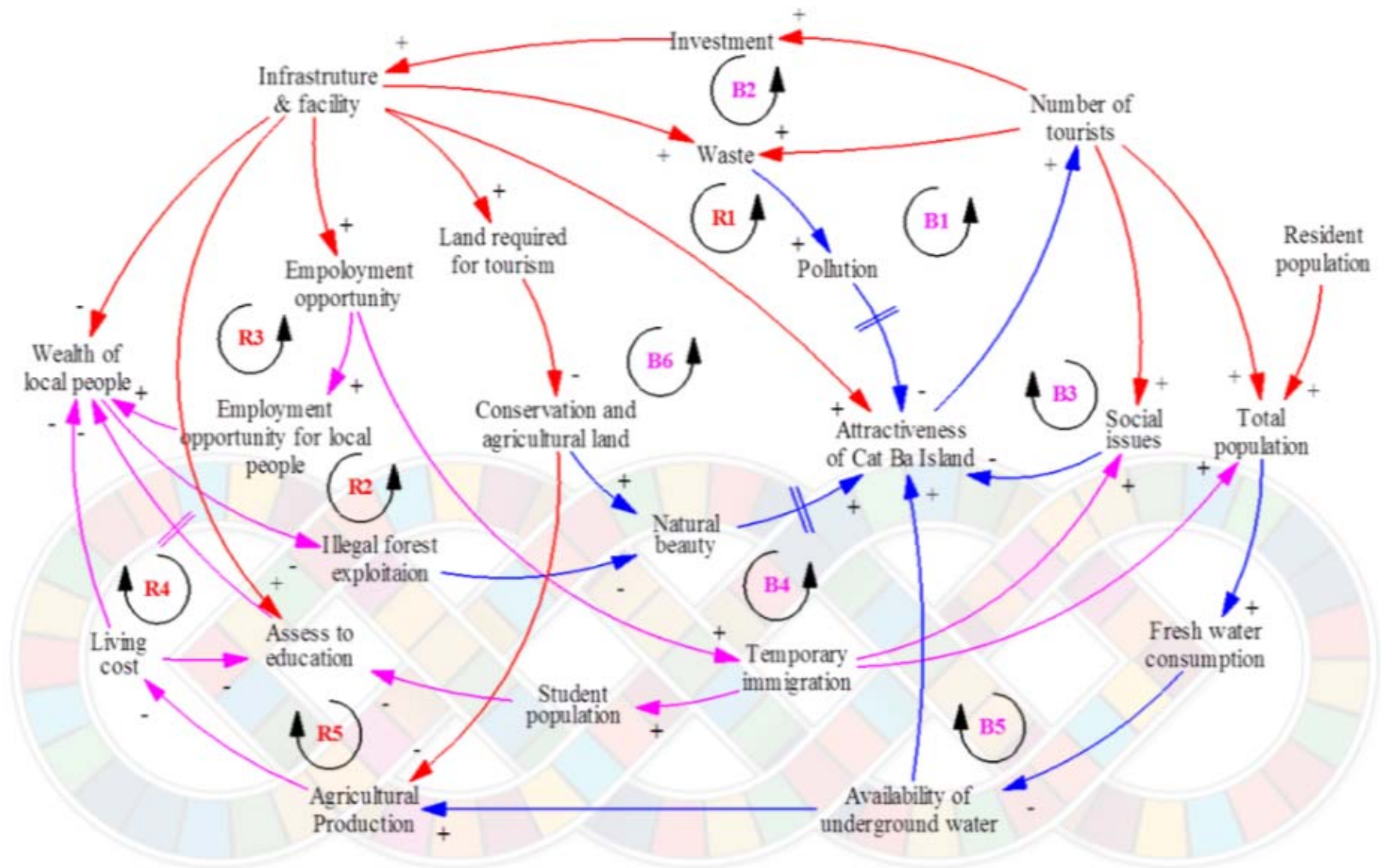


Case study: Cat Ba Biosphere Reserve of Vietnam

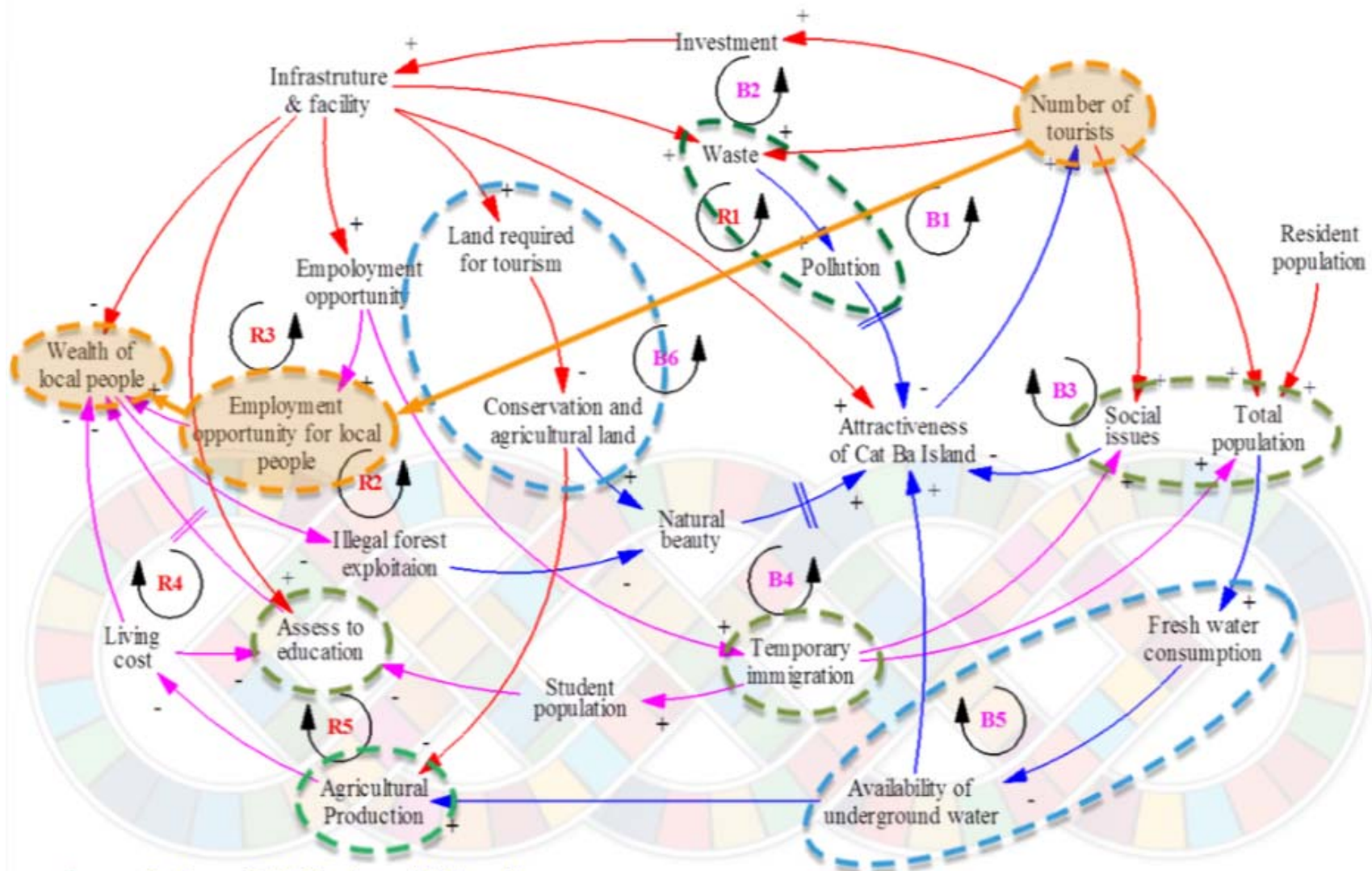


Source: Vietnam Travel Guide

- Located in Northern Vietnam
- High priority area for conservation of biodiversity
- Ha Long Bay is the main urban tourist hub
- Main water supply – groundwater
- Economic output comes from tourism



Source: [Professor Ockie Bosch and Dr Nam Nguyen](#)

