DESIGN

System Thinking

RAMBØLL

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Our world is facing complex and wicked problems (such as climate change, energy, social inequality, biodiversity loss, etc) and tackling these separately no longer work as these systemic problems are all interconnected and interdependent.

Systems thinking can provide a broader, interconnected, and holistic view to solving the challenges and bringing more creative, multidisciplinary, balanced, adaptable, and permanent solutions...

It's about thinking in terms of relationships, connectiveness, patterns and context.

"The world is a complex, interconnected, finite, ecological - social - psychological - economic system. We treat it as if it were not, as if it was divisible, separable, simple, and infinite. Our persistent, intractable global problems arise directly from this mismatch."

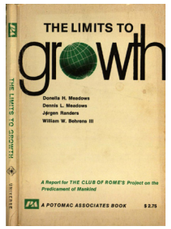
Donella Meadows

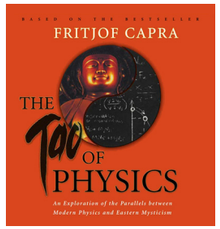
A brief history of System Thinking

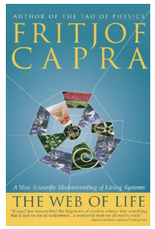
The origins of system thinking can be traced back to the early 20th century with Alexander Bogdanov, a Russian philosopher, who proposed a holistic approach to organically integrate diverse disciplines. Gregory Bateson, an English anthropologist, expanded on these ideas in the mid-20th century by emphasizing the interconnectedness and interdependence of systems in nature and society.

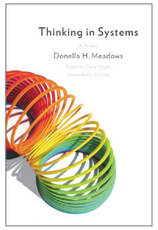
In the 1970s Donella Meadows, a prominent environmental scientist, further popularized system thinking with the book "Limits to Growth," where she and a group of researchers at MIT applied systemic approaches to address global environmental challenges. Fritjof Capra, a quantum physicist and writer of the highly acclaimed book "The Tao of Physics", merged system thinking with deep ecological principles in his book "The Web of Life", highlighting the interconnectedness and complexity of natural systems.

Overall, the evolution of system thinking has been deeply influenced by the works of these visionaries and many others, including Anatol Rapoport, a Soviet physiologist and psychologist, Russell Ackoff, an architect and system educator; and others. Their insights have played a significant role in the development and popularization of system thinking, shaping how we perceive and address complex issues in various fields ranging from ecology and economics to organizational management and social dynamics. By understanding the interconnectedness and interdependence of systems, we can better address the complex challenges facing our world today.









It is noteworthy that most of these pioneering and leading system thinkers tend to come from professions like psychology, physiology, biology, and similar topics talking about life and the way natural phenomena relate to one another. This is a clear indication of how the study of the natural environment instills in one a feeling of connectedness, and how nature is the ultimate system of systems.

A tendency that, to a large extent, still prevails among contemporary system thinkers.

Anthropologists, humanities, life sciences, and scientists, in contrast to management consultants and leadership gurus!

Why do we need System Thinking?

We need System Thinking because life is complicated.
Or is it complex, chaotic, or disorderly?

Simple

Known Knowns:

simplicity, cause and effect, often an obvious answer exists to be found.

Complicated

Known Unknowns:

often more than one correct answer, to be found and selected by the leader.

Complex

Unknown Unknowns:

right answers must be constructed through experience and exploration, the realm of most contemporary business leadership decisions.

Chaotic

Unknowables:

no answer to be found; leaders must not look for solutions but for stability, then nudge the context towards complexity.

