Give me the wrong place to stand, and I won't necessarily know *why* I can't move the Earth.

Not Archimedes

Ryan J.A. Murphy
fulcra.design

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fulcra.design

Finding Leverage for Systems Change

Towards a modern theory of leverage in systemic design

Ryan J.A. Murphy
fulcra.design

Some statistics*

Google Books Ngram Viewer

Some statistics*

1820–1998: ~116,000 hits

1998–2023: ~685,000 hits

*Note that “leverage point” is also a term used in statistical research

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What are leverage points?

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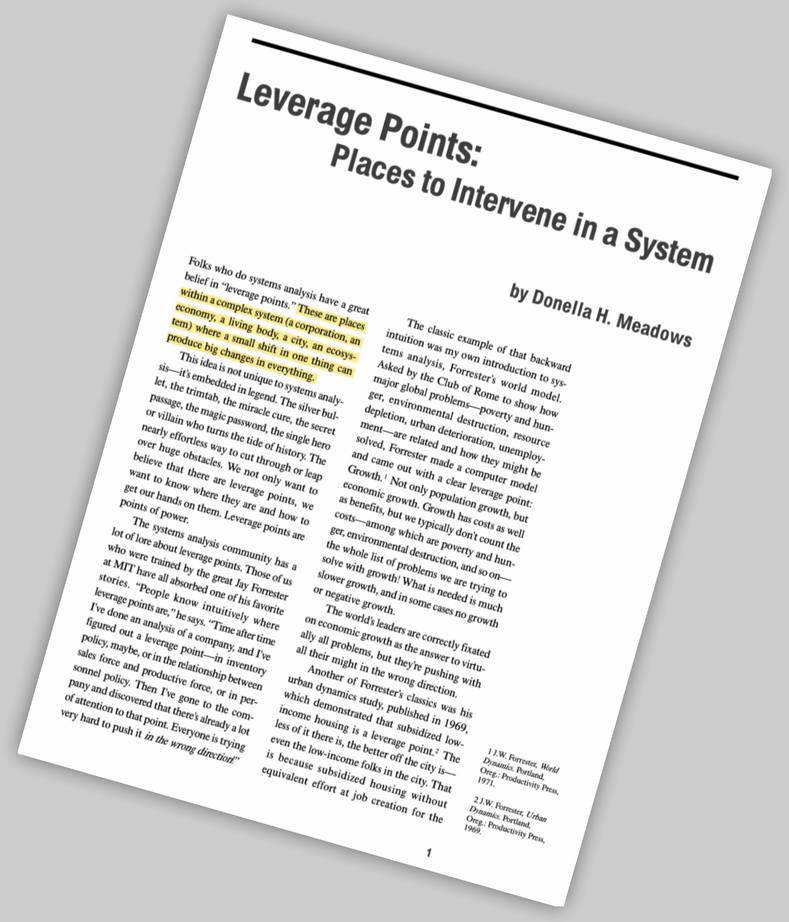

Leverage Points:
Places to Intervene in a System

by Donella H. Meadows

Folks who do systems analysis have a great belief in "leverage points." These are places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything.

This idea is not unique to systems analysis—it's embedded in legend. The silver bullet, the trimtab, the miracle cure, the secret passage, the magic password, the single hero or villain who turns the tide of history. The nearly effortless way to cut through or leap over huge obstacles. We not only want to believe that there are leverage points, we want to know where they are and how to get our hands on them. Leverage points are points of power.

The systems analysis community has a lot of lore about leverage points. Those of us who were trained by the great Jay Forrester at MIT have all absorbed one of his favorite stories. "People know intuitively where leverage points are," he says. "Time after time I've done an analysis of a company, and I've figured out a leverage point—in inventory policy, maybe, or in the relationship between sales force and productive force, or in personnel policy. Then I've gone to the company and discovered that there's already a lot of attention to that point. Everyone is trying very hard to push it *in the wrong direction!*"

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The world's leaders are correctly fixated on economic growth as the answer to virtually all problems, but they're pushing with all their might in the wrong direction.

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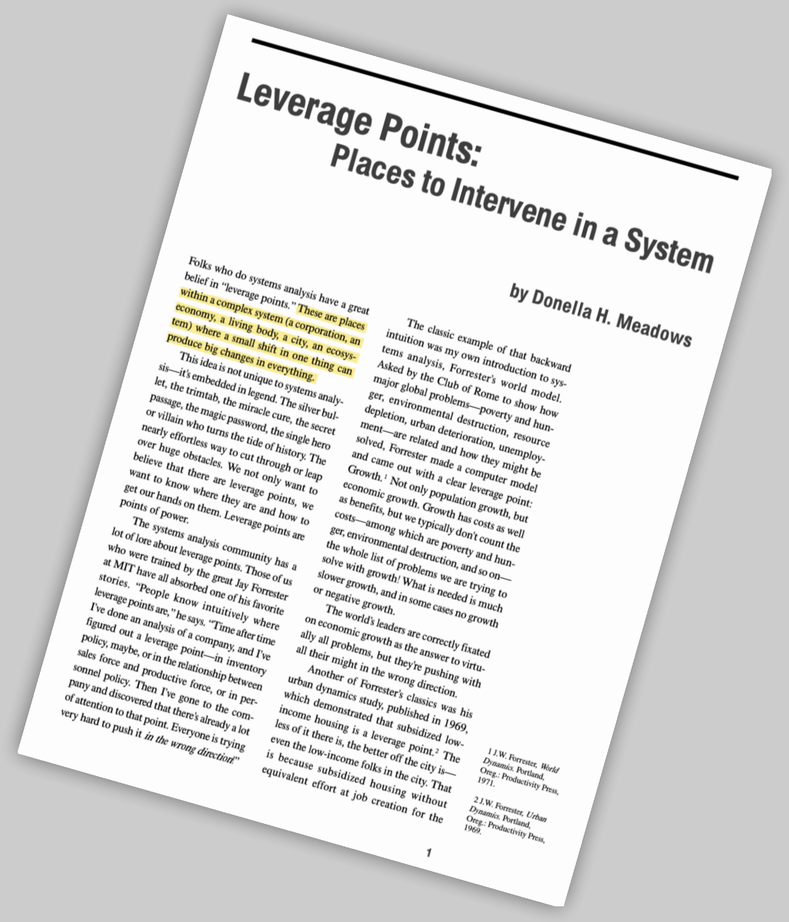

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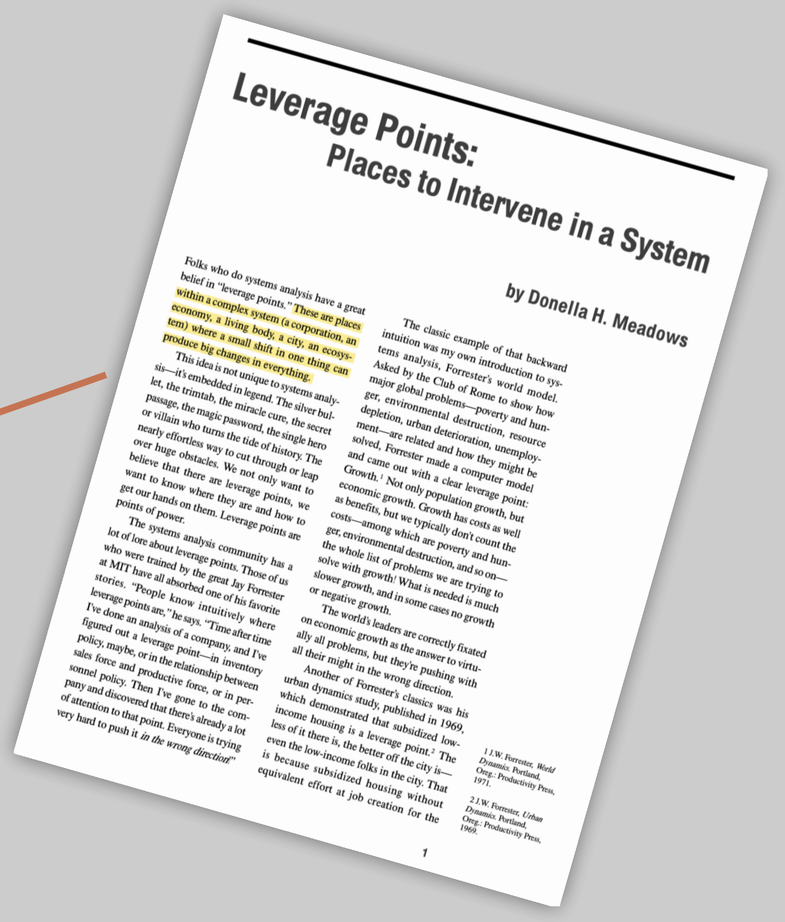

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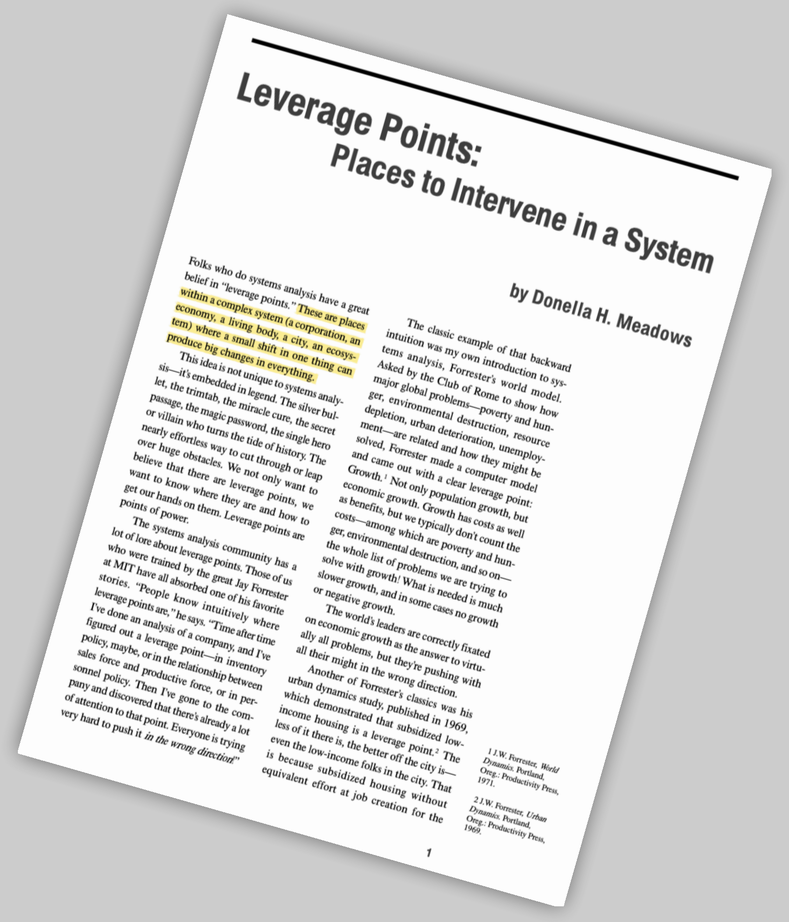
"These are **places within a complex system** (a corporation, an economy, a living body, a city, an ecosystem) **where a small shift in one thing can produce big changes in everything.**"

What are leverage points?

- Silver bullets
- Trimtabs
- Panaceas
- Heroes and villains who turn the tide of history



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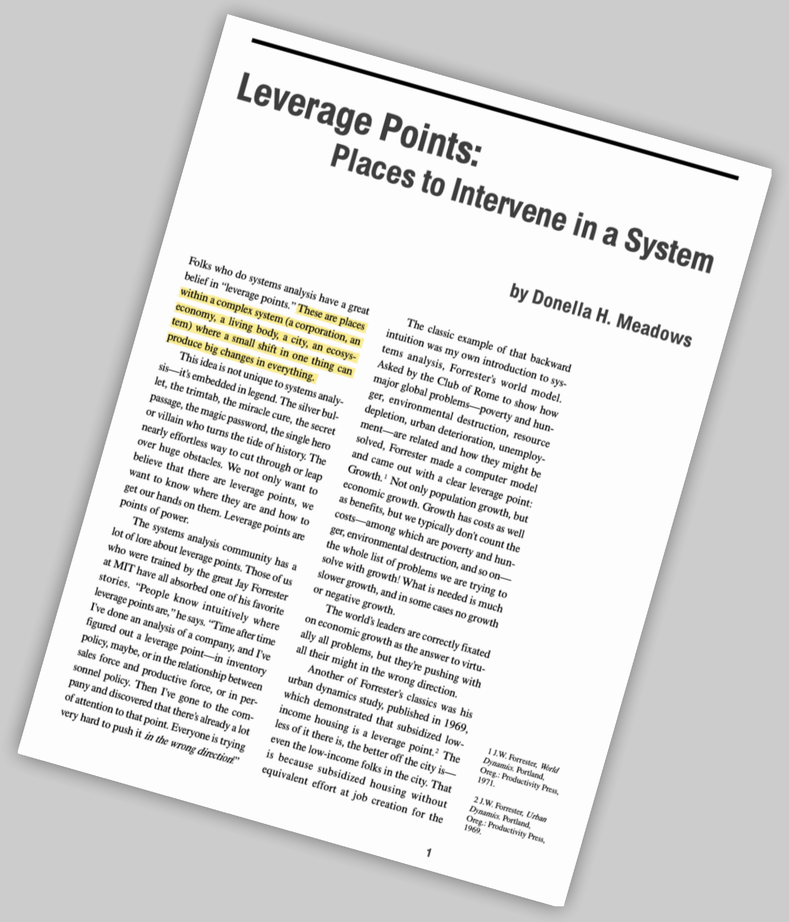
- A mythology



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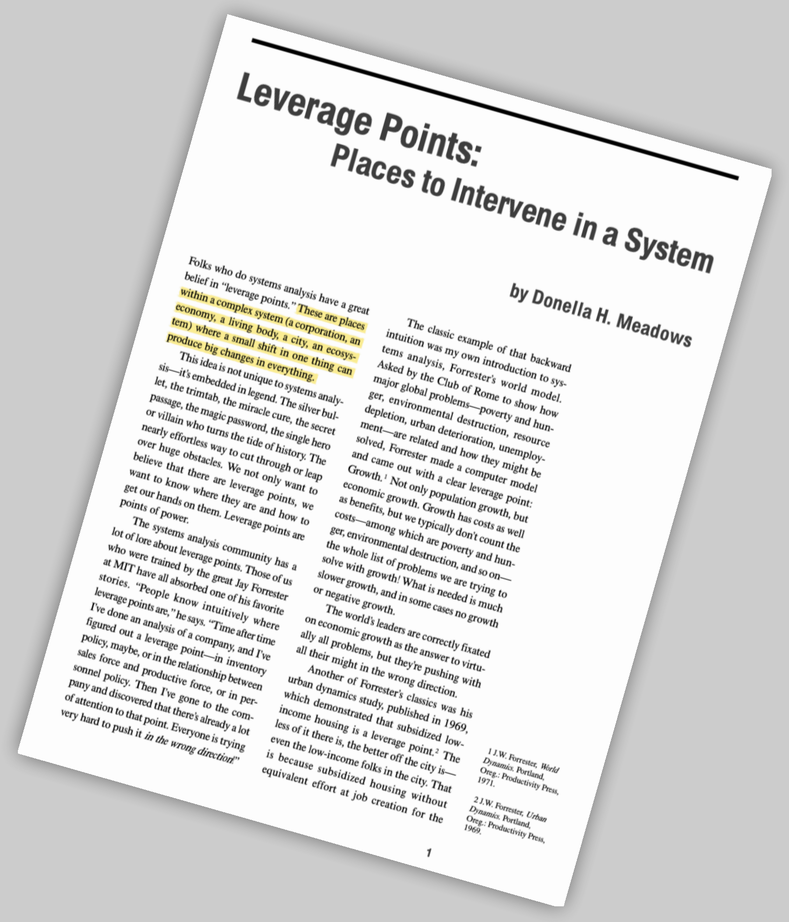
What are leverage points?