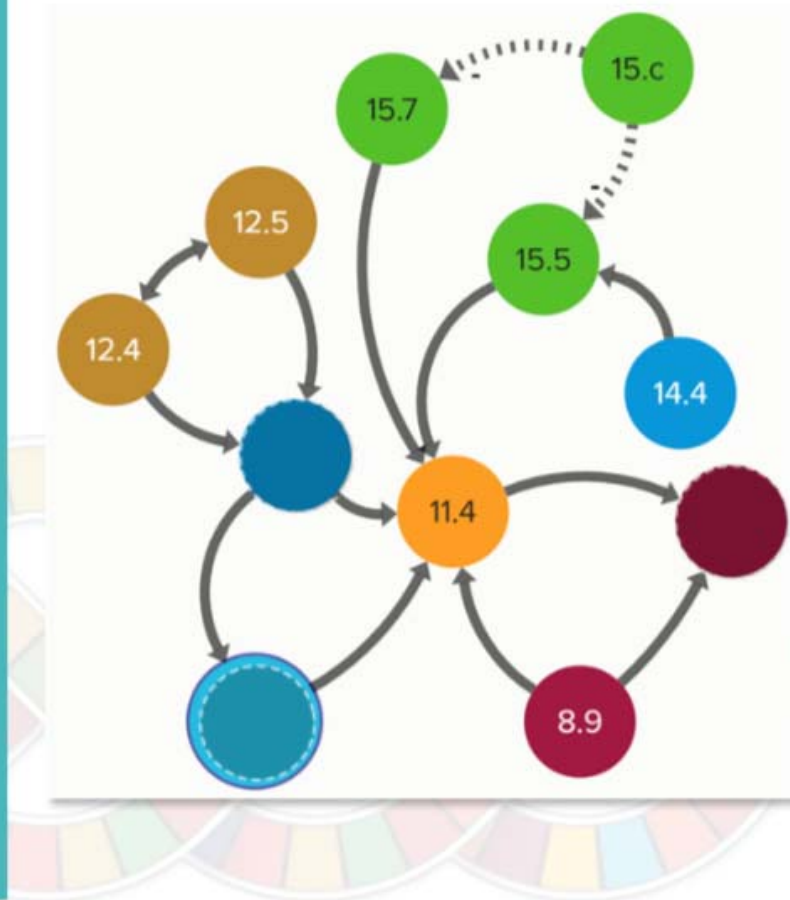


Source: [Professor Ockie Bosch and Dr Nam Nguyen](#)

QUIZ : Cat Ba Biosphere Reserve of Vietnam

Case Study

<u>SDG Indicators</u>	<u>SDG</u>
Lack of fresh water:	6.3,6.4
Employment opportunities:	8.5
Waste management:	12.4
Waste generation prevention:	12.5
Marine pollution from land based activities:	14.1,14.2
Ending overfishing:	14.4
Exploiting forest products:	15.5
Prevent the loss of biodiversity/extinction of threatened species:	15.7
Prevent poaching/hunting to put at risk flora and fauna:	15.c

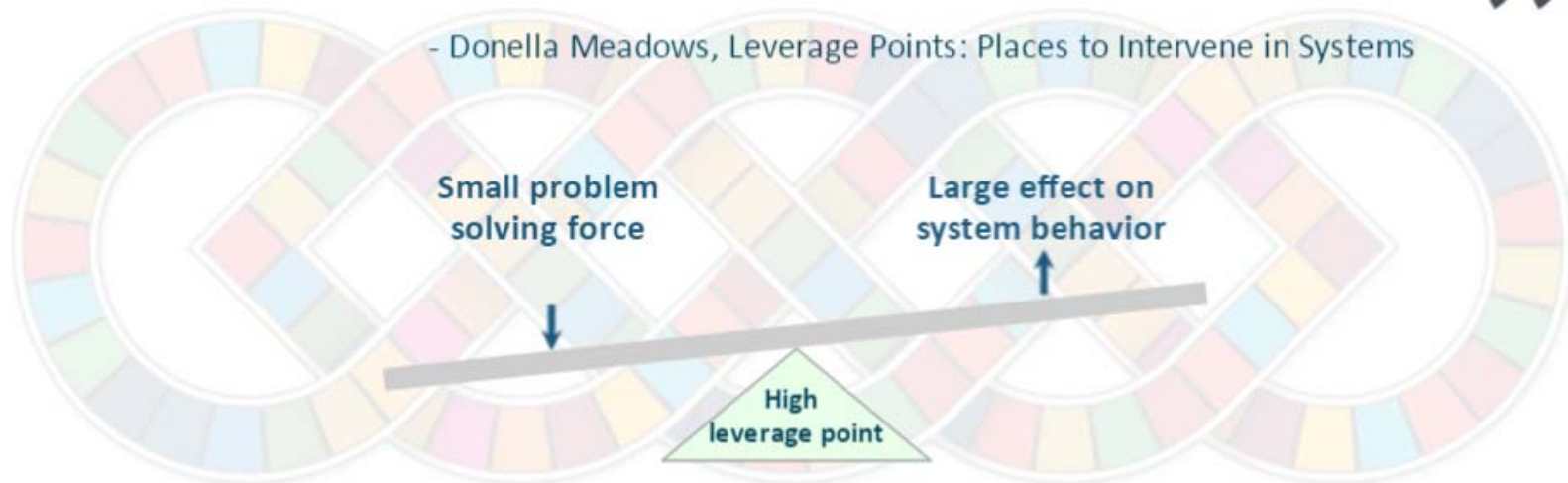


Leverage Points

“

Leverage points are “places to intervene in a complex system...” – be it a company, an economy, a living body, a city, an ecosystem, or even a galaxy for that matter – “...where a small shift in one thing can produce big changes in everything.” They are, therefore, of immense interest to anyone seeking to affect change within our interconnected ecological, social and economic systems.

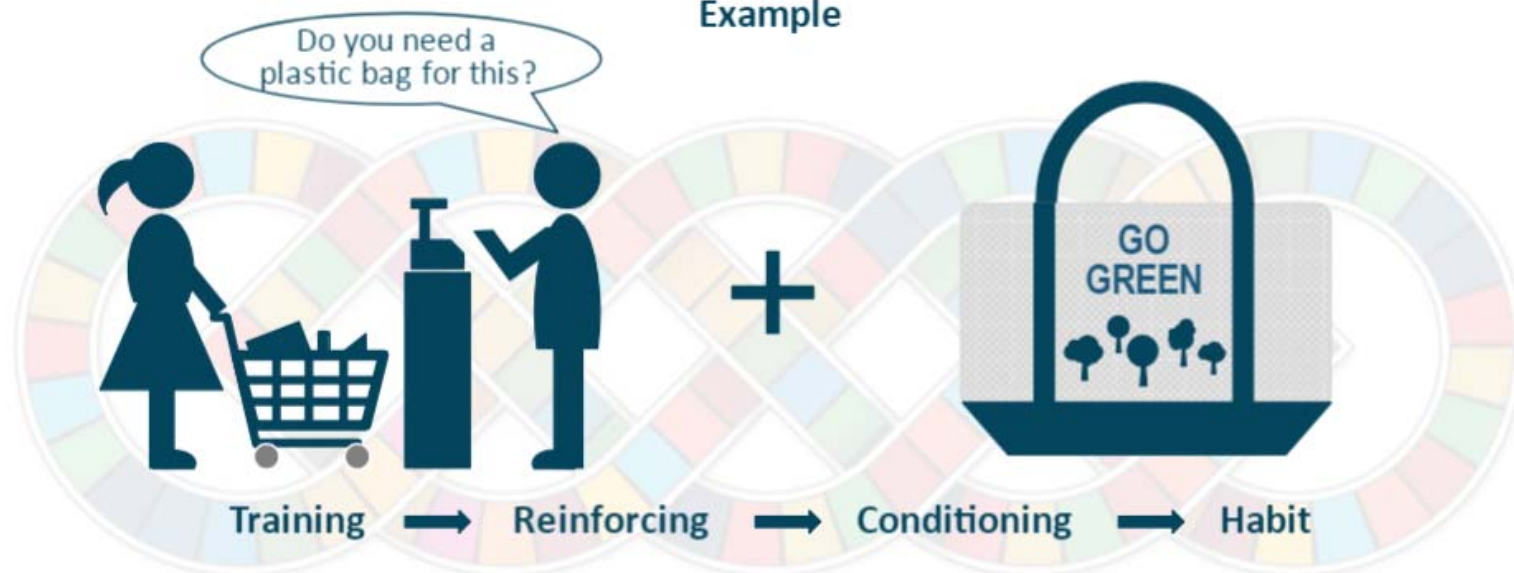
”