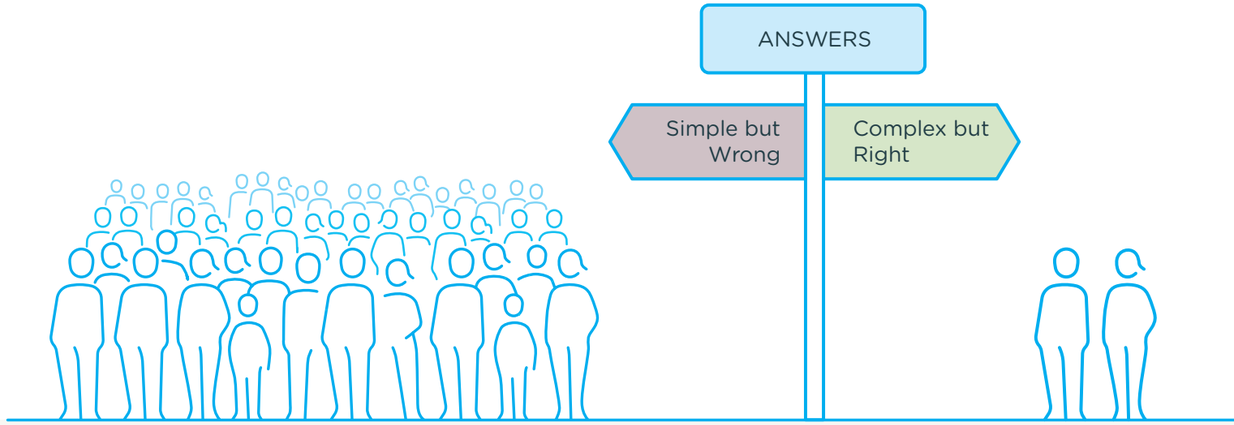
Disorderly

Mixture of Above 4:

summarily sack the leader who's led the team to this context.

“ If everything in the universe depends upon everything else in a fundamental way, it might be impossible to get close to a full solution by investigating parts of the problem in isolation.”

Stephen Hawking



“For every complex problem, there is a simple answer that is wrong.”

“We need to embrace complexity.“

Inspired by
wileyink@earthlink.net

The Tyranny of Simplicity

"If we have system of an improvement, that's directed at improving the parts taken separately. You can be absolutely sure that the performance of a whole will not be improved."

Russell L. Ackoff

Our obsession with simplicity, and with looking for simple answers regardless of the context of the problem, must stop. Criticism and debate of the traditional encouragement and incentivisation of simple and simplicity. How do we refer to simple answers as good. How do we incentivise people who come up with simple answers.

We now understand that complex problems do not have simple answers. Our complex problems have therefore grown and transformed into dilemmas and "wicked problems" of our time.

Wicked Problems and Dilemmas

A dilemma is a problem that exists in one system within which there is no solution to it. Solving dilemmas requires a system change; to create a system within which this problem does not exist, or has a solution.

Solutions to wicked problem in one system, only exist inside another system; adjacent or far. So, to solve wicked problem or dilemma, one needs to understand the system within which the problem resides, as well as the system within which the solution may exist.

When Einstein mentioned "problems can not be solved at the same level of consciousness that created them", he was in fact referring to wicked problems.

"You do not rise to the level of your ambition...

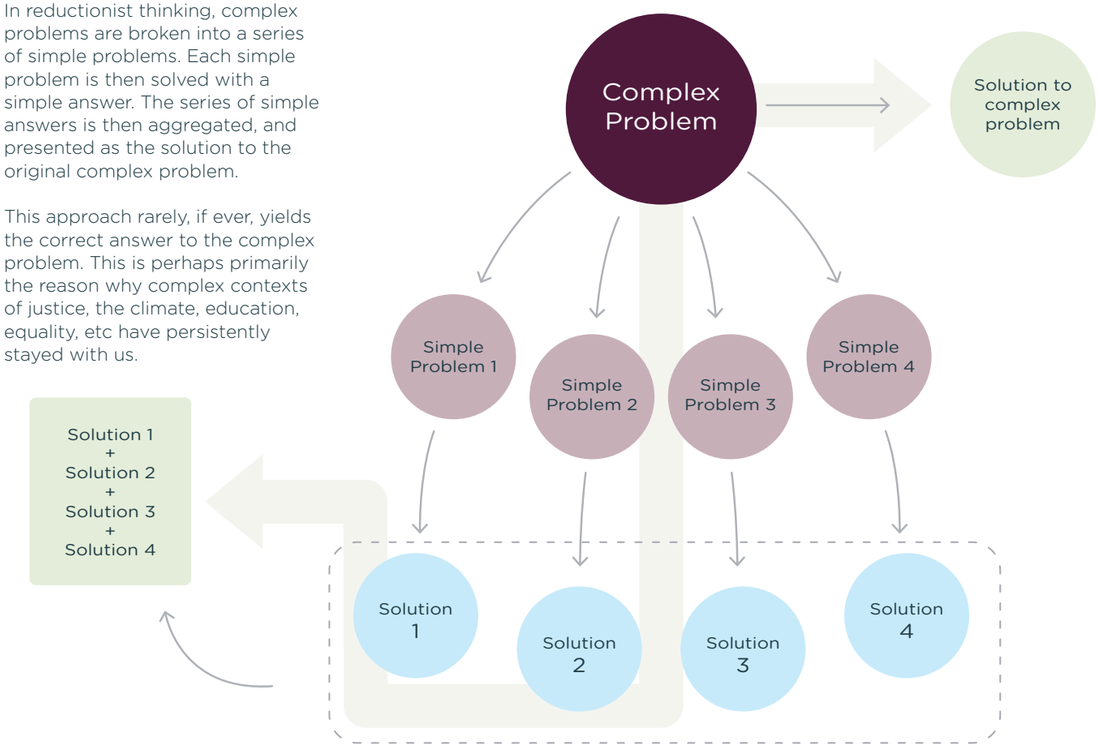
...you fall to the level of your system."