- **Often, leverage points are well-known… but being used to push in the wrong direction**
  - E.g., growth
- **We tend to use leverage points counter-intuitively**
- **Leverage points (and how to use them) are often disbelieved by decision-makers**
  - E.g., low-income subsidized housing (without job creation; Forrester, 1969)



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Donella was attending a meeting about how NAFTA/ GATT/the World Trade Organization was likely to make the world worse, not better:

> **"This is a huge new system people are inventing!"**
>
> **"They haven't the slightest idea how this complex structure will behave."**
>
> "**It's almost certainly an example of cranking the system in the wrong direction** [...] and **the control measures** these nice, liberal folks are talking about to combat it—small parameter adjustments, weak negative feedback loops—**are way too puny!!!**"

What are leverage points?

Places to Intervene in a System
(in increasing order of effectiveness)

9. Constants, parameters, numbers (subsidies, taxes, standards)
8. Regulating negative feedback loops
7. Driving positive feedback loops
6. Material flows and nodes of material intersection
5. Information flows
4. The rules of the system (incentives, punishments, constraints)
3. The distribution of power over the rules of the system
2. The goals of the system
1. The mindset or paradigm out of which the system—its goals, power structure, rules, its culture—arises.

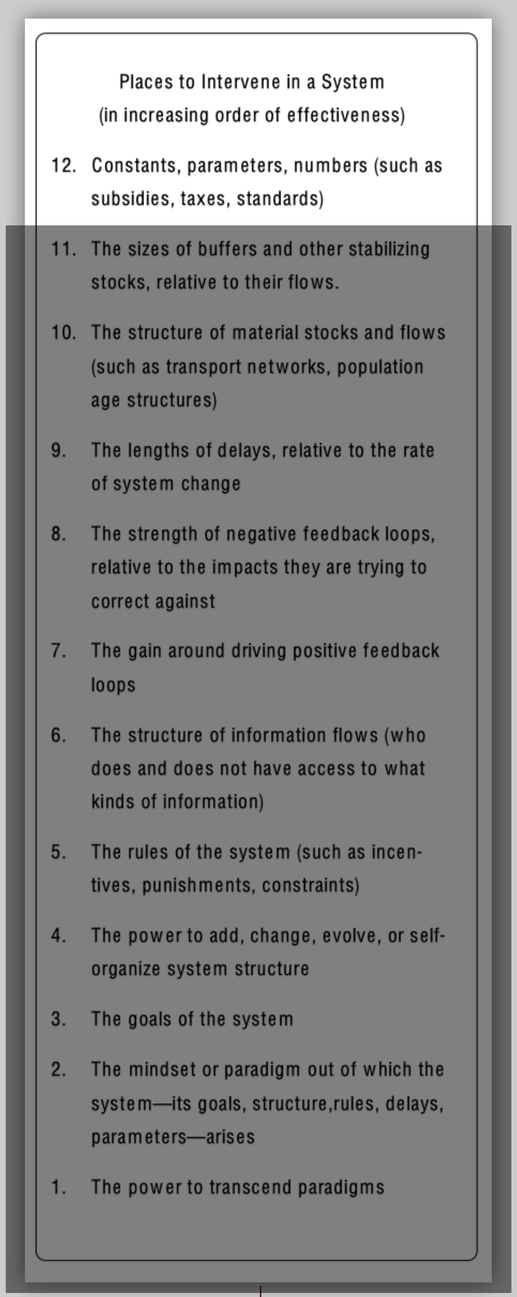
As I began to share it with others, especially with systems analysts who had their own lists, and with activists who wanted to put the list to immediate use, **questions and comments came back that caused me to rethink, add and delete items, change the order, add caveats.**

Places to Intervene in a System
(in increasing order of effectiveness)

12. Constants, parameters, numbers (such as subsidies, taxes, standards)
11. The sizes of buffers and other stabilizing stocks, relative to their flows.
10. The structure of material stocks and flows (such as transport networks, population age structures)
9. The lengths of delays, relative to the rate of system change
8. The strength of negative feedback loops, relative to the impacts they are trying to correct against
7. The gain around driving positive feedback loops
6. The structure of information flows (who does and does not have access to what kinds of information)
5. The rules of the system (such as incentives, punishments, constraints)
4. The power to add, change, evolve, or self-organize system structure
3. The goals of the system
2. The mindset or paradigm out of which the system—its goals, structure,rules, delays, parameters—arises
1. The power to transcend paradigms

12. Parameters

- E.g., air quality standards, wages, speed limits
- Rates of things
  - "Probably 90—no 95—no 99 percent of our attention goes to parameters, but there's not a lot of leverage in them."
- Parameters rarely change behaviour, unless…
- … they go into ranges that kick off one of the items later on this list.



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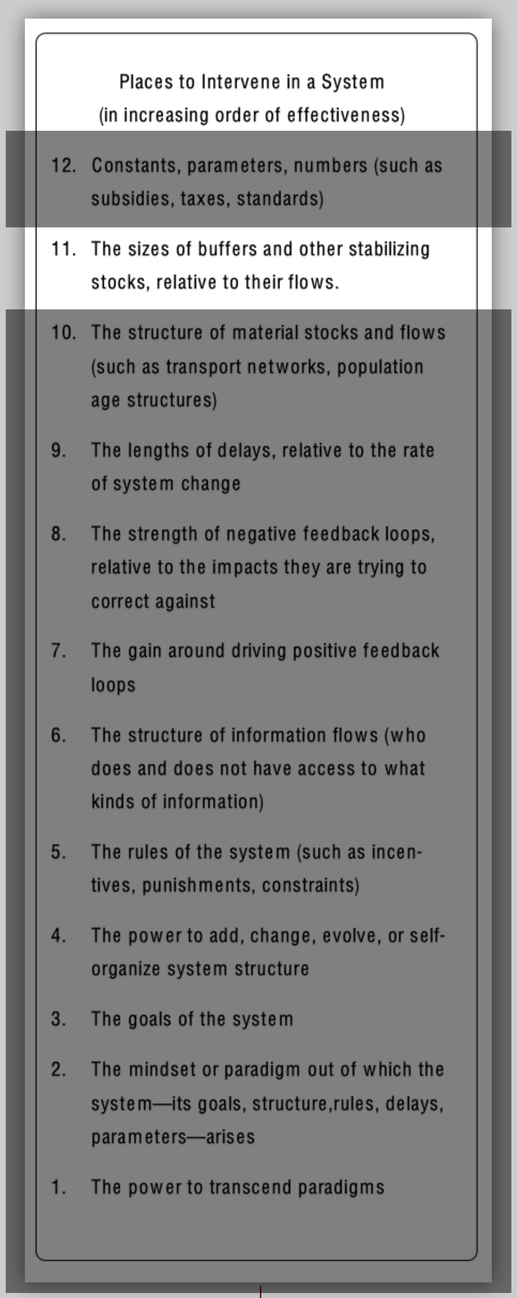
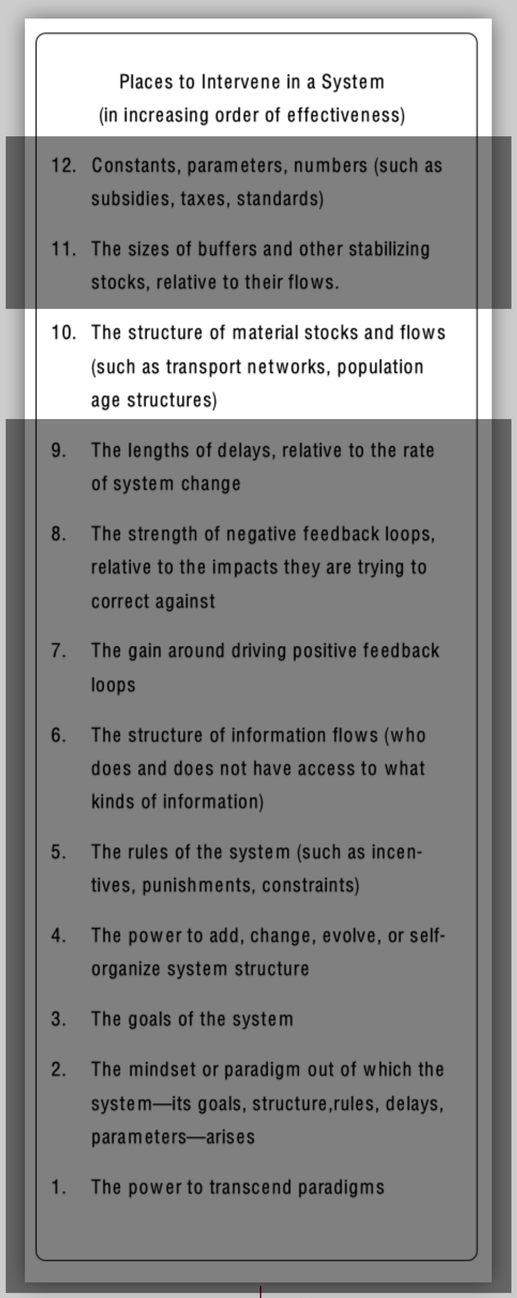
11. Buffers (relative to flows)

- E.g., dam storage capacity, your current debt, store inventory
- Amounts of things
  - "Soils in the eastern U.S. are more sensitive to acid rain than soils in the west, because they haven't got big buffers of calcium to neutralize acid."
- Buffers are stabilizing
  - They also make systems inflexible
  - … and they're usually expensive



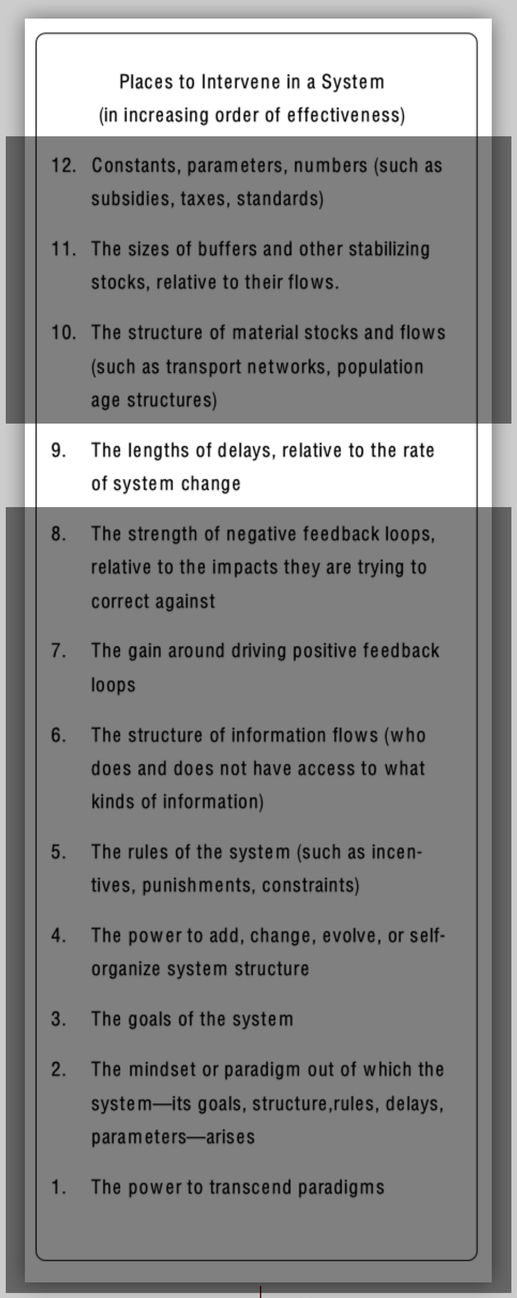
10. The structure of material stocks and flows

- E.g., road layout, baby booms
- “The leverage point is in proper design in the first place.”
  - “After the structure is built, the leverage is in understanding its limitations and bottlenecks and refraining from fluctuations or expansions that strain its capacity.”