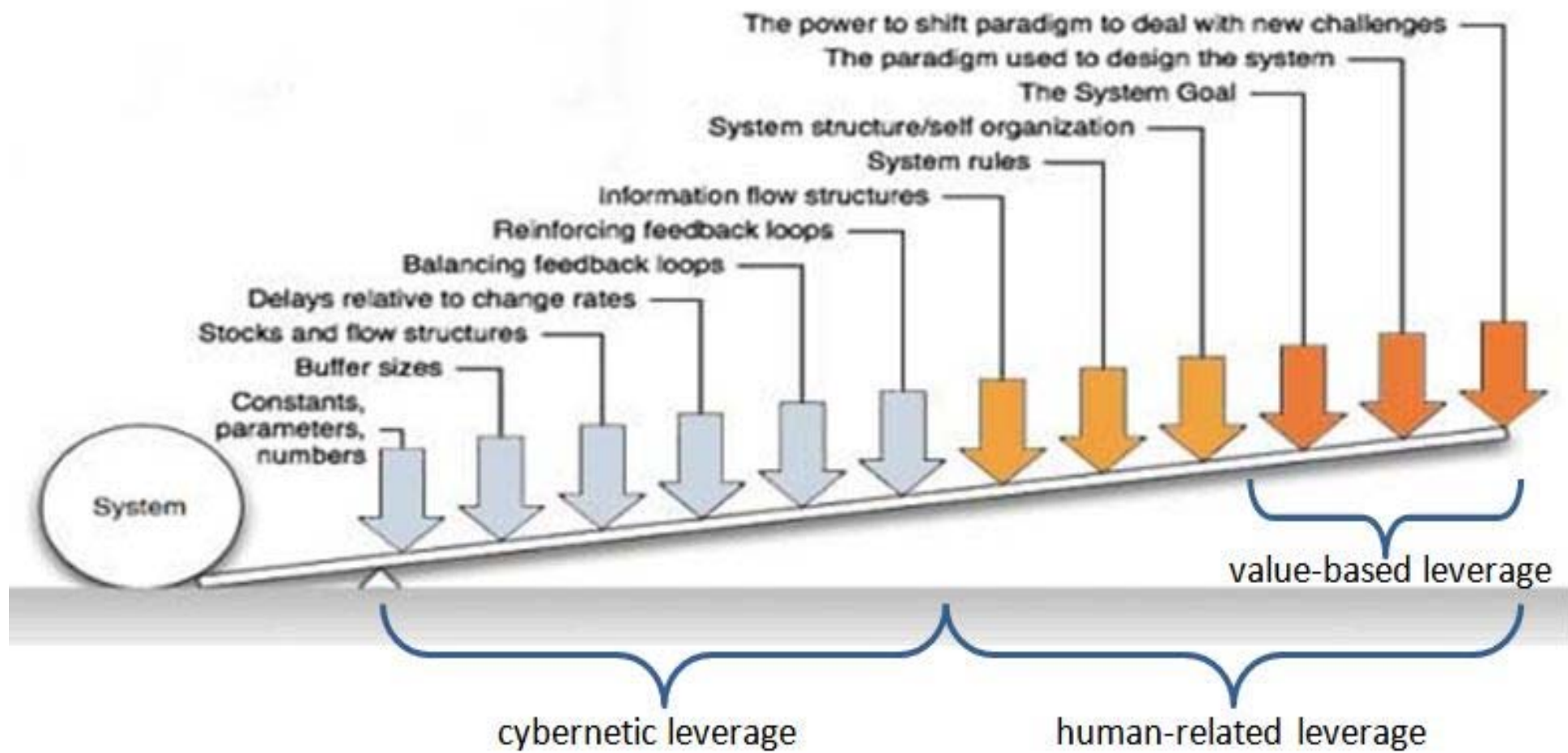


Leverage Points

1. A leverage point is a place in the system's structure when an intervention can be applied.
2. A **low leverage point** is one where a small level of intervention or change force results in a small change in the behavior of the system. This change is often short-lived and not sustainable.
3. In contrast a **high leverage point** is one where a small level of intervention/ change force, causes a large change in the system's behavior. In contrast, high leverage points resolve the root or underlying causes of the undesired system behaviour.

Example



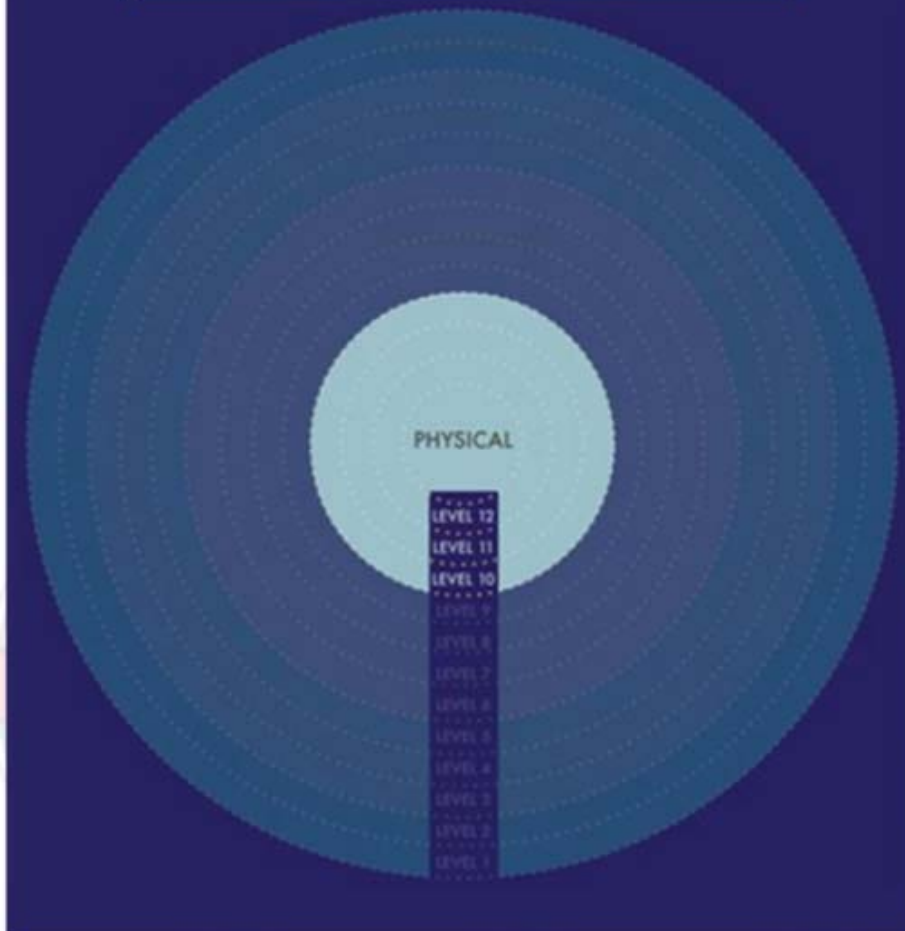


Applying 12 Leverage Points Framework



Donella Meadows developed a 12 leverage point framework for system intervention

DONELLA MEADOWS' 12 LEVERAGE POINTS FOR
SYSTEM INTERVENTION



Physical level

12. **Численные показатели:** переменные, константы, а также субсидии, налоги и стандарты
11. **Буфер:** размер запаса, оказывающий стабилизирующее влияние, в зависимости от величины потоков
10. **Структуры запасов и потоков:** физические системы и их точки пересечения