James Clear

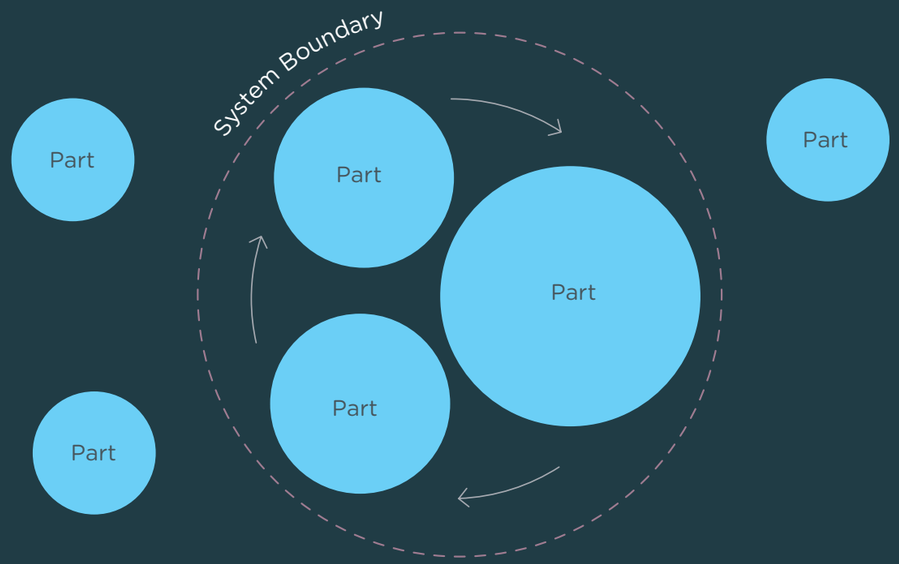
Reductionism VS System Thinking

In reductionist thinking, complex problems are broken into a series of simple problems. Each simple problem is then solved with a simple answer. The series of simple answers is then aggregated, and presented as the solution to the original complex problem.

This approach rarely, if ever, yields the correct answer to the complex problem. This is perhaps primarily the reason why complex contexts of justice, the climate, education, equality, etc have persistently stayed with us.