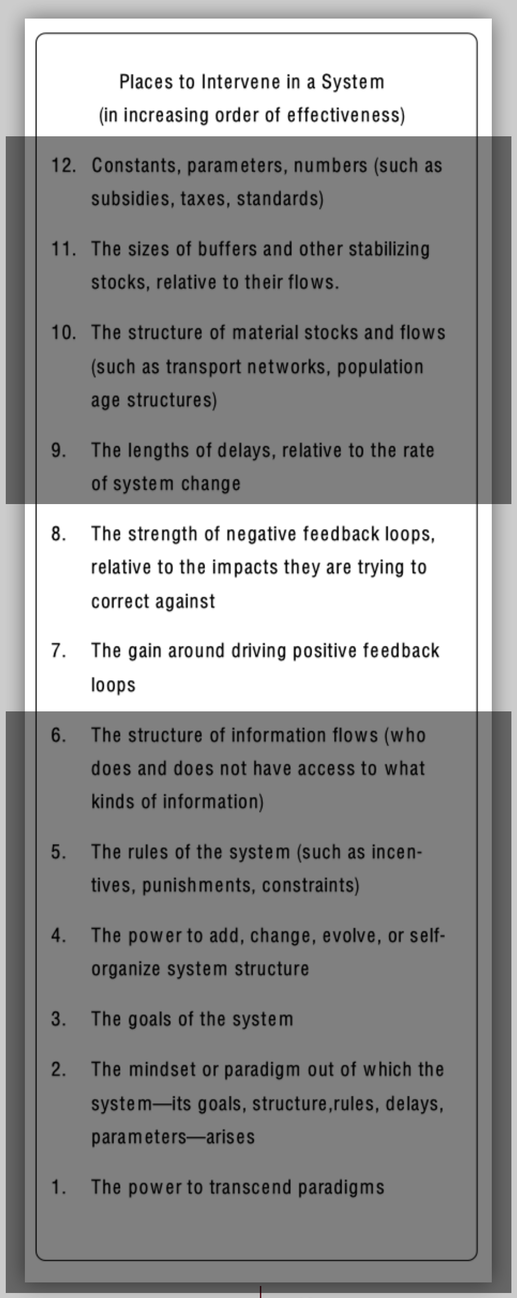
9. The lengths of delays, relative to the rate of system change

- E.g., how far away the hot water heater is, how long it takes to get a new vaccine to market
- Delays often cause oscillations
- Hard to respond to short-term changes when with long-term actions
  - “Overlong delays in a system with a threshold, a danger point, a range past which irreversible damage can occur, cause overshoot and collapse.”



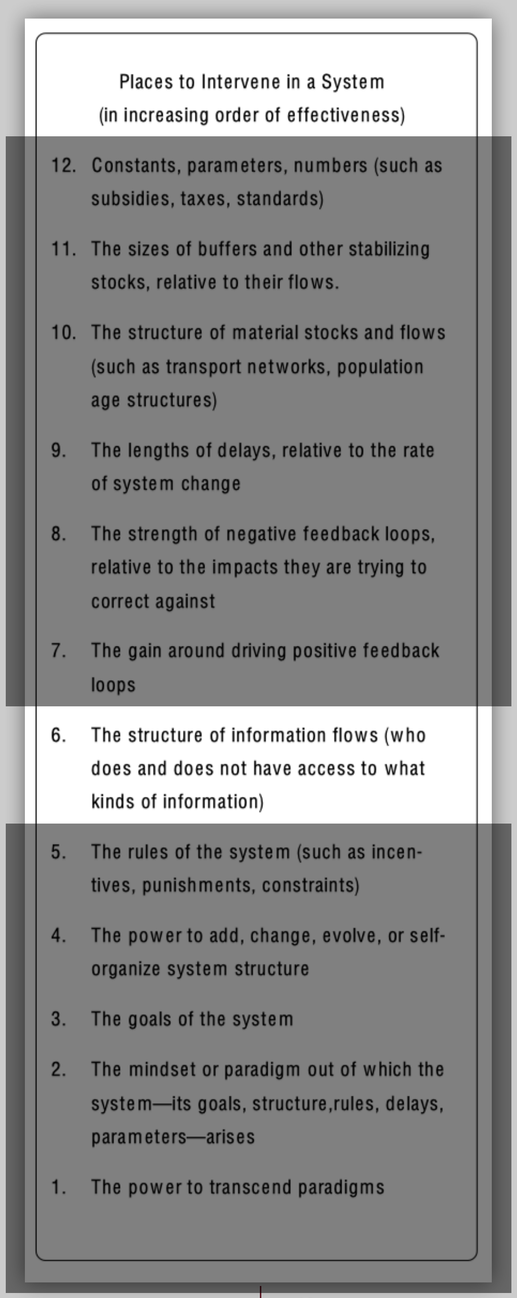
8. & 7. Loops

- **E.g., preventative medicine, whistleblower protection; soil erosion, wealth, population growth**
- **Negative feedback loops are self-correction mechanisms**
  - "The strength of a negative feedback loop is important relative to the impact it is designed to correct. If the impact increases in strength, the feedbacks have to be strengthened too."
- **Positive feedback loops are growth mechanisms**
  - Weakening the gain of a positive loop is key to controlling it



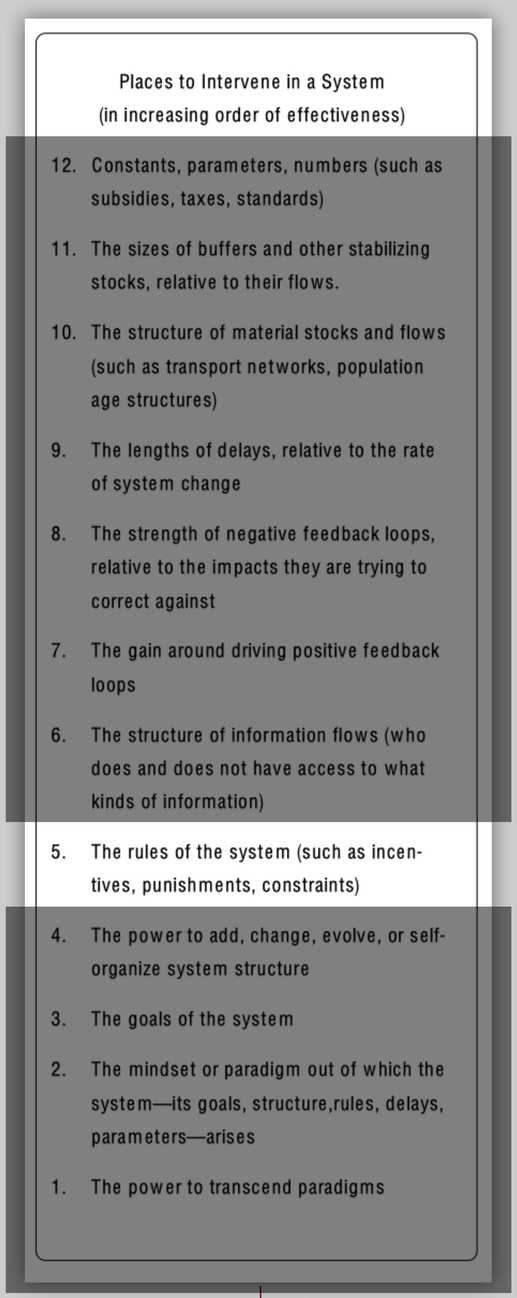
6. Information flows

- E.g., publicizing pollution rates, putting the power meter in the hallway instead of the basement
- Changing who has access to information tends to create new subsystems (e.g., feedback loops)



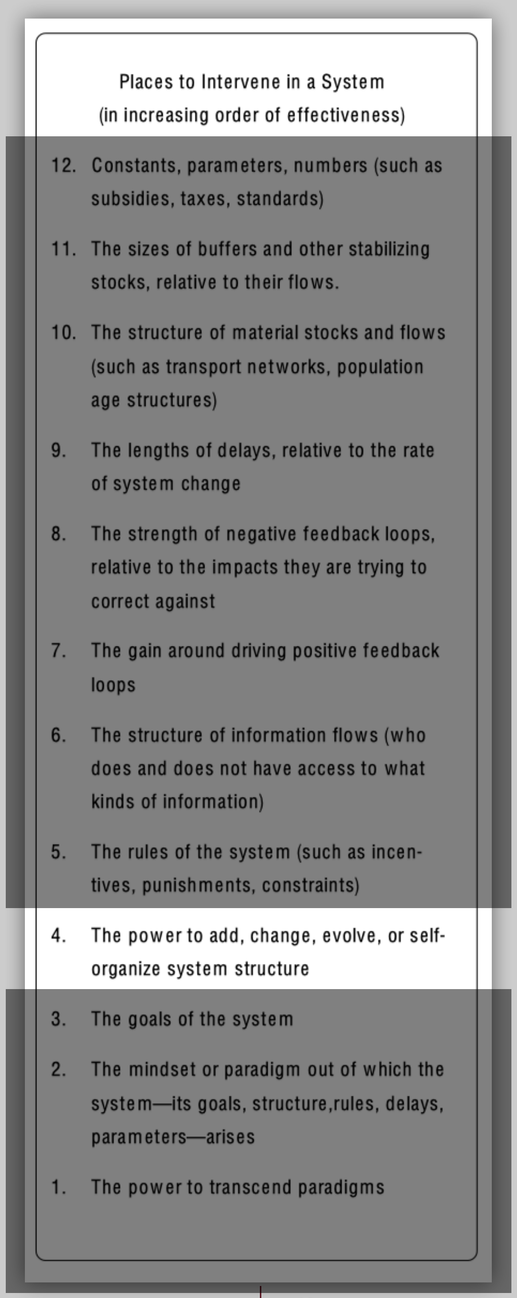
5. Rules

- E.g., everyone gets one vote, you can't use your debit card if there's no money in your account, everyone is muted when they join the Zoom call
- "Power over the rules is real power"
  - "Pay attention to the rules, and to who has power over them."



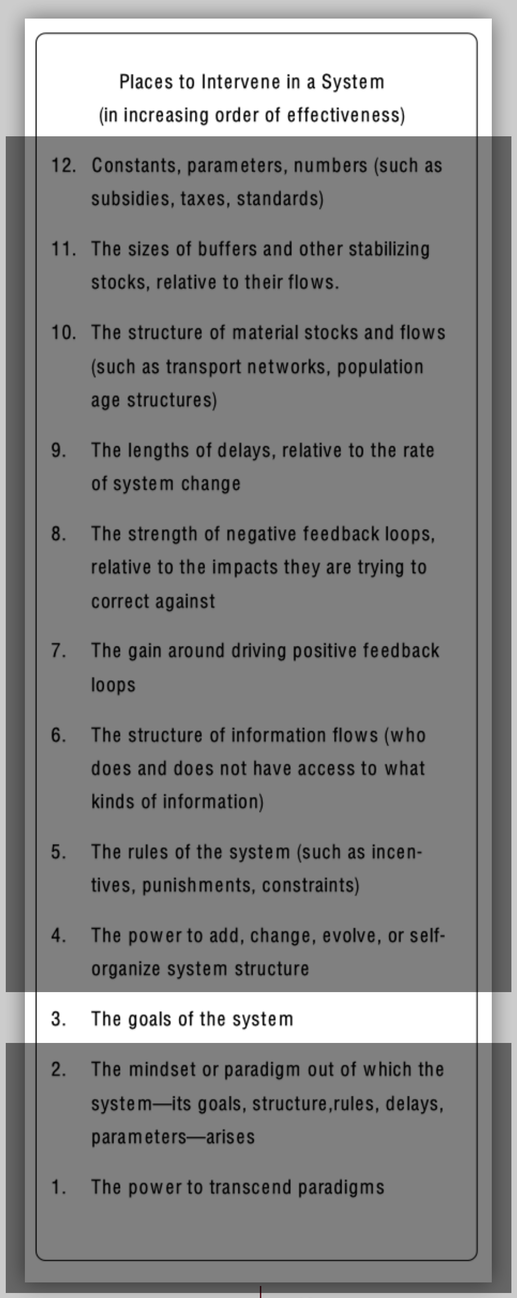
4. Power over system structure

- E.g., technology, ecosystem succession, evolution; changing anything on this list
- “A system that can evolve can survive almost any change, by changing itself.”
- Rules for self-organizing: how, where, and what a system can add onto or subtract from itself under what conditions



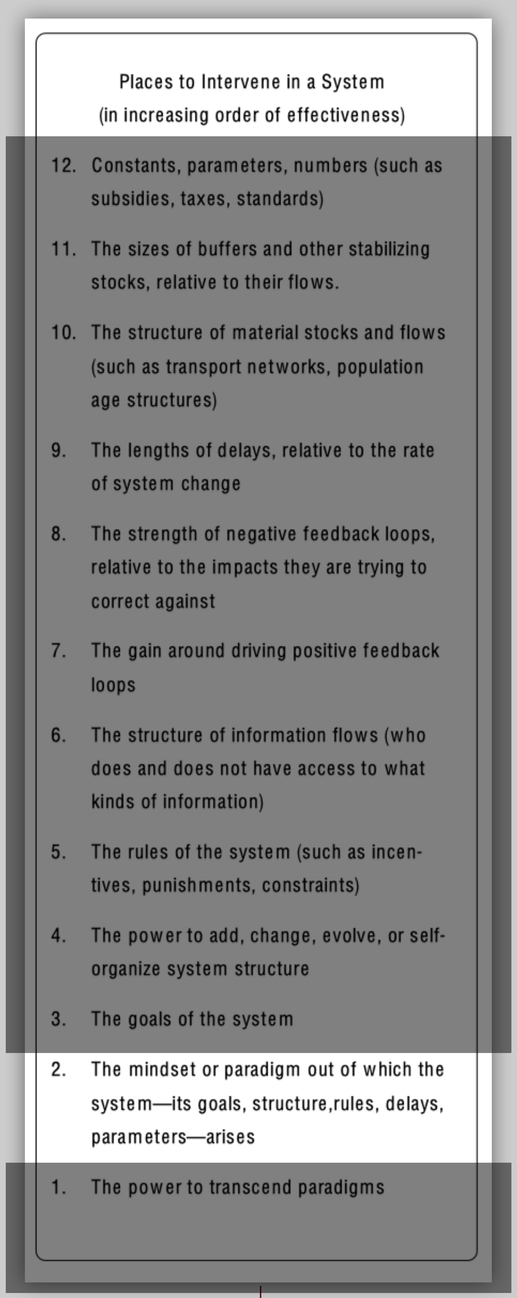
3. Goals

- E.g., ecosystems seek homeostasis, culture seeks mimesis, public businesses seek growth and consumption in service of shareholder ROI
- Ronald Reagan: “The goal is to get the government off our backs”