DONELLA MEADOWS' 12 LEVERAGE POINTS FOR SYSTEM INTERVENTION

INFORMATIONAL

LEVEL 12
LEVEL 11
LEVEL 10
LEVEL 9
LEVEL 8
LEVEL 7
LEVEL 6
LEVEL 5
LEVEL 4
LEVEL 3
LEVEL 2
LEVEL 1

Informational level

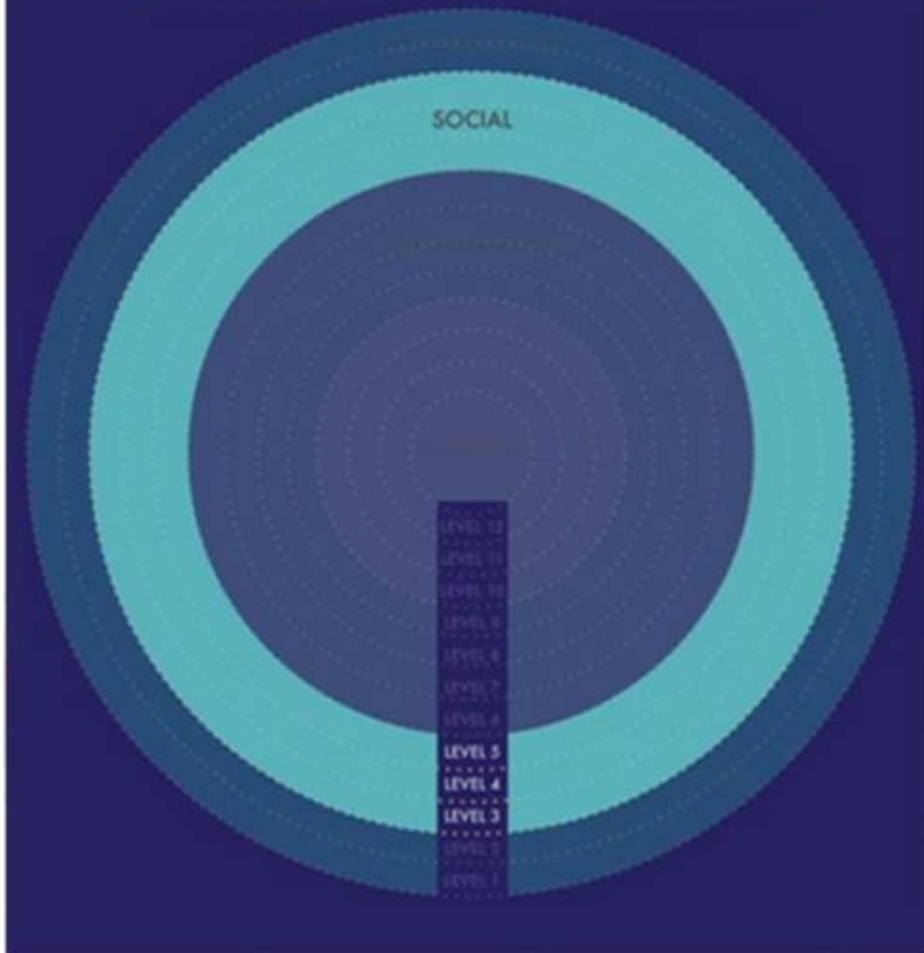
9. **Запаздывания:** величина задержки относительно скоростей изменения системы

8. **Балансирующие циклы обратной связи:** мощность циклов относительно воздействий, которые они пытаются скомпенсировать

7. **Усиливающие циклы обратной связи:** влияние прироста на движущие циклы

6. **Информационные потоки:** структура, определяющая, кто имеет доступ к информации, а кто — нет

DONELLA MEADOWS' 12 LEVERAGE POINTS FOR
SYSTEM INTERVENTION



Social level

5. **Правила:** стимулы, наказания, принуждение
4. **Самоорганизация:** добавление, изменение и эволюционные преобразования системных структур
3. **Цели:** назначение и функция систем

DONELLA MEADOWS' 12 LEVERAGE POINTS FOR
SYSTEM INTERVENTION

CONSCIOUSNESS

LEVEL 12
LEVEL 11
LEVEL 10
LEVEL 9
LEVEL 8
LEVEL 7
LEVEL 6
LEVEL 5
LEVEL 4
LEVEL 3
LEVEL 2
LEVEL 1

Consciousness level

2. **Система взглядов и понятий:**
мировоззрение, в рамках которого построена система — ее цели, структура, правила, запаздывания и другие параметры
1. **Расширение границ мировоззрения**



REFERENCES

Integrated Approaches for SDG Planning: The Case of Goal 6 on Water and Sanitation
<http://www.unescap.org/publications/integrated-approaches-sustainable-development-goals-planning-case-goal-6-water-and>

Low Carbon Green Growth Roadmap for Asia and the Pacific (1 January 2012),
<http://www.unescap.org/resources/low-carbon-green-growth-roadmap-asia-and-pacific>

Integrating of the Three Dimensions of Sustainable Development: A Framework and Tools
<http://www.unescap.org/sites/default/files/Integrating%20the%20three%20dimensions%20of%20sustainable%20development%20A%20framework.pdf>

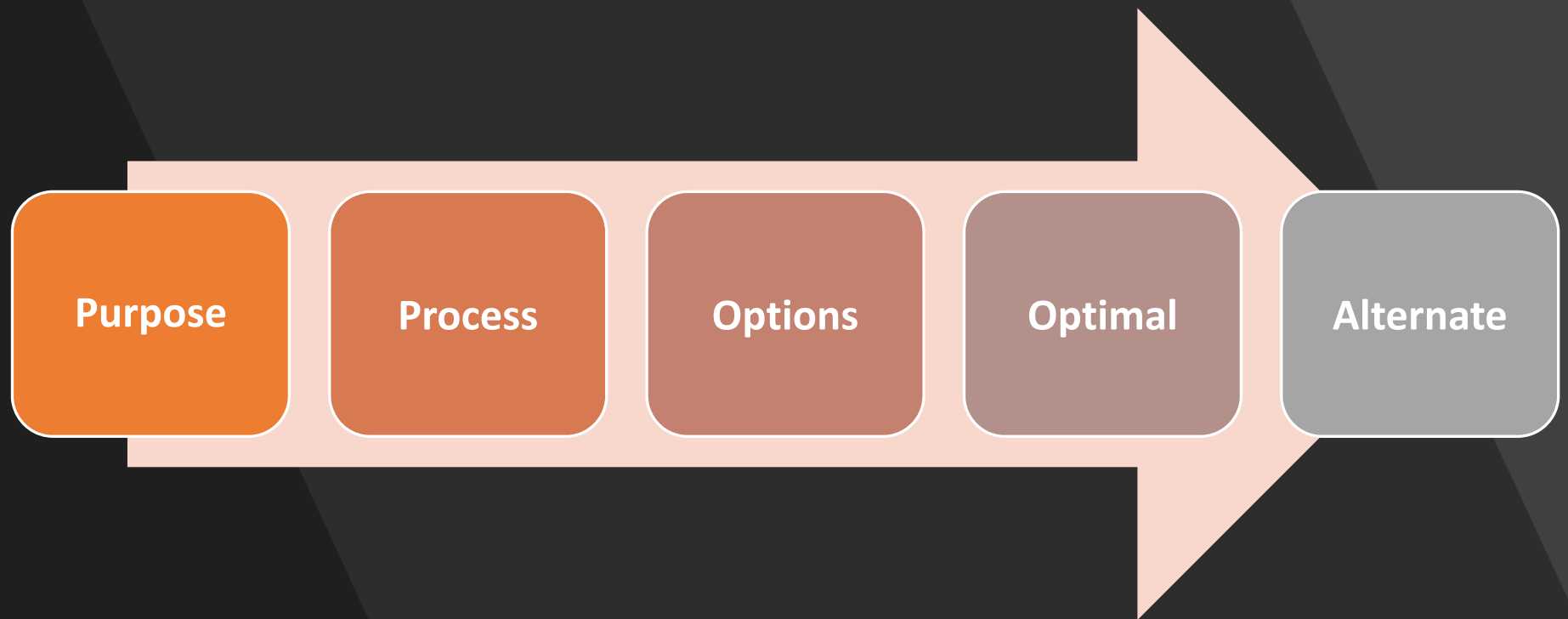
A framework for understanding sustainable development goal interactions; ICSU; 2018
<https://www.icsu.org/cms/2017/03/SDGs-interactions-framework.pdf>

Bosch, O. (2008) Biosphere Reserves as Learning Laboratories for Sustainable Development with special reference to the involvement of The University of Queensland, Australia (unpublished paper). Brisbane, Australia.

Meadows, D. (1999). Leverage points: Place to intervene in a System. The Sustainability Institute, Hartland, VT, USA.