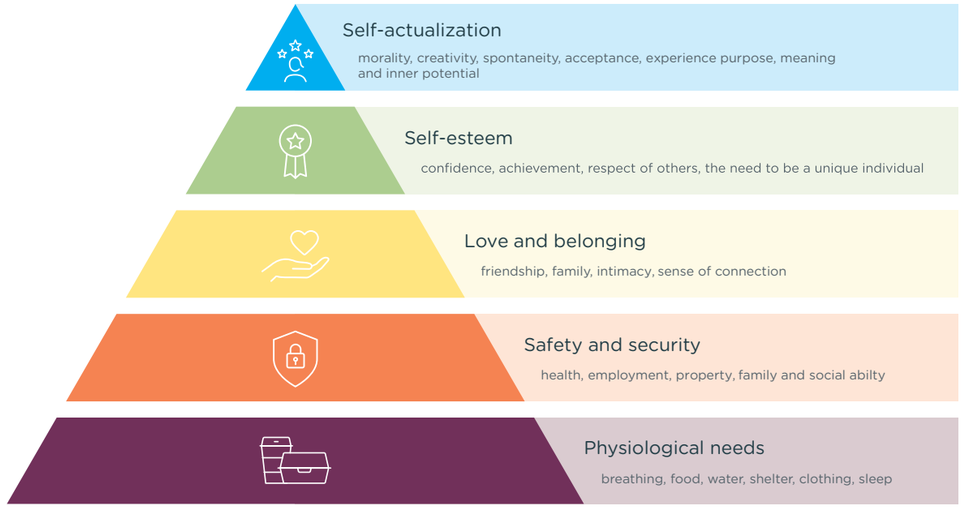
System Boundaries



Systems have no hierarchy, nor do they have a "foundation"! Every component is key in delivering the system outcome. If it were not, then it would not be part of the system but exists outside the boundary of that system. If a system could deliver the same outcome without a component, then that component is not part of that system!

The metaphor of foundations, pillars, support, etc which come from structural engineering, do not apply in system thinking.

Maslow's Hierarchy of Needs theory



Maslow's Hierarchy of Needs presents a linear, hierarchical structure of human needs. Maslow's theory suggests that people must fulfill lower-level needs (like physiological needs) before they can pursue higher-level needs (like self-actualization).

"the trouble with Maslow is that he was not a system thinker!"

From a systems perspective, human needs are not strictly hierarchical but interdependent and dynamic.

People may simultaneously seek fulfillment at multiple levels (e.g., social connections and self-esteem), and these needs are influenced by a variety of factors (e.g., environment, relationships, and personal context).

The idea of a rigid, hierarchical structure oversimplifies the complexity of human experience, whereas a systems thinker would recognize the interconnectedness of needs and the fluidity of how they are met.

System Thinking and Patterns

In a system comprising multi -components, each component performs a role/function. But the whole system performs a higher function. in other words, constituent parts of a system perform multiple functions by default. As such, they perform a higher role than if they were not part of a system. Therein lies the value of a system which produces more than the sum total of the parts.

Of Resilience, Efficiency, and Circularity

Circularity is part of resilience.

Resilience is dynamic.

Dynamic systems are nonlinear.

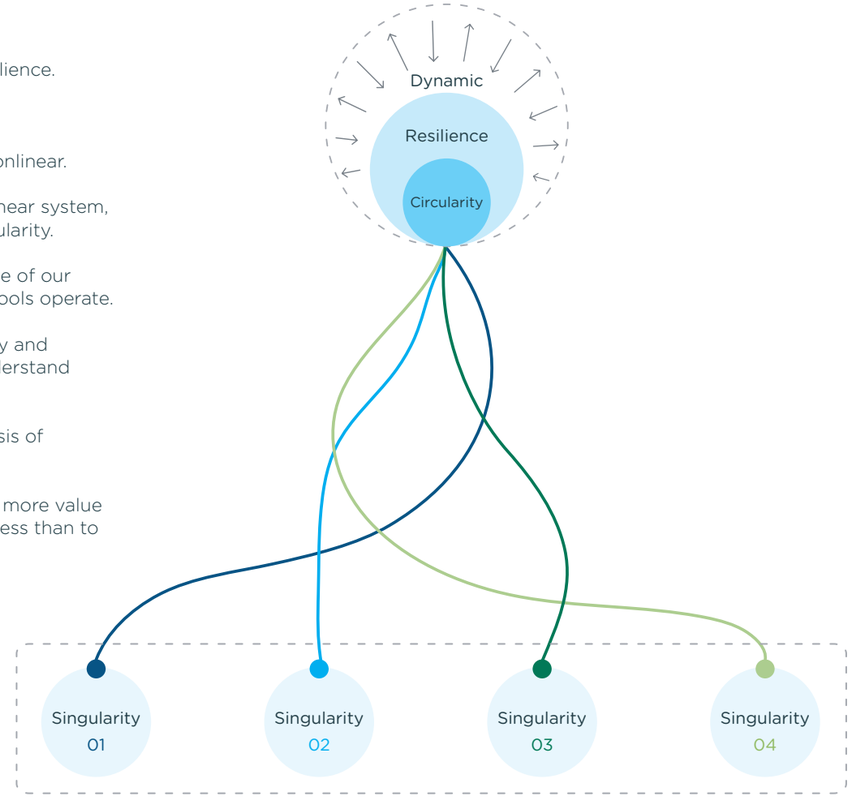
At one end of any nonlinear system, there is a potential singularity.