2. Paradigms

- E.g., the Earth orbits the sun, masks limit the spread of respiratory viruses
- Shared social agreements about the nature of reality: what the actors in the system value/assume to be true
- All other aspects of systems come from the system's paradigms



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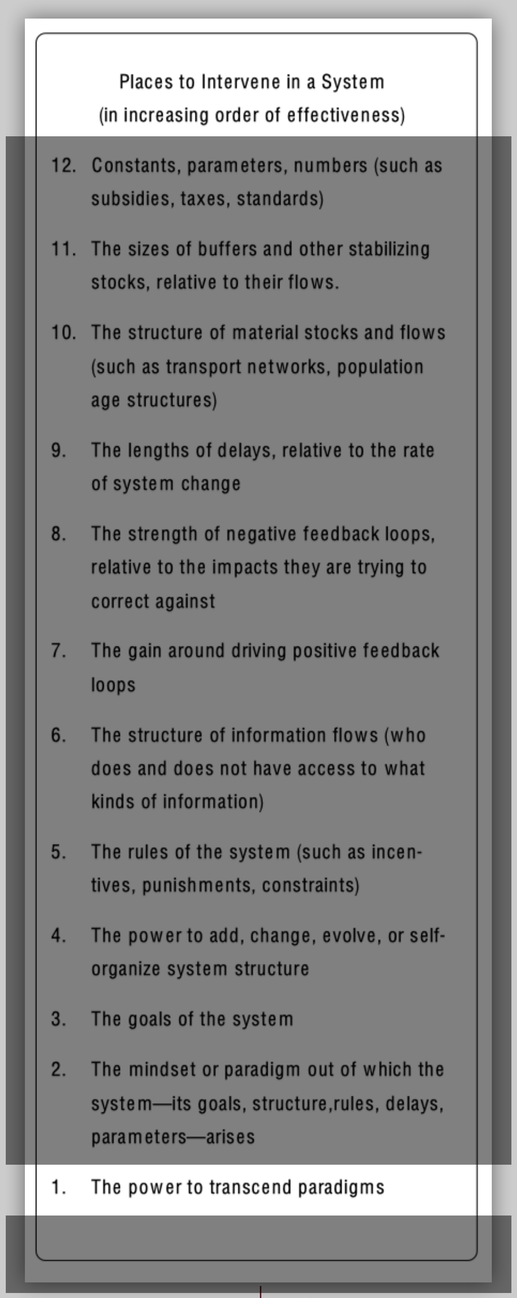
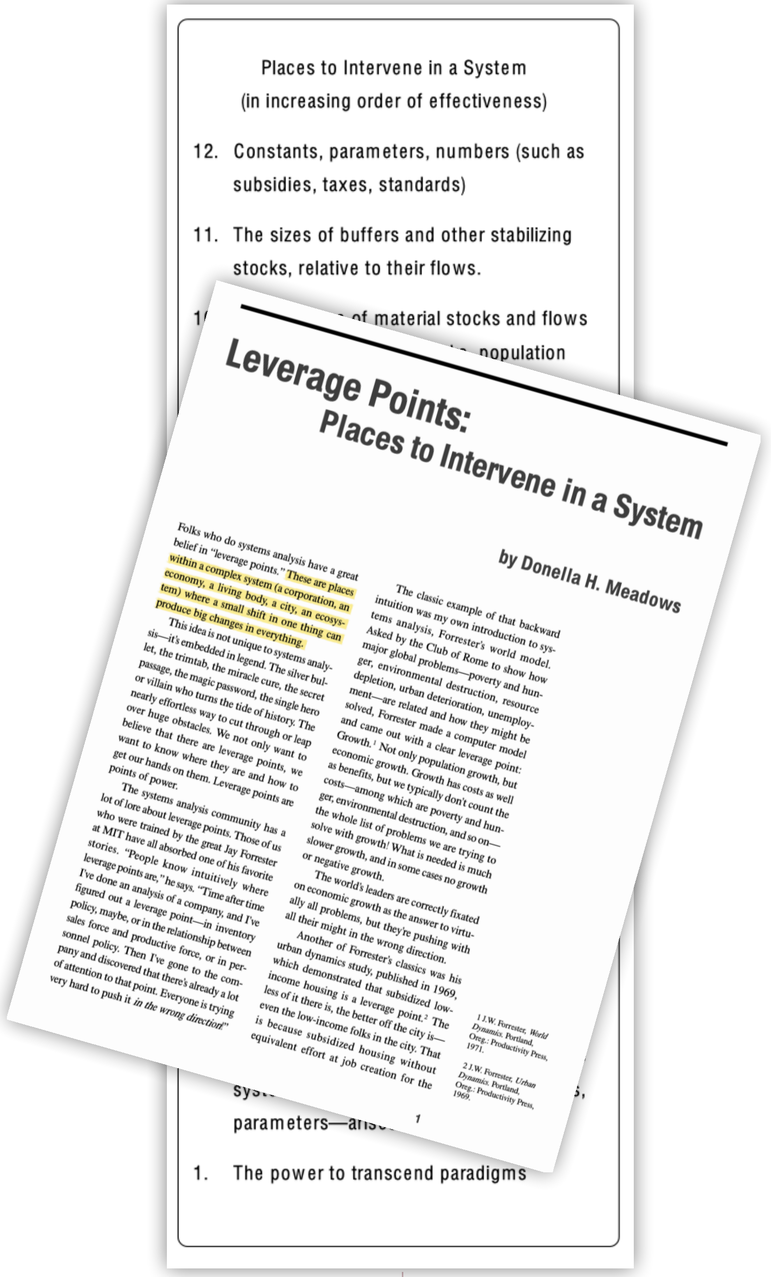
1. Transcending paradigms

- The realization that there are no paradigms — and that that is, itself, a paradigm
- If no paradigm is right or true, then we may choose the one(s) that help to achieve our purpose(s)



Places to Intervene in a System
(in increasing order of effectiveness)

12. Constants, parameters, numbers (such as subsidies, taxes, standards)
11. The sizes of buffers and other stabilizing stocks, relative to their flows.
10. The structure of material stocks and flows (such as transport networks, population age structures)
9. The lengths of delays, relative to the rate of system change
8. The strength of negative feedback loops, relative to the impacts they are trying to correct against
7. The gain around driving positive feedback loops
6. The structure of information flows (who does and does not have access to what kinds of information)
5. The rules of the system (such as incentives, punishments, constraints)
4. The power to add, change, evolve, or self-organize system structure
3. The goals of the system
2. The mindset or paradigm out of which the system—its goals, structure,rules, delays, parameters—arises
1. The power to transcend paradigms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Leverage Points:
Places to Intervene in a System
by Donella H. Meadows
Folks who do systems analysis have a great belief in "leverage points." These are places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything.
This idea is not unique to systems analysis—it's embedded in legend. The silver bullet, the trimtab, the miracle cure, the secret passage, the magic password, the single hero or villain who turns the tide of history. The nearly effortless way to cut through or leap over huge obstacles. We not only want to believe that there are leverage points, we want to know where they are and how to get our hands on them. Leverage points are points of power.
The systems analysis community has a lot of lore about leverage points. Those of us who were trained by the great Jay Forrester at MIT have all absorbed one of his favorite stories. "People know intuitively where leverage points are," he says. "Time after time I've done an analysis of a company, and I've figured out a leverage point—in inventory policy, maybe, or in the relationship between sales force and productive force, or in personnel policy. Then I've gone to the company and discovered that there's already a lot of attention to that point. Everyone is trying very hard to push it *in the wrong direction!*"
The classic example of that backward intuition was my own introduction to systems analysis, Forrester's world model. Asked by the Club of Rome to show how major global problems—poverty and hunger, environmental destruction, resource depletion, urban deterioration, unemployment—are related and how they might be solved, Forrester made a computer model and came out with a clear leverage point: Growth.[1] Not only population growth, but economic growth. Growth has costs as well as benefits, but we typically don't count the costs—among which are poverty and hunger, environmental destruction, and so on—the whole list of problems we are trying to solve with growth! What is needed is much slower growth, and in some cases no growth or negative growth.
The world's leaders are correctly fixated on economic growth as the answer to virtually all problems, but they're pushing with all their might in the wrong direction.
Another of Forrester's classics was his urban dynamics study, published in 1969, which demonstrated that subsidized low-income housing is a leverage point.[2] The less of it there is, the better off the city is—even the low-income folks in the city. That is because subsidized housing without equivalent effort at job creation for the
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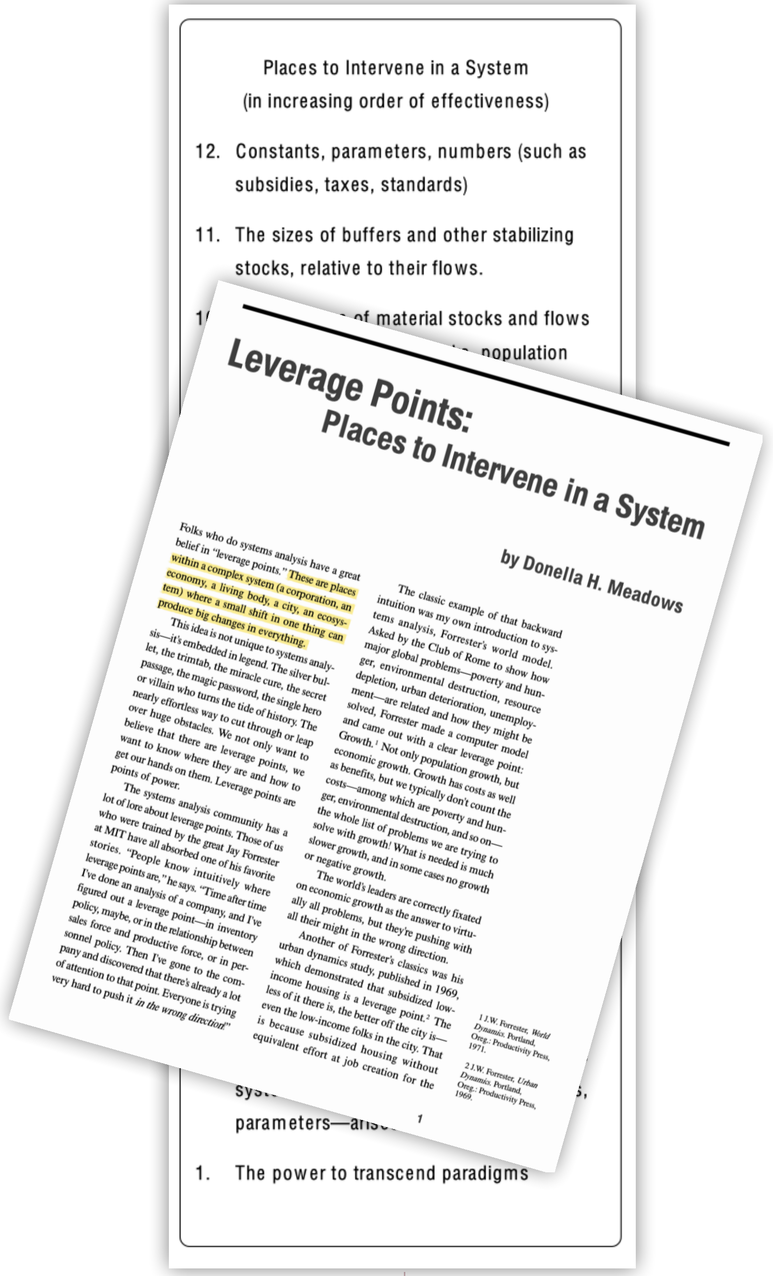

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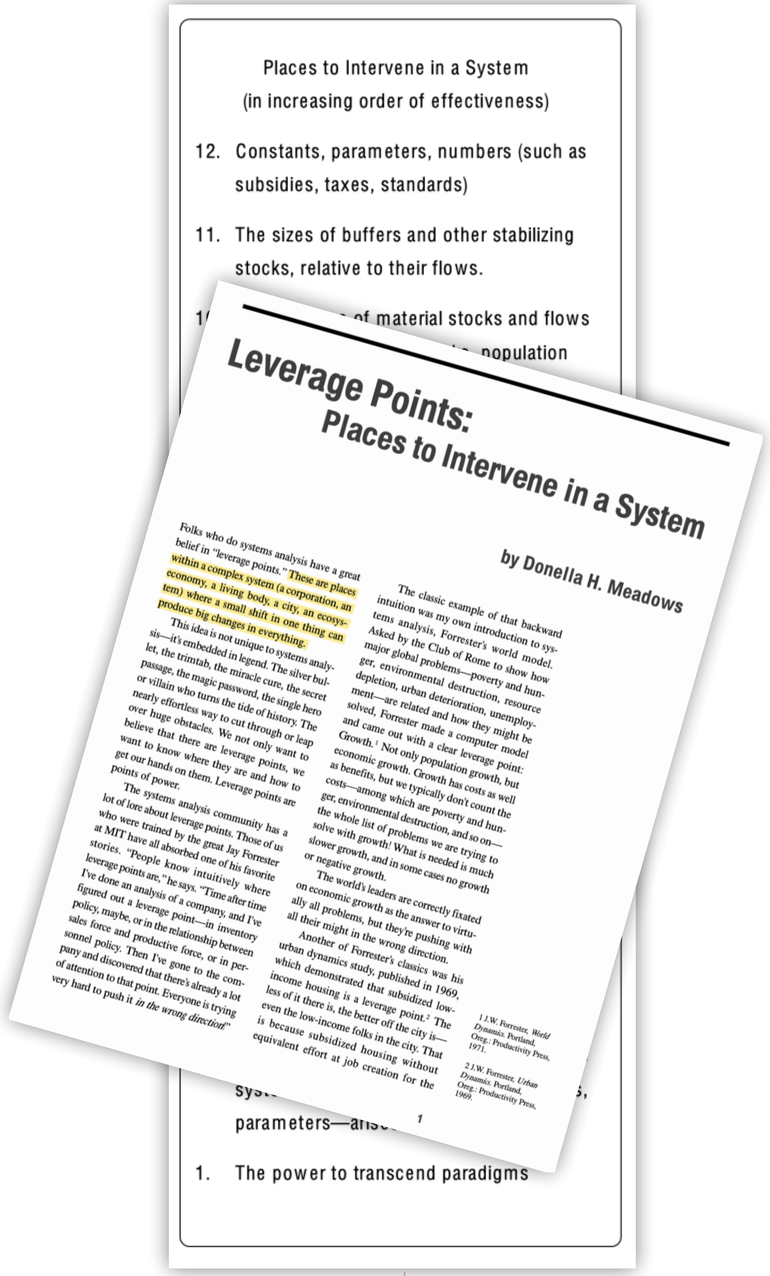