Quantitative Modelling



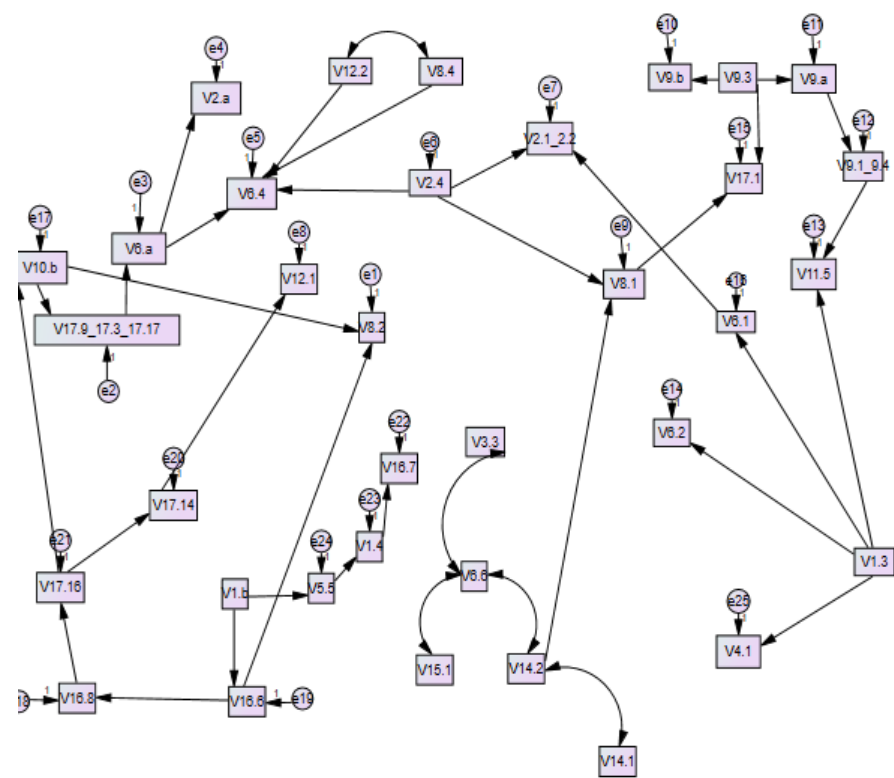
Slide 41

ZK2

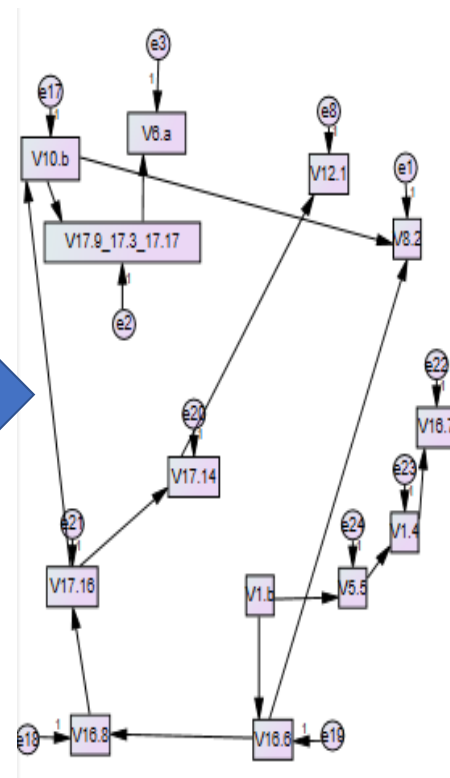
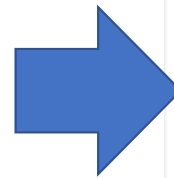
I think slides 41, 42, 43 would better match the session 3 morning presentation as tis quantitative modelling was part of ESCAP methodology and project... I think better to show it as part of those presentation along with the correlation analyses

Zulfiya Kalimollategi, 21/02/2019

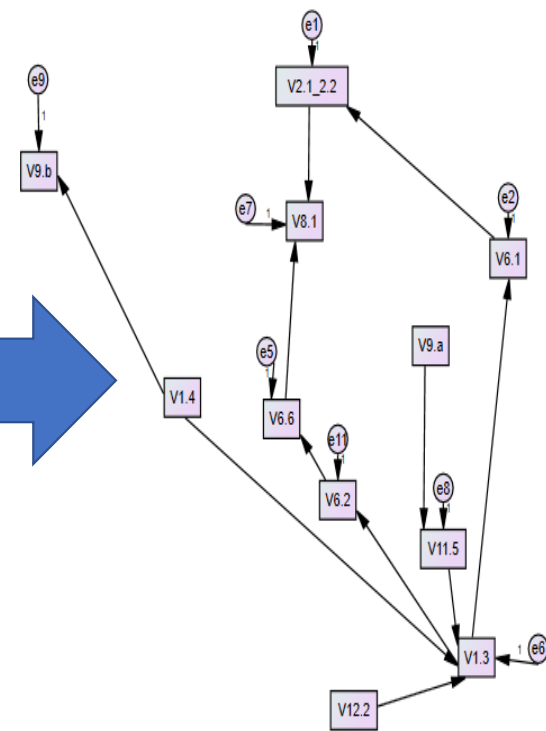
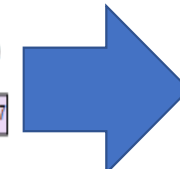
Quantitative Modelling – SEM results



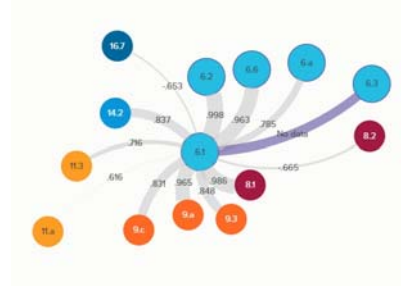
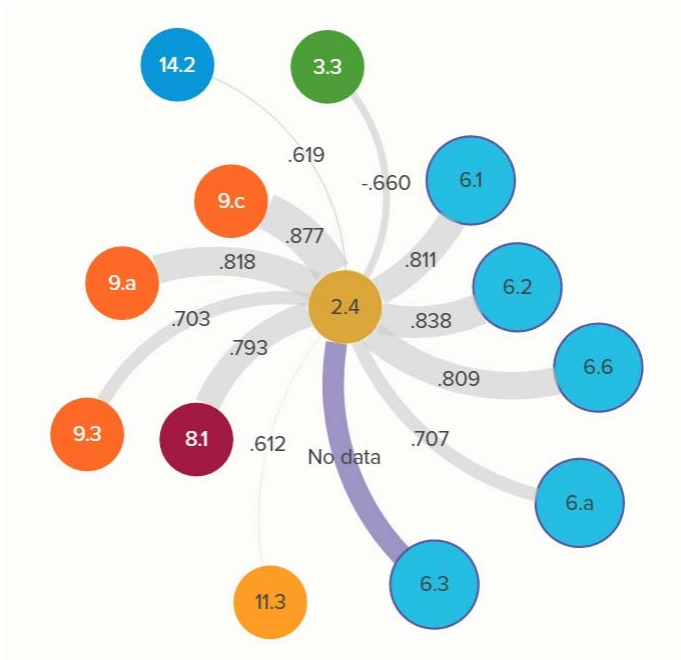
Model 1: Perfect replication of KUMU



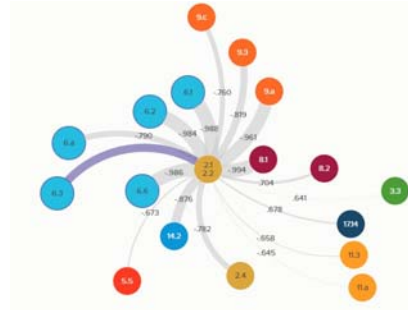
Model 4: Governance Transparency & Partnerships



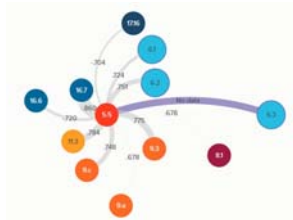
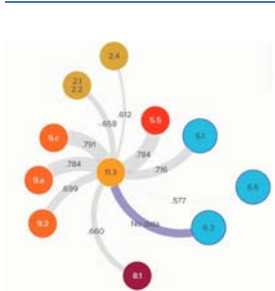
Model 9: FA Original Variables