Singularity is where none of our current processes and tools operate.

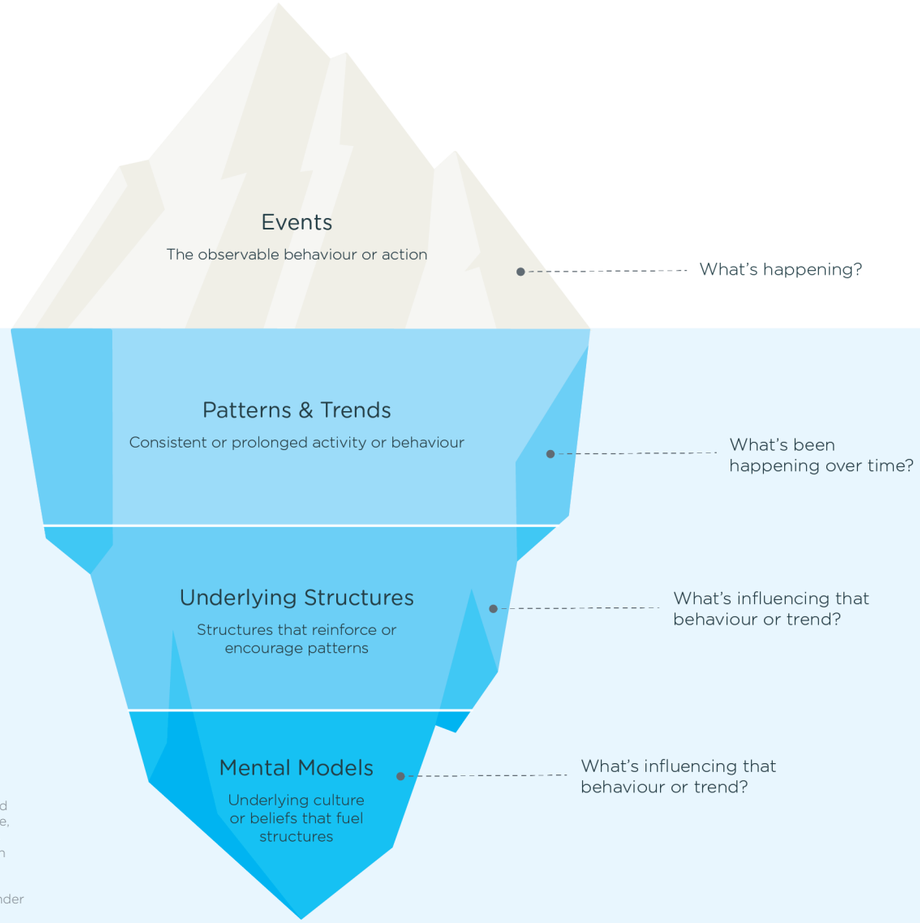
To understand circularity and resilience, one must understand singularity.

Resilience is the antithesis of efficiency.

In regenerative systems more value is ascribed to effectiveness than to efficiency.



The Iceberg Model



An iceberg model
The layers of system thinking: visible events and patterns above the surface, and underlying structures and mental models hidden beneath.