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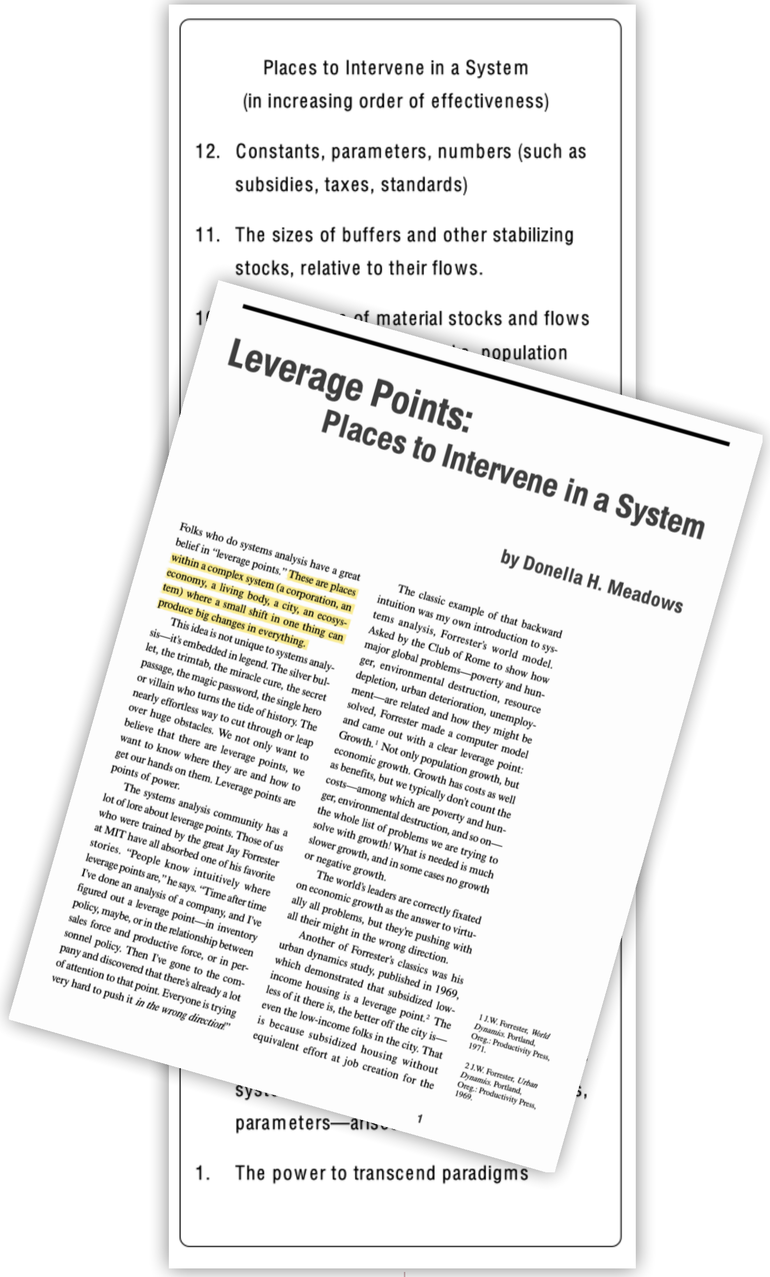

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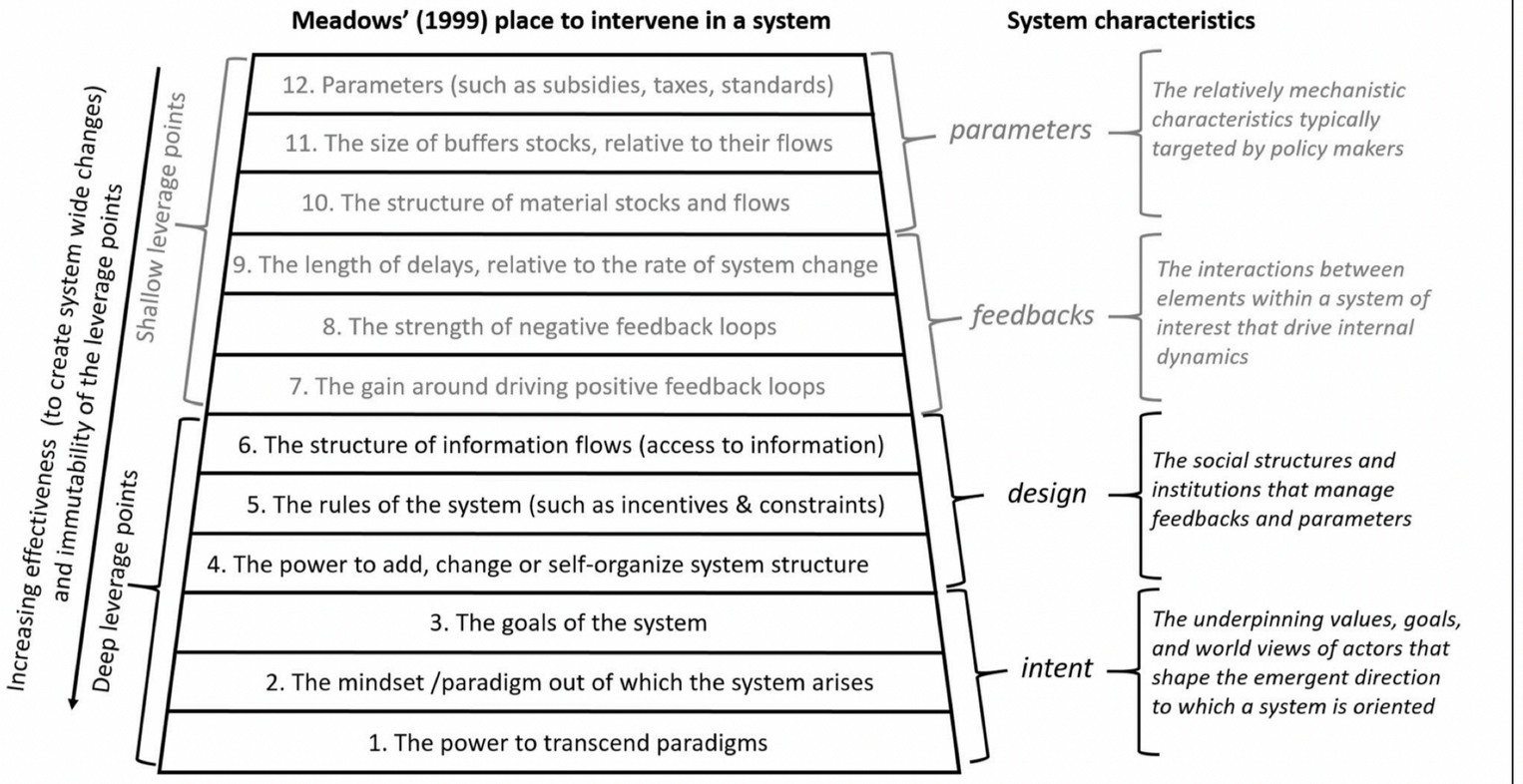
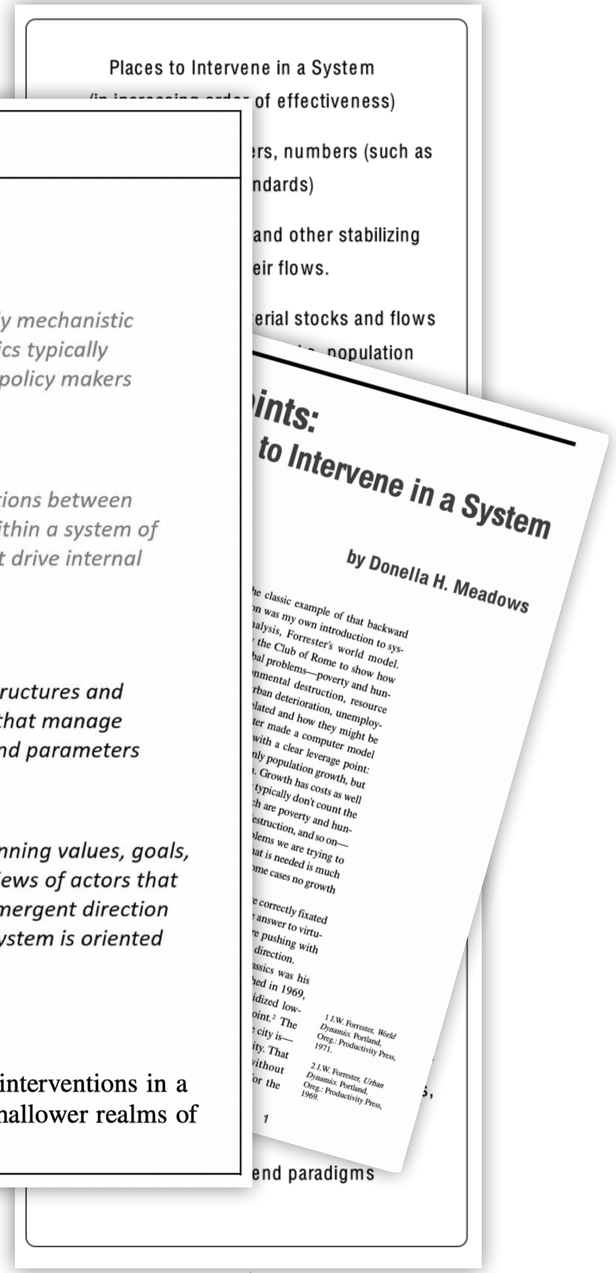
Box 2 From twelve leverage points to four system characteristics



The four system characteristics represent a nested hierarchy of, tightly interacting, realms of leverage within which interventions in a given system of interest may be made. Deeper system characteristics constrain the types of interventions possible at shallower realms of leverage



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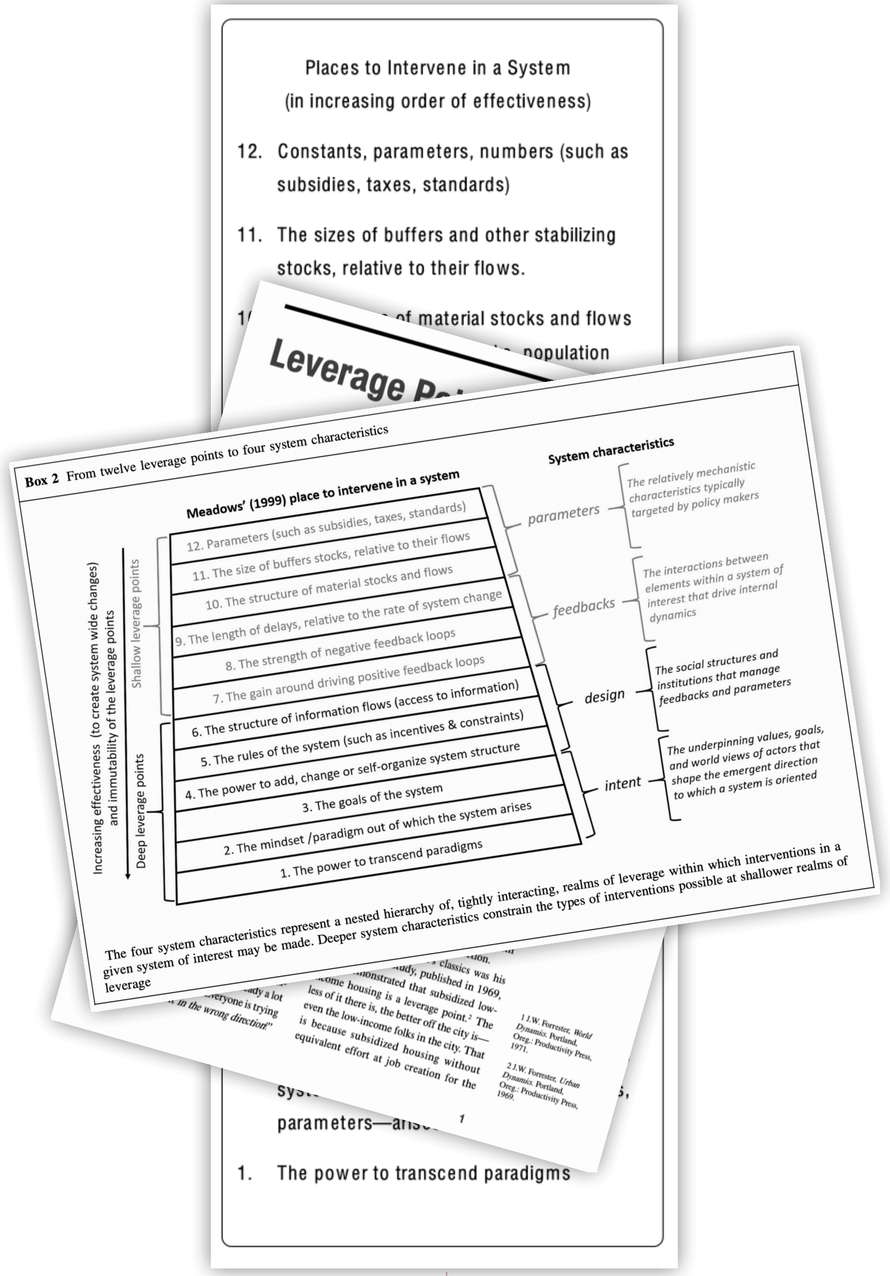