Qualitative Modelling



In the absence of ideal data – correlational analysis



Three Ways to Create a causal Systems Map



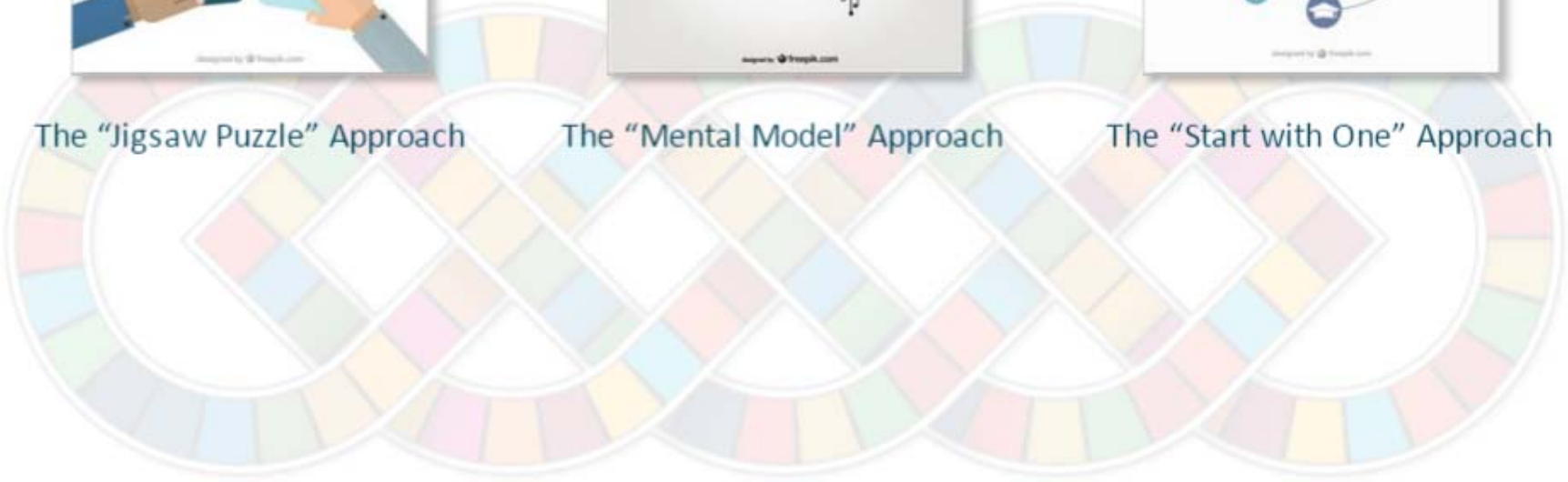
The "Jigsaw Puzzle" Approach



The "Mental Model" Approach



The "Start with One" Approach



Slide 44

ZK3 Slides from this one till the end are more practical and cover hows of preparing the system diagram. I think it would perfectly fit the afternoon of Session 3 that is hands-on session

Zulfiya Kalimollategi, 21/02/2019

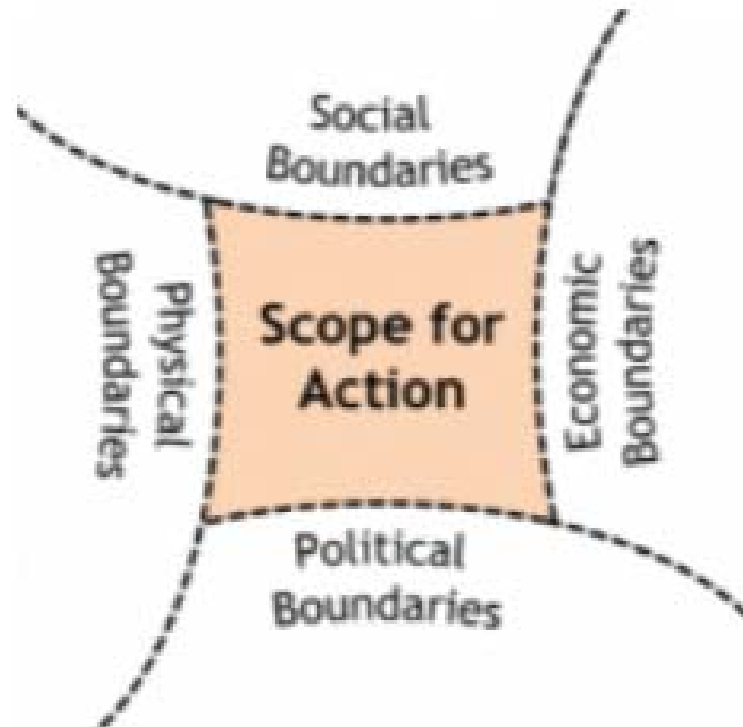
AN1 yes, this is one presentation for the whole day