(Inspired from The pathfinder coach)

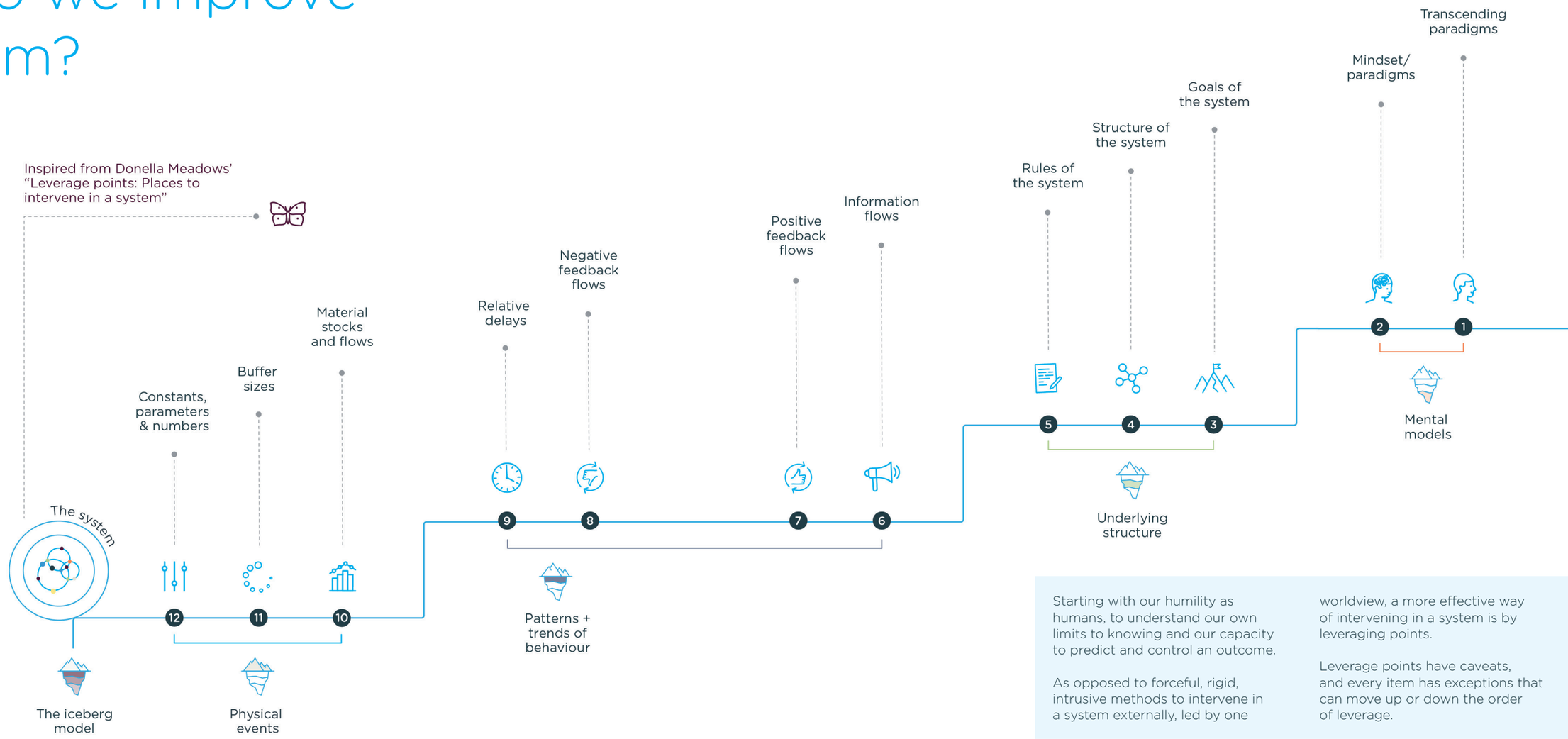
Iceberg Model is often used in systems thinking, which focuses on understanding the interconnectedness and complexity of systems.

In systems thinking, the Iceberg Model provides a framework for identifying root causes. It reminds us that what we see on the surface is often just a small part of a much larger reality.

This model is a valuable tool for navigating complexity. By delving beneath the surface to uncover patterns, structures, and mental models, we can gain a deeper understanding of problems and craft meaningful, lasting solutions.

This model is referenced on page 18 of this Edition

How do we improve a system?



12 leverage points to intervene in a system
Just like acupuncture, we look for high-potential leverage points to create significant shifts in a system.