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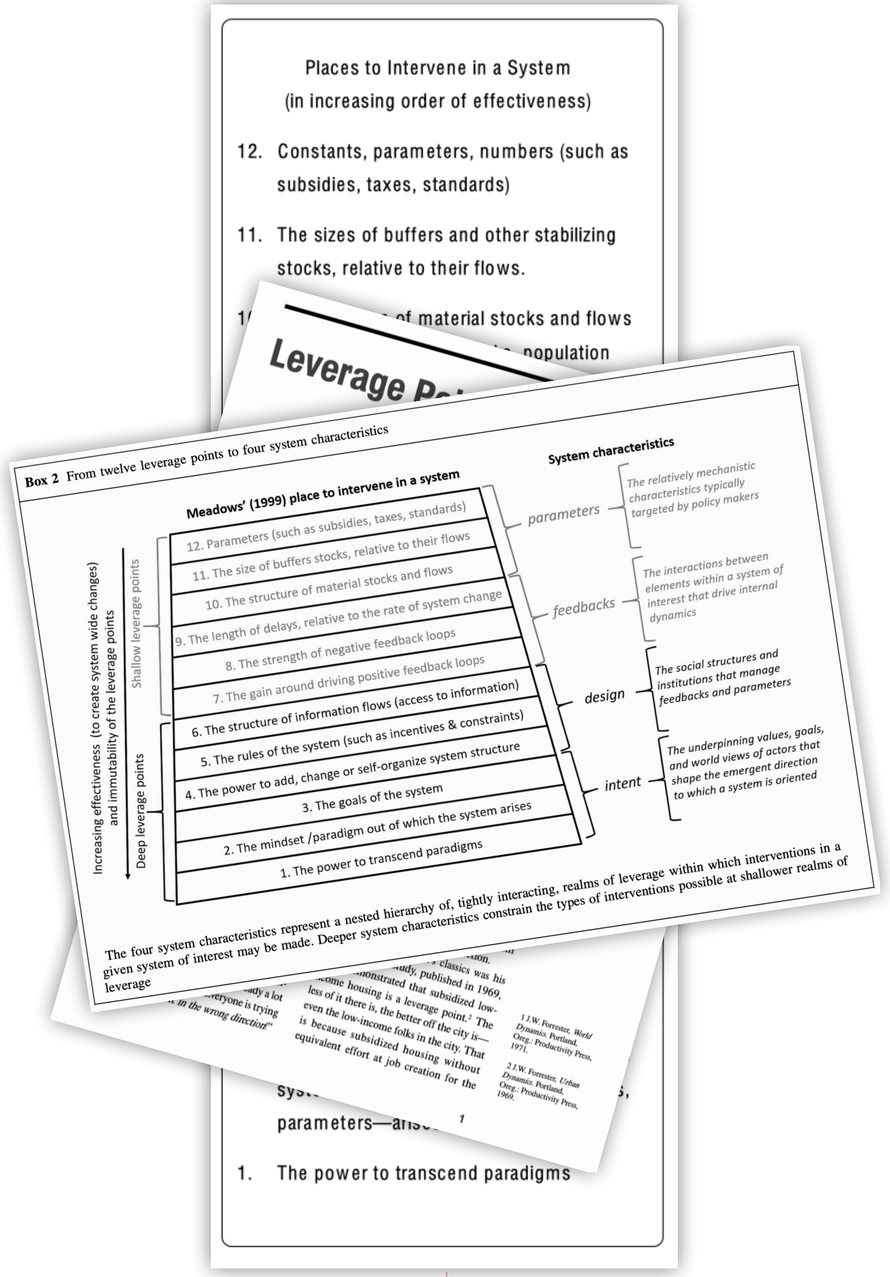

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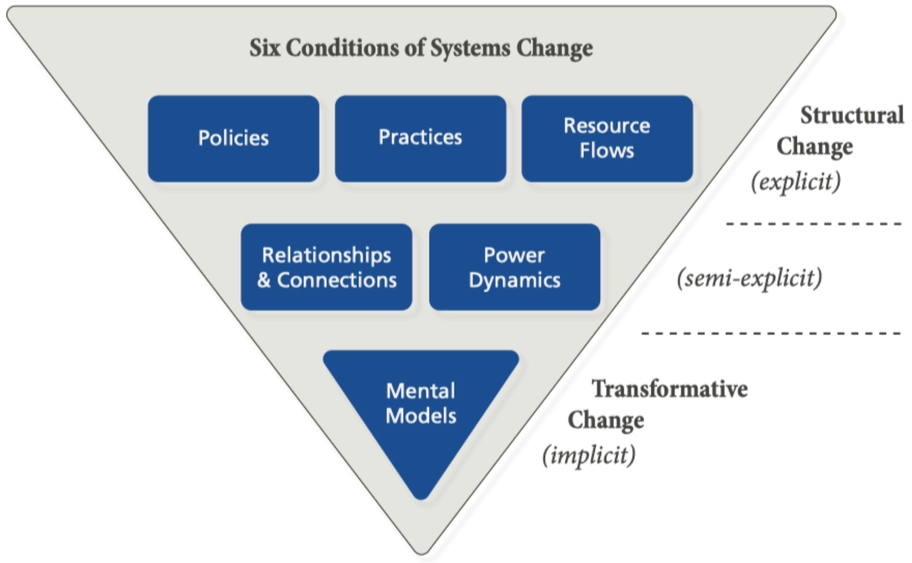
FIGURE 1. SHIFTING THE CONDITIONS THAT HOLD THE PROBLEM IN PLACE



SYSTEMS CHANGE CONDITIONS—DEFINITIONS

Policies: Government, institutional and organizational rules, regulations, and priorities that guide the entity's own and others' actions.

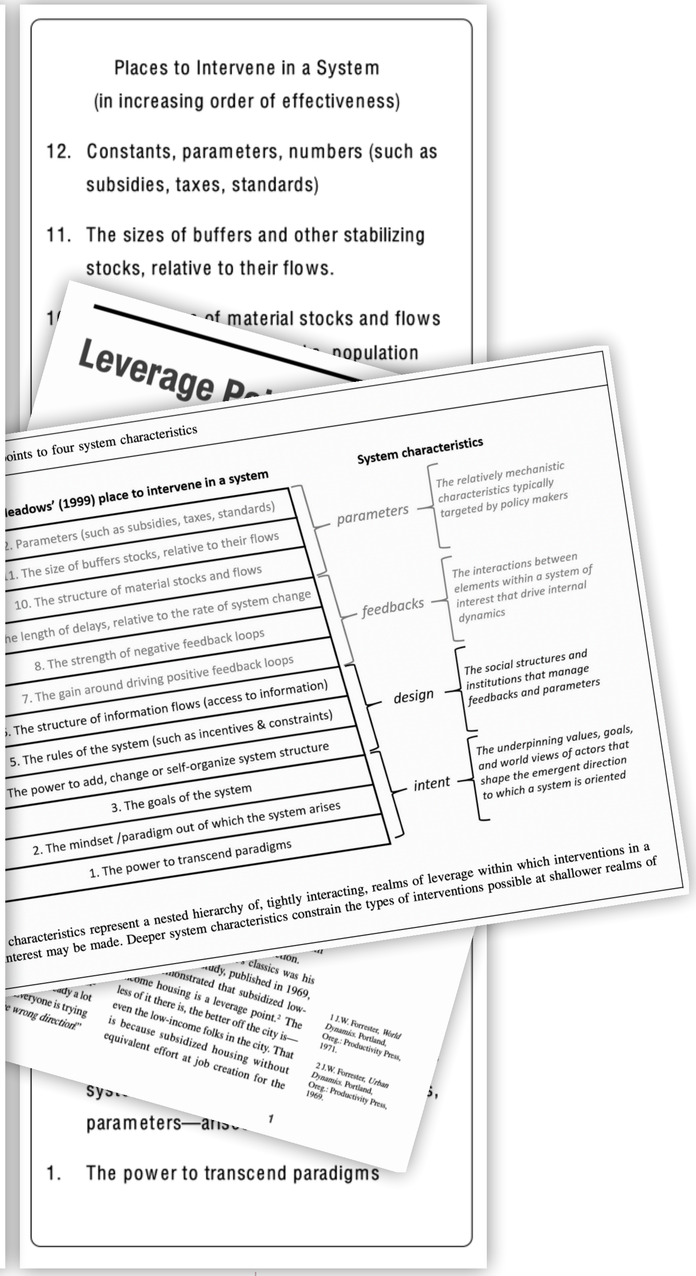
Practices: Espoused activities of institutions, coalitions, networks, and other entities targeted to improving social and environmental progress. Also, within the entity, the procedures, guidelines, or informal shared habits that comprise their work.

Resource Flows: How money, people, knowledge, information, and other assets such as infrastructure are allocated and distributed.

Relationships & Connections: Quality of connections and communication occurring among actors in the system, especially among those with differing histories and viewpoints.

Power Dynamics: The distribution of decision-making power, authority, and both formal and informal influence among individuals and organizations.

Mental Models: Habits of thought—deeply held beliefs and assumptions and taken-for-granted ways of operating that influence how we think, what we do, and how we talk.



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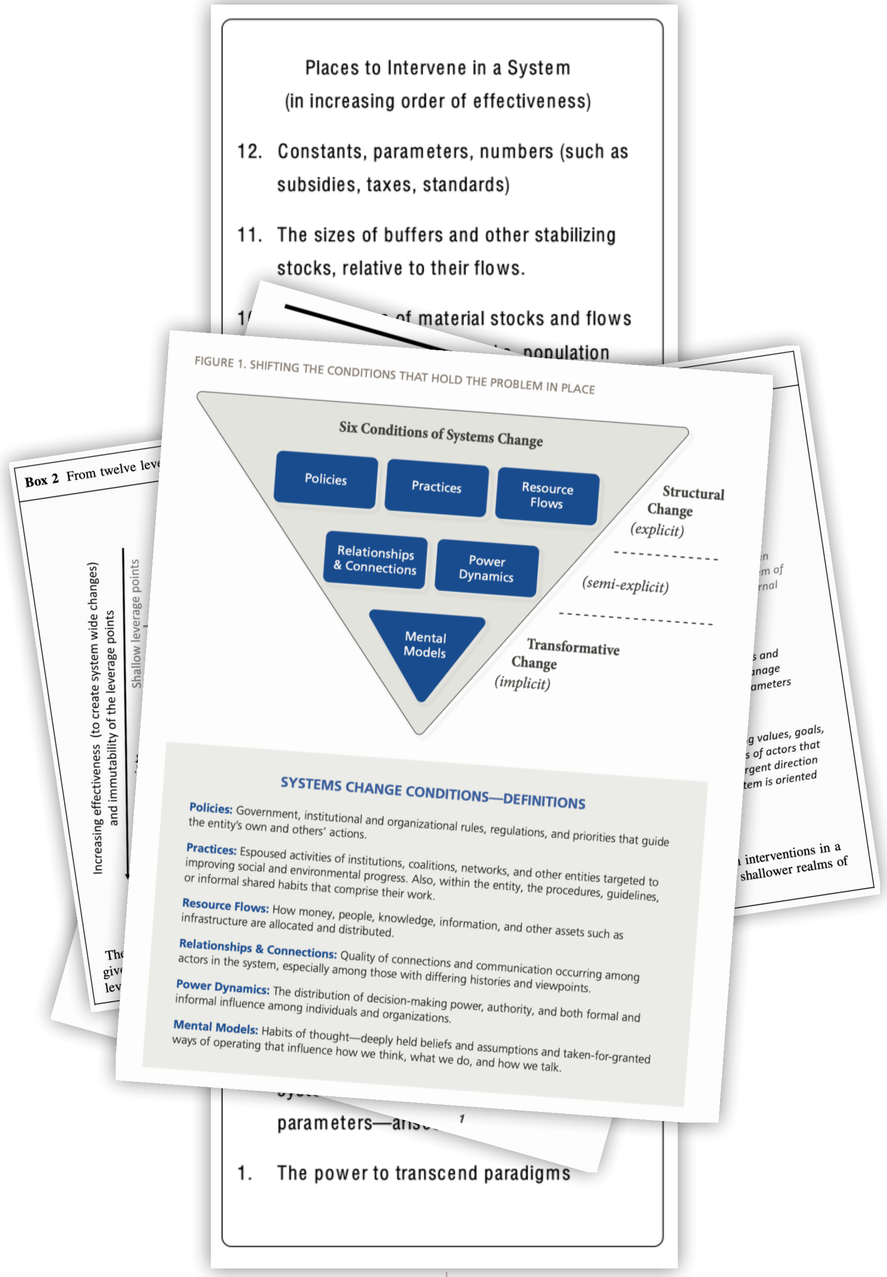