Aneta Nikolova, 21/02/2019

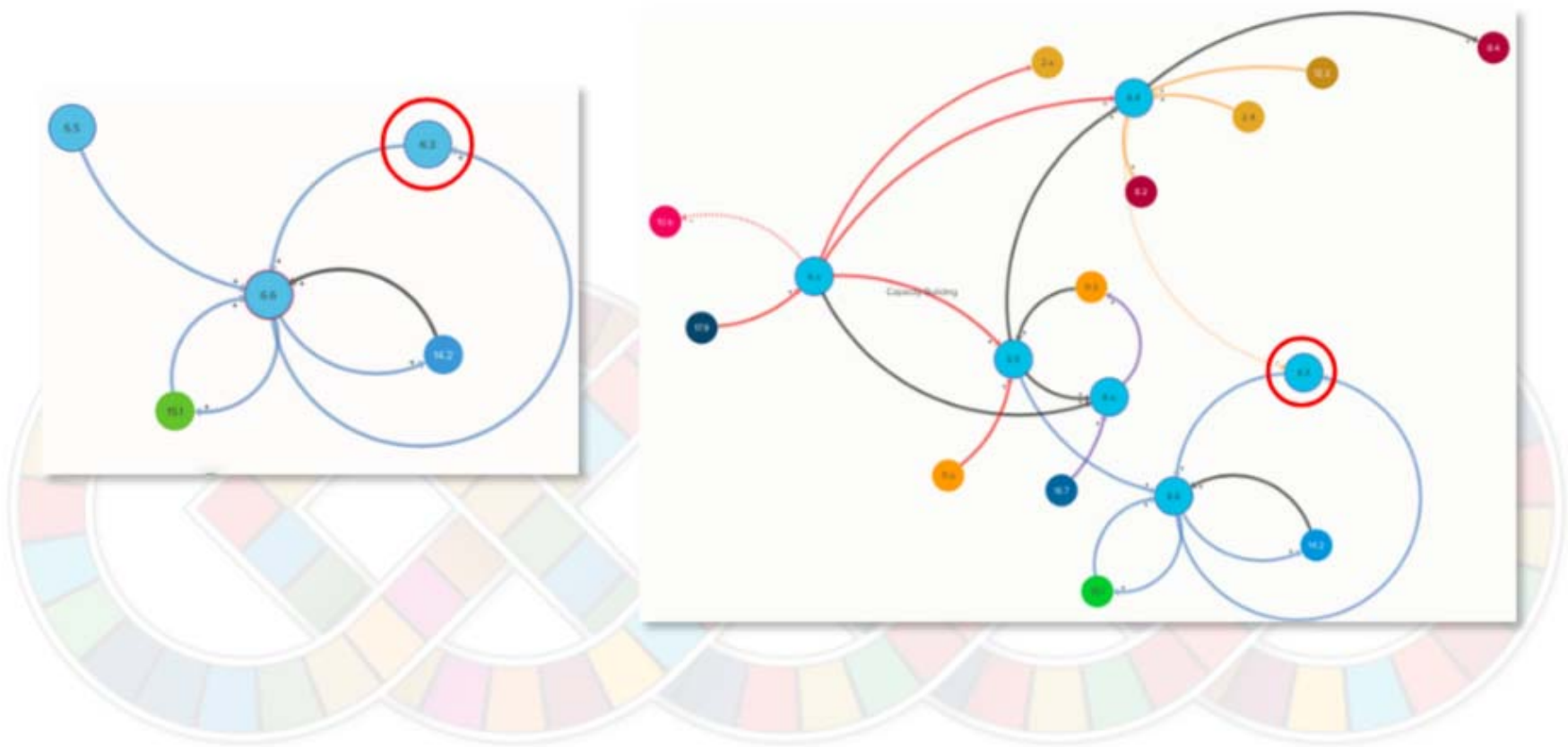
How to Develop A Systems Thinking Model



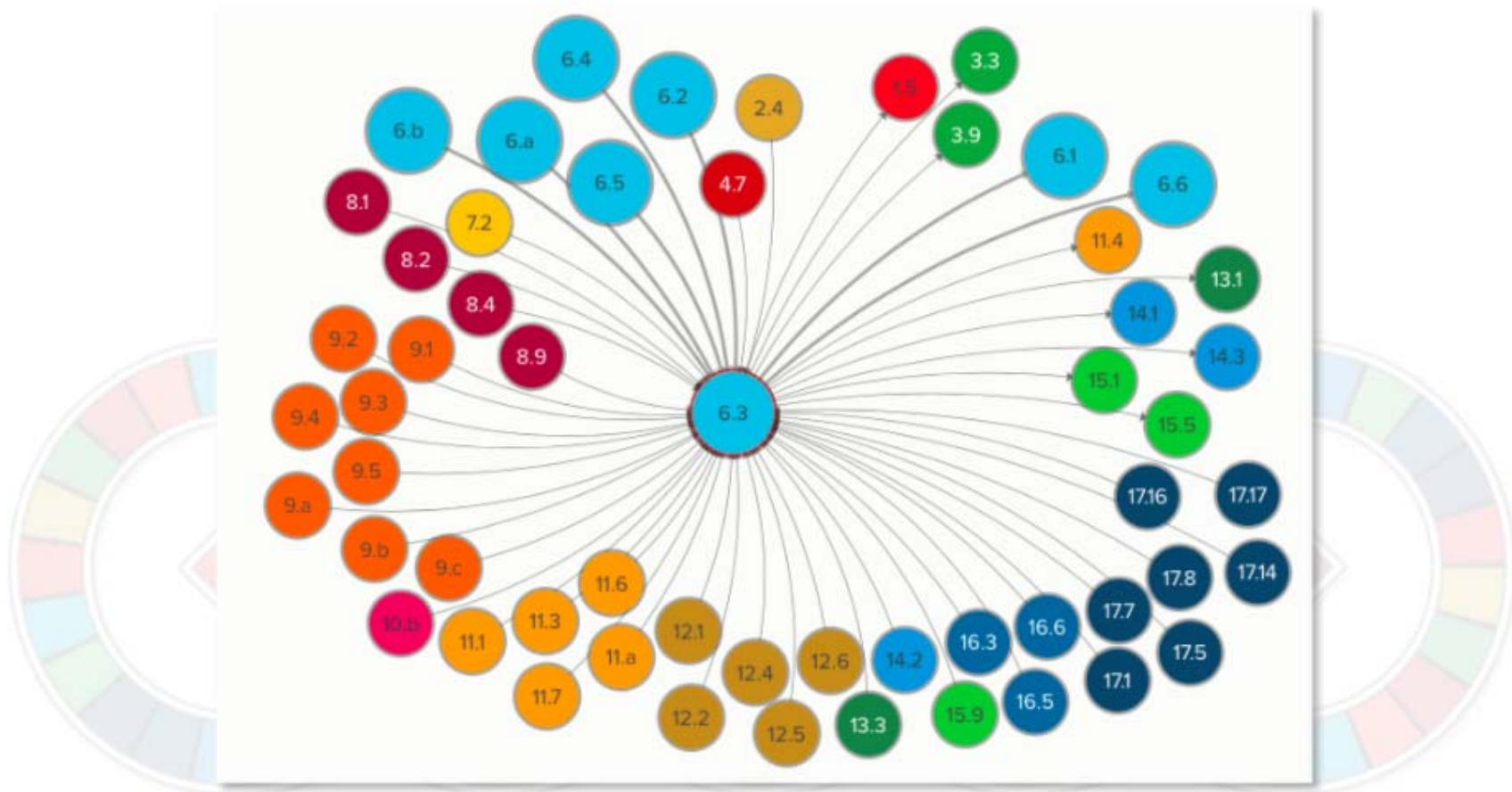
Identify system boundaries



Differentiating Drivers and Responses
Mapping driver linkages
How to begin? Start with a 'Seed Model'



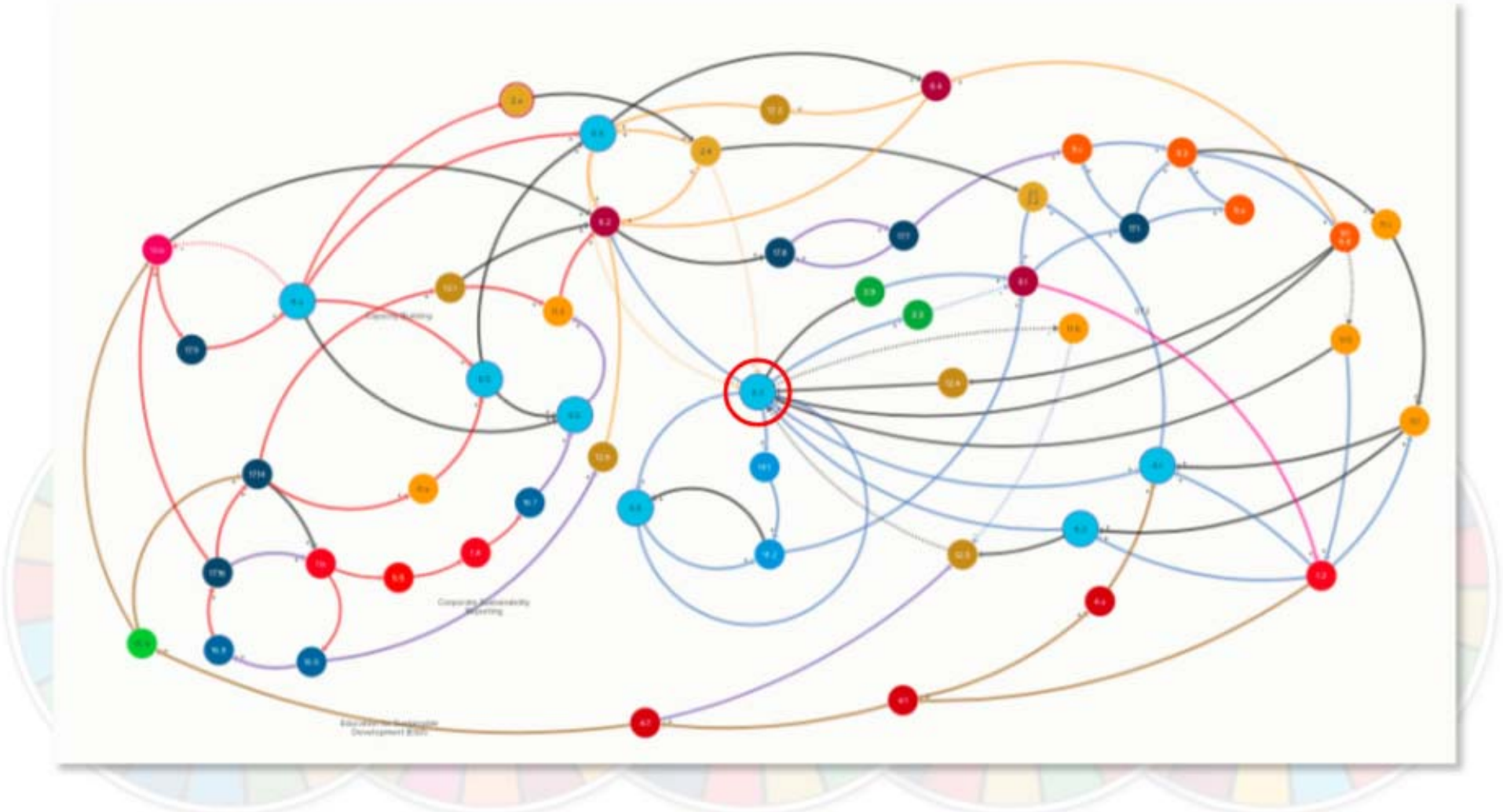
Continue Linking Causal Variables & Build on your Seed Model