Source: Ramboll, adapted from Meadows, 1999

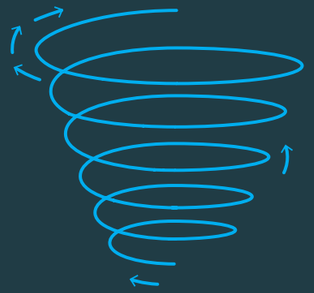
Starting with our humility as humans, to understand our own limits to knowing and our capacity to predict and control an outcome.

As opposed to forceful, rigid, intrusive methods to intervene in a system externally, led by one worldview, a more effective way of intervening in a system is by leveraging points.

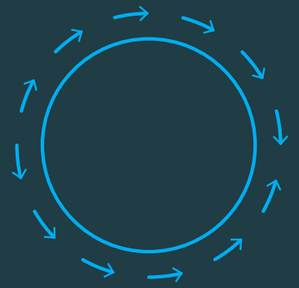
Leverage points have caveats, and every item has exceptions that can move up or down the order of leverage.

Feedback Loops

Reinforcing loops



Restoring loops



Feedback loops are an inherent feature of any system.

These loops exist—or can be introduced—through the interactions and connections among the system's components.

Two primary types of feedback loops are reinforcing loops and restoring loops.

- Reinforcing loops amplify an existing trend or tendency within a system, driving it further in the same direction.
- Restoring loops, on the other hand, act to suppress or moderate tendencies, helping the system avoid extremes.

An example of a reinforcing loop in today's social and economic systems is the accumulation of more wealth and power by those who are already wealthy and powerful.

In contrast, a restoring loop can be seen in measures like taxation, social security, and similar policies, which are designed to mitigate extremes of wealth and poverty.

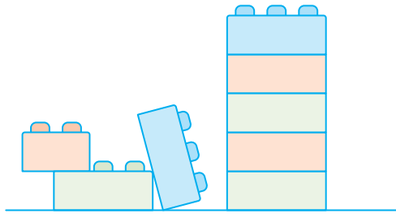
The Duality of System Change

Inherent in most systems is a resistance to change. If a new component is added to a system, the rest of the system wants to reject it. Interventions in existing systems that are dancing in balance tend to trigger a natural resistance to that which is new and alien.

Organ transplant in humans or other biological systems, is a clear example of such resistance to interventions. The rest of the body tends to reject the new organ. We now know that further interventions, in the form of additional medication, are required in order to rebalance and attenuate such system resistance. Design decisions that we make and implement within the built environment are by default interventions in the existing natural systems. A dilemma, therefore, arises when we design, as any design is in fact an intervention. This questions the concepts of co-creation with nature, unless we fully align with nature. Partial integration and co-creation will have elements of intervention which will be rejected.

Co-creation, therefore, may need to occur at a much higher level of a new system creation, rather than tweaking the existing, which is oxymoronically impossible!

System restoration is different, in that it identifies the previous interventions, and sets out to eliminate them. You solve a complex problem by changing the context or the framework within which they exist and thrive. You don't solve them by first order tackling them.



Cities as Systems of Systems

Cities – developed by people – are dynamic adaptive systems that consist of different layers from mobility sub-system to social systems that each form a part of the bigger system that is the city. Within and through these are other sub-systems that are interconnected to each other, which makes cities 'systems of systems'

Recognizing these interlinkages and the points of leverage can help to build resilient and regenerative living environments for the future. This requires holistic living systems thinking.

In many indigenous cultures, holistic, systemic, and symbiotic view of life by default understood as the basis for daily life and its processes. In contrast, especially in the Western world, we are trained differently. Many times, we have a reductionist view where we try to simplify complexity into parts and fix only the parts, not thinking of the whole system. This applies well to engineering...

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DESIGN is a periodical publication by the Design Excellence Board (DEB) within the Buildings Market in Ramboll.

The publication promotes and articulates latest ideas on matters relating to design, technology, environment and ethos within the design industry and the built environment, at large. It aims to address key issues facing contemporary design professionals, including our evolving relationship with the natural environment; as well as pressing political and social agendas for the built environment.

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