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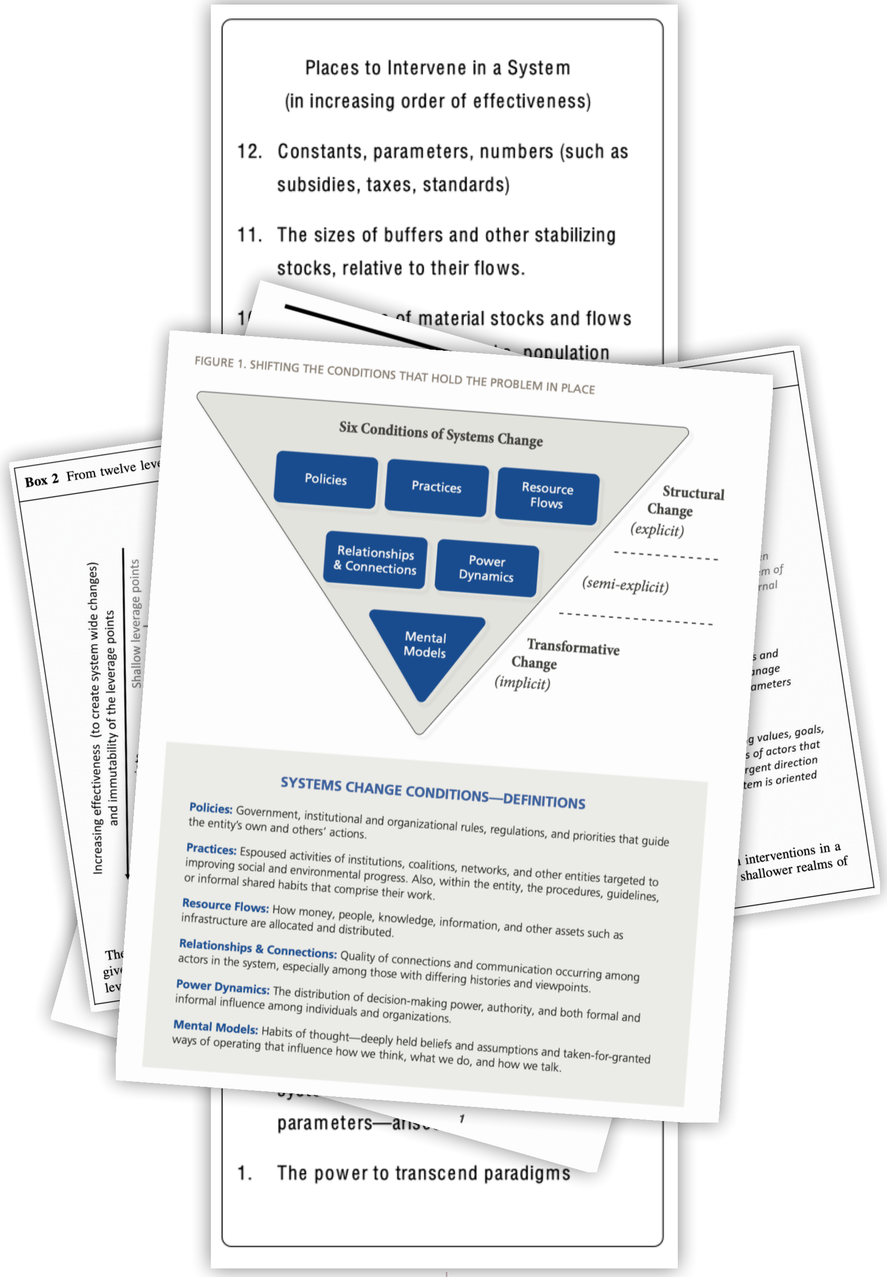

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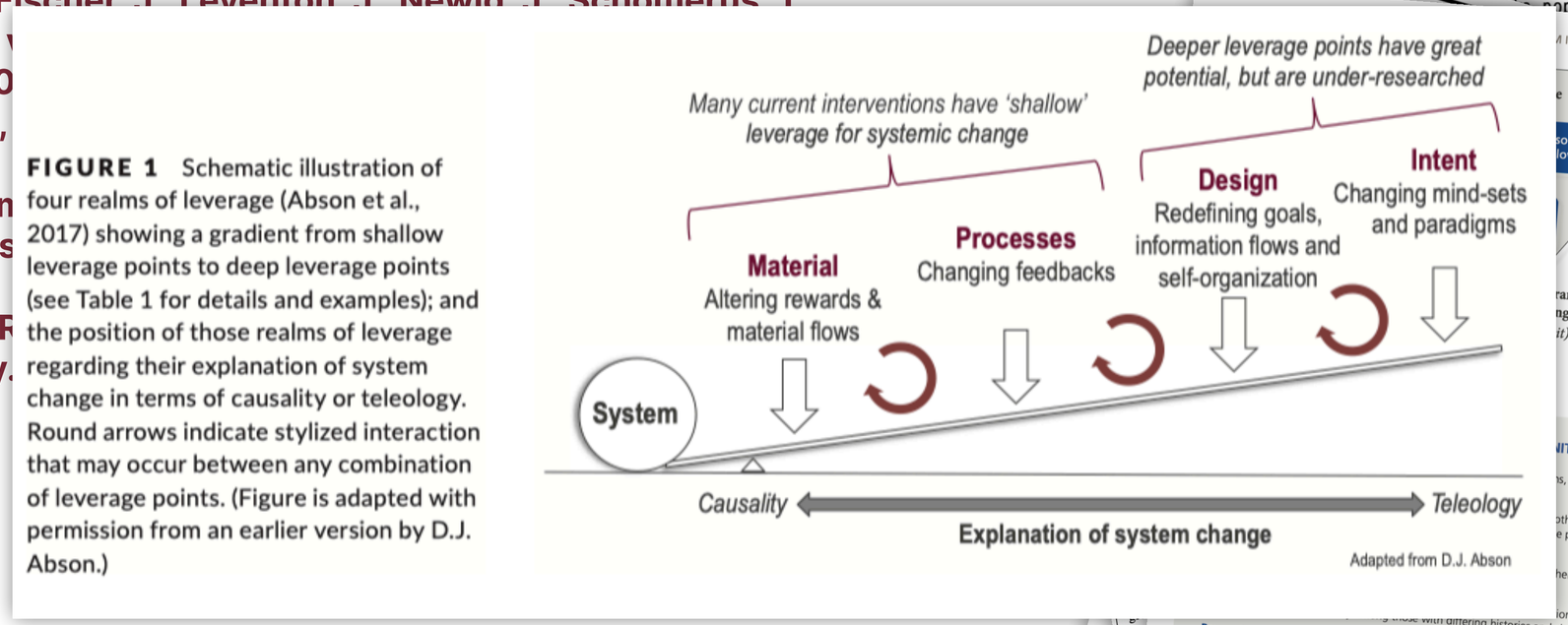
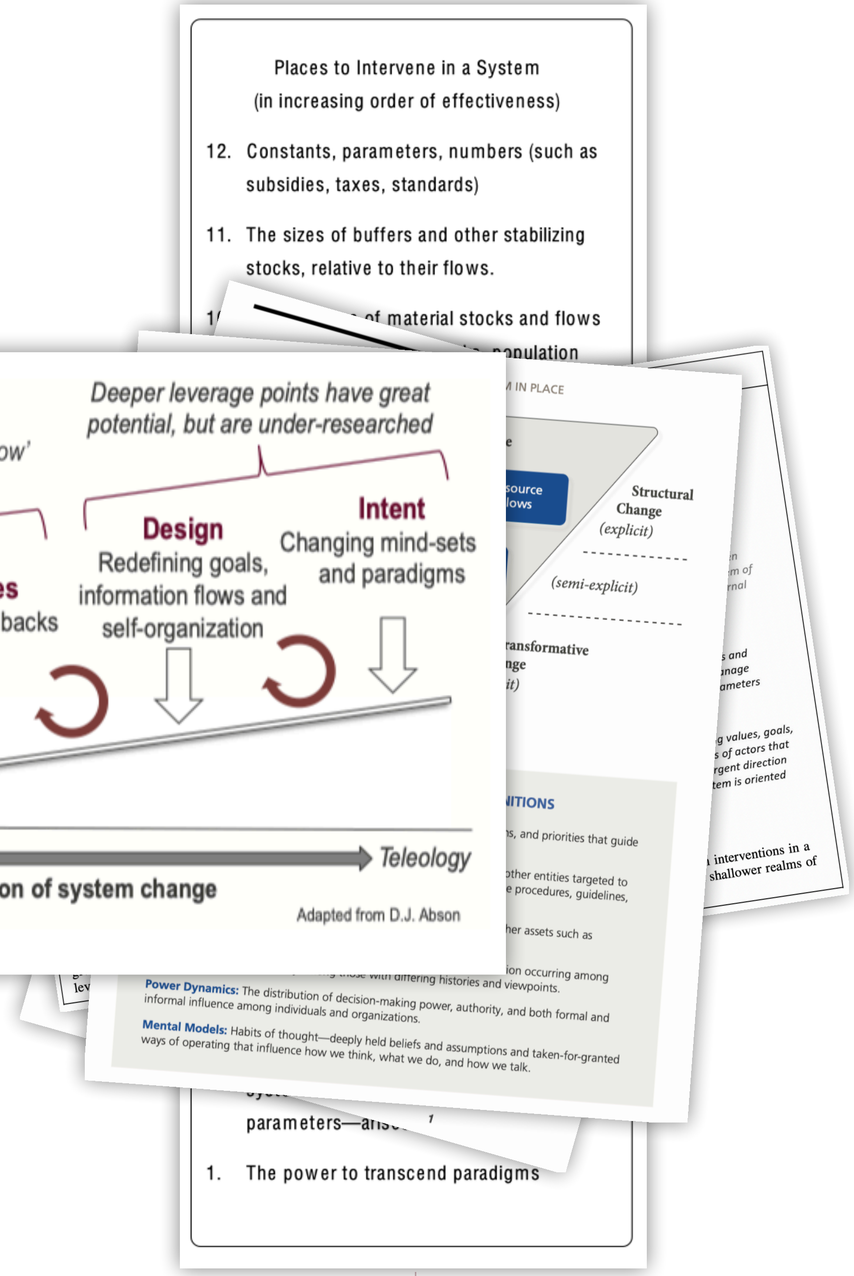


FIGURE 1 Schematic illustration of four realms of leverage (Abson et al., 2017) showing a gradient from shallow leverage points to deep leverage points (see Table 1 for details and examples); and the position of those realms of leverage regarding their explanation of system change in terms of causality or teleology. Round arrows indicate stylized interaction that may occur between any combination of leverage points. (Figure is adapted with permission from an earlier version by D.J. Abson.)



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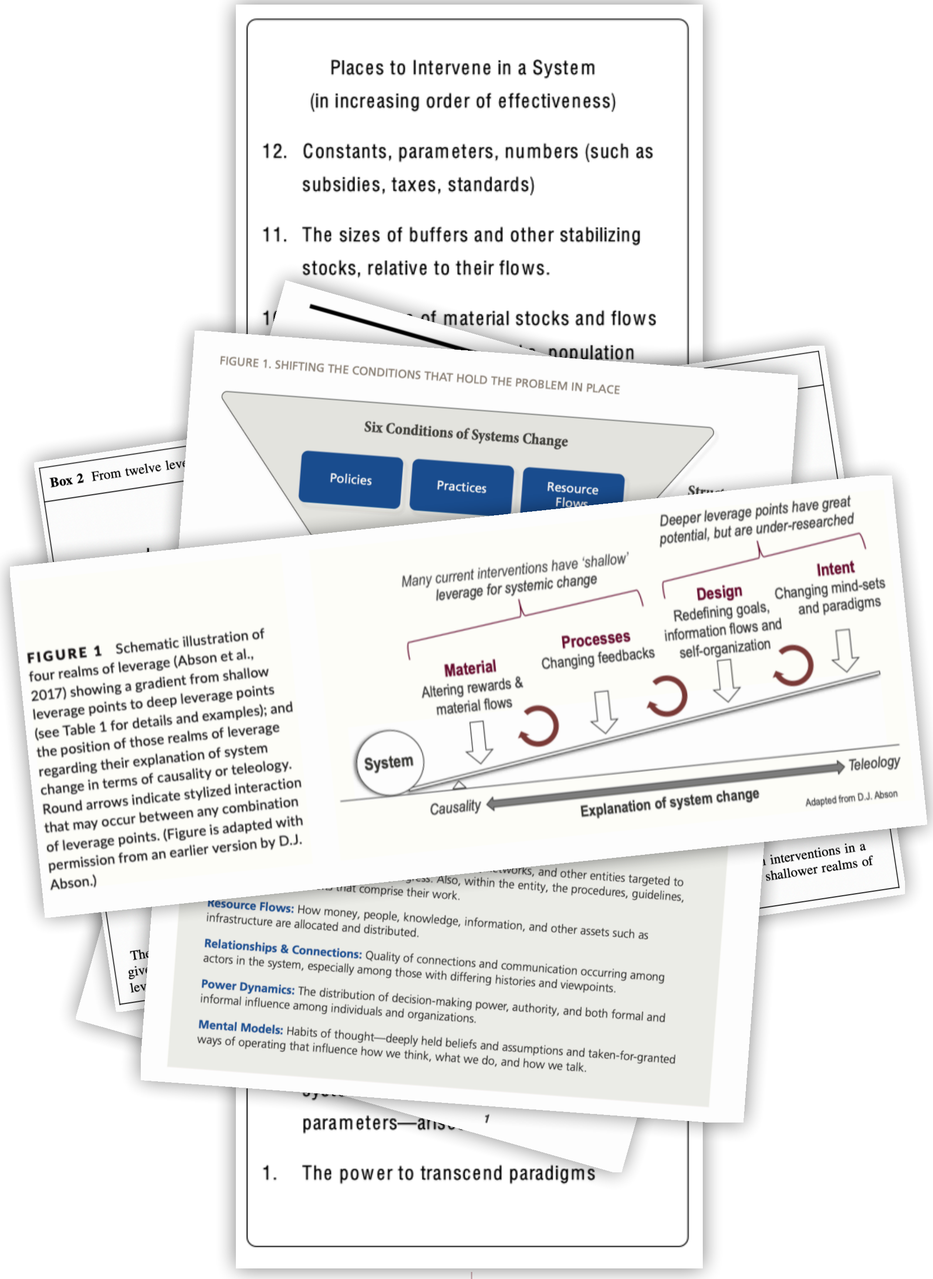