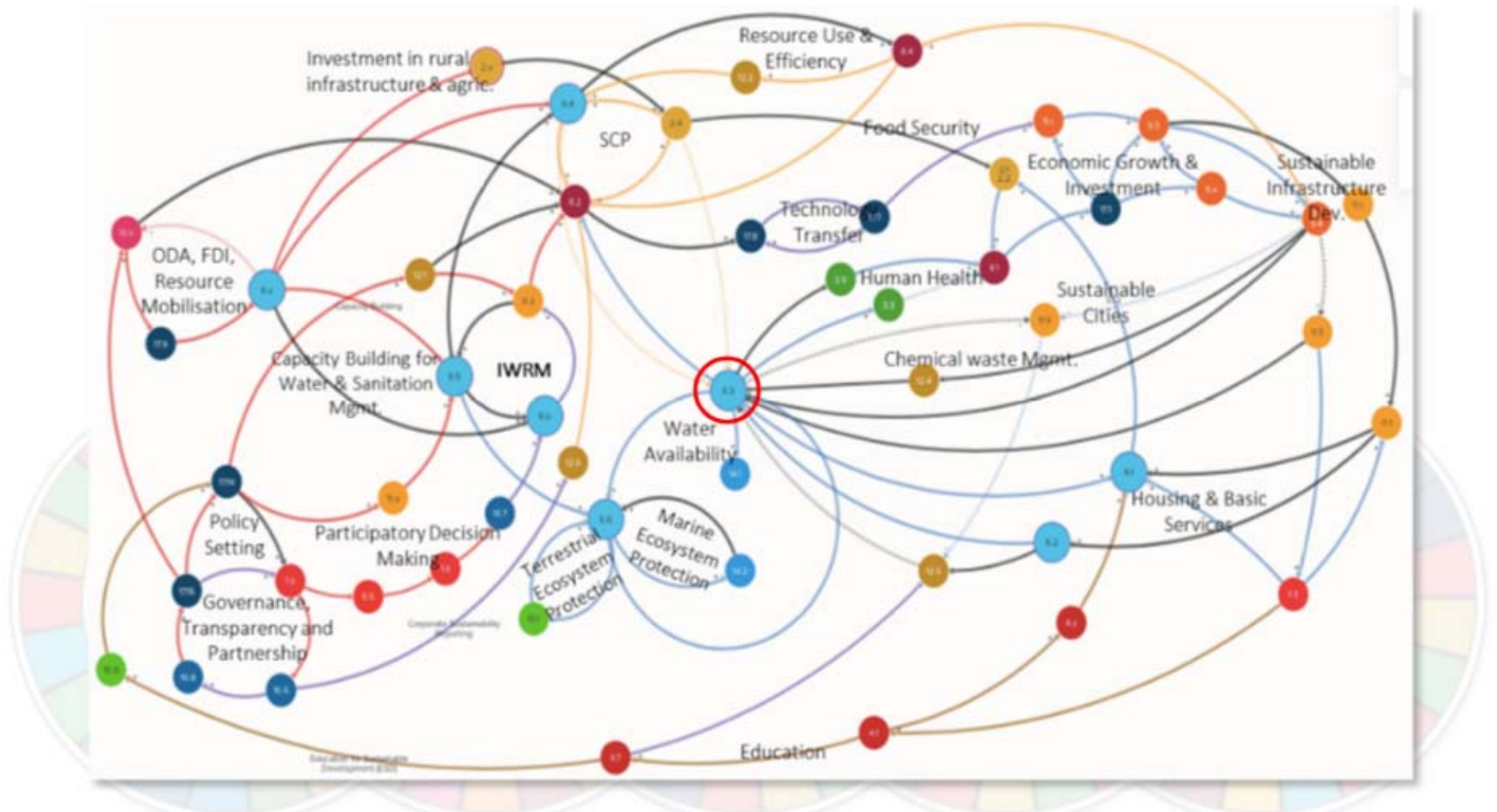
Continue Linking Causal Variables & Build on your Seed Model

Inter-target linkages whereby the SDG 6 Target is the direct 'driver' for change for the other SDG targets (Identified by Target Number)	Inter-target linkages whereby the SDG 6 Target is being influenced (Response) by the other target. (Identified by Target Number)
<p><u>Total Direct 'Driver' linkages deriving from 6.3: (11)</u></p> <p>SDG 1: 1.5</p> <p>SDG 3: 3.3, 3.9</p> <p>SDG 6: 6.1, 6.6</p> <p>SDG 11: 11.4,</p> <p>SDG 13: 13.1</p> <p>SDG 14: 14.1, 14.3</p> <p>SDG 15: 15.1, 15.5</p>	<p><u>Total Direct 'Response' linkages going to 6.3: (44)</u></p> <p>SDG 2: 2.4</p> <p>SDG 4: 4.7</p> <p>SDG 6: 6.2, 6.4, 6.5, 6.a, 6.b</p> <p>SDG 7: 7.2</p> <p>SDG 8: 8.1, 8.2, 8.4, 8.9</p> <p>SDG 9: 9.1, 9.2, 9.3, 9.4, 9.5, 9.a, 9.b, 9.c</p> <p>SDG 10: 10.b</p> <p>SDG 11: 11.1, 11.3, 11.6, 11.7, 11.a</p> <p>SDG 12: 12.1, 12.2, 12.4, 12.5, 12.6</p> <p>SDG 13: 13.3</p> <p>SDG 14: 14.2</p> <p>SDG 15: 15.9</p> <p>SDG 16: 16.3, 16.5, 16.6</p> <p>SDG 17: 17.1, 17.5, 17.7, 17.8, 17.14, 17.16, 17.17</p>

Map the "Responses or Outcomes" and Identify Feedback

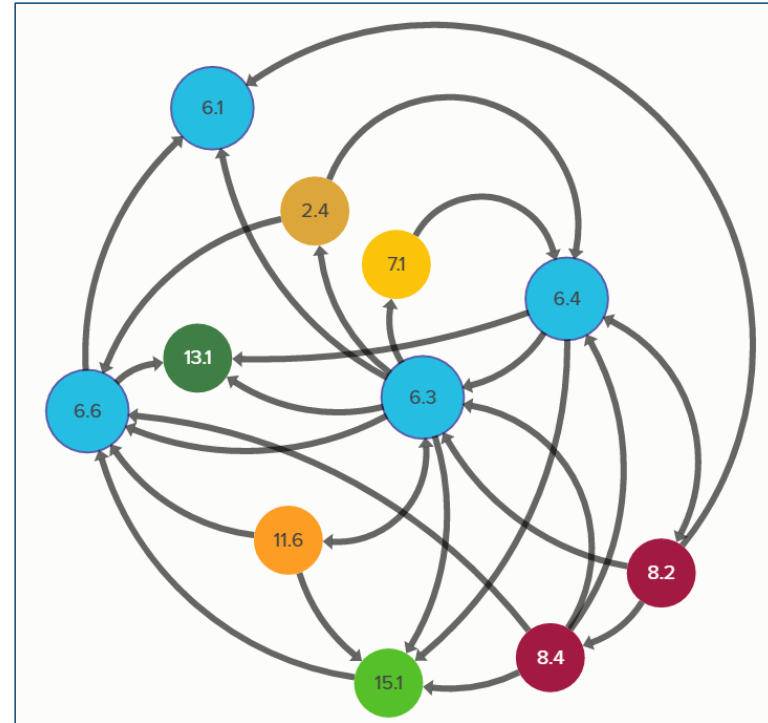
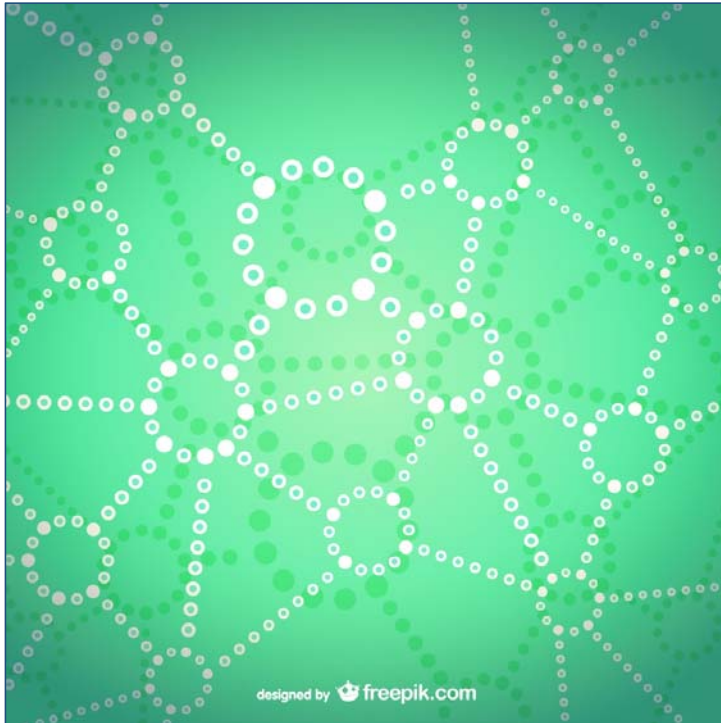


Naming Loops and Links



Kumu Mapping

Kumu enables you to build interactive maps with narratives, links, video and other background for each element, connection, and loop in the map.



Interlinkages Scale

Interaction	Name	Explanation	Example
+3	Indivisible	Inextricably linked to the achievement of another goal.	Ending all forms of discrimination against women and girls is indivisible from ensuring women's full and effective participation and equal opportunities for leadership.
+2	Reinforcing	Aids the achievement of another goal.	Providing access to electricity reinforces water-pumping and irrigation systems. Strengthening the capacity to adapt to climate-related hazards reduces losses caused by disasters.
+1	Enabling	Creates conditions that further another goal.	Providing electricity access in rural homes enables education, because it makes it possible to do homework at night with electric lighting.
0	Consistent	No significant positive or negative interactions.	Ensuring education for all does not interact significantly with infrastructure development or conservation of ocean ecosystems.
-1	Constraining	Limits options on another goal.	Improved water efficiency can constrain agricultural irrigation. Reducing climate change can constrain the options for energy access.
-2	Counteracting	Clashes with another goal.	Boosting consumption for growth can counteract waste reduction and climate mitigation.
-3	Cancelling	Makes it impossible to reach another goal.	Fully ensuring public transparency and democratic accountability cannot be combined with national-security goals. Full protection of natural reserves excludes public access for recreation.