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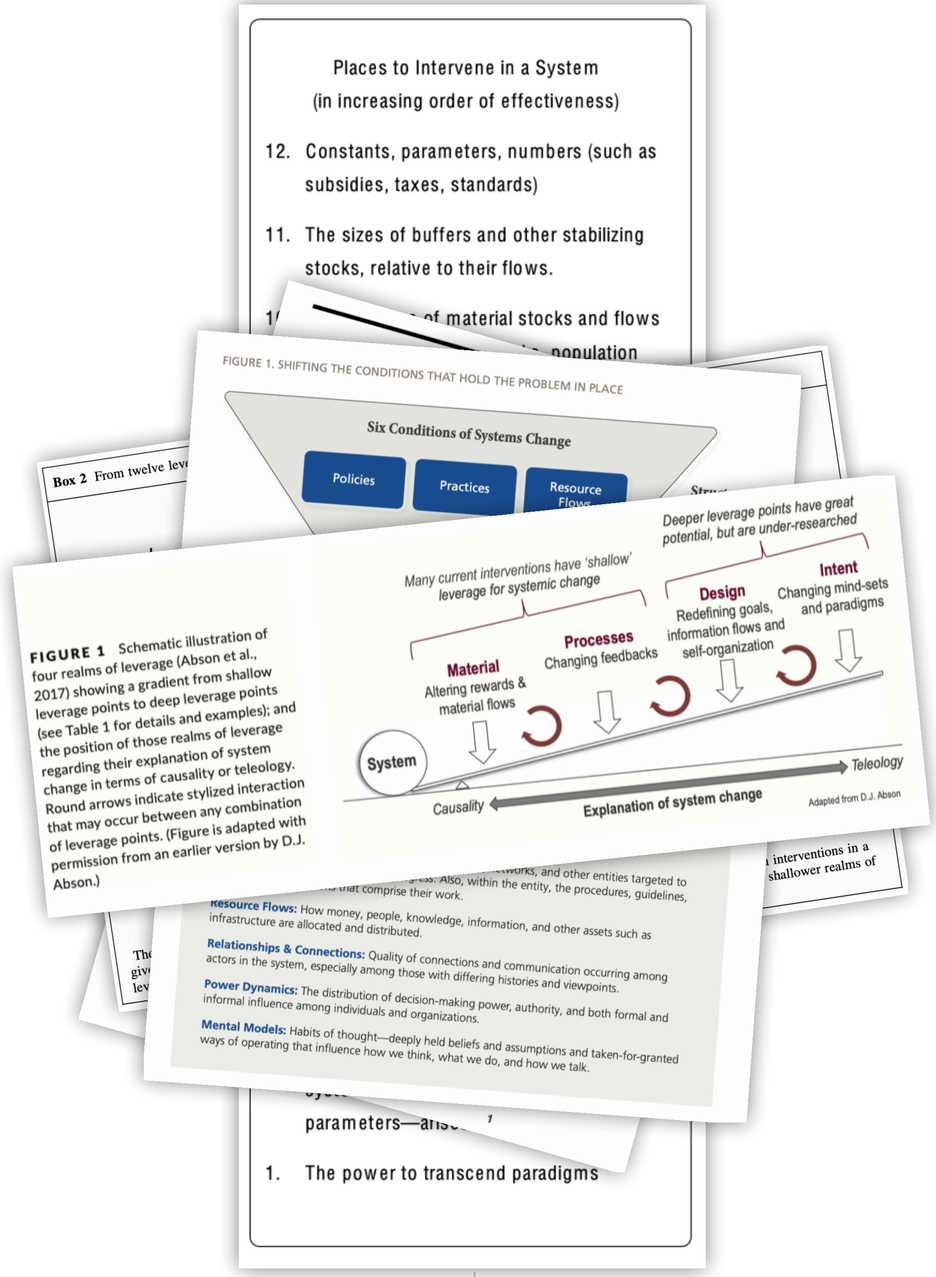

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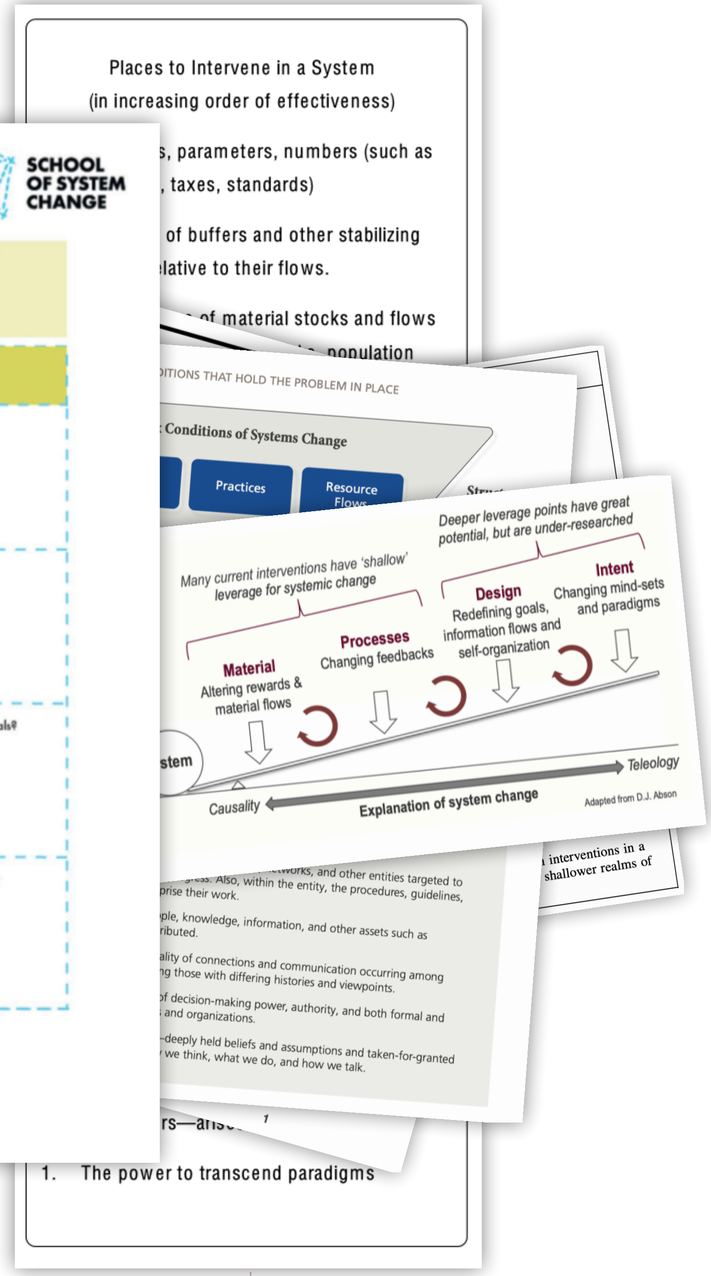
Leveraging Systems Change

SCHOOL OF SYSTEM CHANGE

What is your project?	What is the system you are seeking to change?	What is the projects contribution to systems change?
Systemic Quality	**How do you know a system is changing?** *What might you be looking for?*	**Where might you intervene?** *System changing strategy*
Configuration of system structures and flows	Where is there energy and pressure for change, forces converging or amplifying? Where are there missing information or resource flows? Where is the system starting to rewire?	How might you reconfigure systems structures and flows?
Patterning of relating and organising – incl power and rules that govern	Where is there willingness, agency and power for change? Where are is their new capacity, collaboration and experimental models of organising?	How might you create new systemic ways of organising? How might you support the re-distribution of power?
Whole systems goals	What are the whole system goals your work is nested within? Where is funding and initiatives aligning towards this?	How might you align and coordinate towards whole systems goals?
Paradigm and mind-sets that underpin the system	Where are assumptions being questioned? Where is there openness?	How might you shift the mental models that underpin the system?

FORUM FOR THE FUTURE

Fig. 9 A worksheet for practitioners: Helping understand where and how to leverage systemic impact



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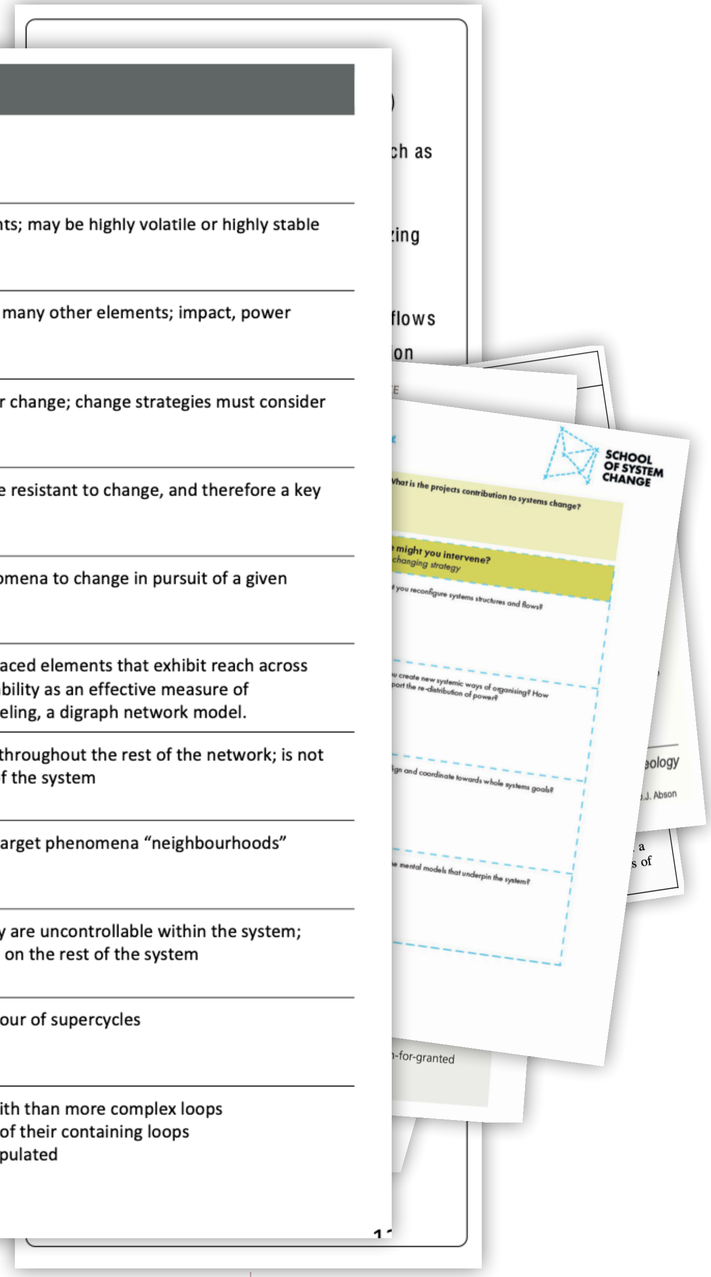
	Detail	Original meaning	Leverage measures in systemic design
Degree	The number of connections	Higher connectivity to the rest of the network; influence, access, prestige (Newman, 2010)	Immediate impact, sensitivity, resilience
Indegree	The number of incoming connections	High inward connectivity to the rest of the network; sensitivity to information, influence (Newman, 2010)	Receives change from many other elements; may be highly volatile or highly stable
Outdegree	The number of outgoing connections	High outward connectivity to the rest of the network; rapid communication/high access to the rest of the network, highly infectious (Newman, 2010)	Change in the given phenomena is felt by many other elements; impact, power
Betweenness	Frequency of participation in the shortest path between two other elements	Member has a high degree of control; the network is dependent on the member; bottlenecking, control, influence (Freeman, 1979)	Phenomena is a gateway or bottleneck for change; change strategies must consider how to prevent blocking
Closeness	Average length of the shortest paths between the given vertex and every other vertex in the graph	High visibility to the rest of the network and information spreads easily from this member; independence from the rest of the graph (Freeman, 1979)	Phenomena is highly powerful; likely to be resistant to change, and therefore a key indicator of success or failure
Eigenvector	Connectedness to other well-connected elements	Influence of highly influential elements; influence (Newman, 2010)	High-impact phenomena; likely key phenomena to change in pursuit of a given strategy
Reach	The number of elements within [x] steps of the given element	Quick propagation of information through the network; widely accessible (Warfield, 2001, Hanneman & Riddle, 2005)	The model is highly sensitive to deeper-placed elements that exhibit reach across the network. Warfield (2001) used reachability as an effective measure of complexity in Interpretive Structural Modeling, a digraph network model.
Reach efficiency	The reach divided by the degree of a given node	Efficient (non-redundant) information spreading; high exposure with limited influence on the given element (Hanneman & Riddle, 2005)	Quickly and efficiently propagate change throughout the rest of the network; is not likely to be highly influenced by the rest of the system
Eccentricity	The distance away of the furthest node	Minimal eccentricity indicates the centre of the graph (Hanneman & Riddle, 2005; Oliva, 2004)	Localization of outcome or intervention; target phenomena "neighbourhoods"
Level partition	Which variables are dependent on which?	Hierarchy of causal structure (Oliva, 2004)	Elements at the "bottom" of the hierarchy are uncontrollable within the system; elements at the top are highly dependent on the rest of the system
Cycle partition	Which other variables share the same set of predecessors/successors?	Illustrates cycle set "dominance" → sub-cycles sets must be understood before their "parents" (but not *that* useful as most elements in models sit in the same cycle set; Oliva, 2004)	Sub-cycle set elements dictate the behaviour of supercycles
Shortest Independent Loop Set (SILS)	A decomposition of the cycle partition showing which loops are included in which	- Illustrates a loop hierarchy - With level partitioning, gives an ordering from simple loops to complex loops Shows isolated loop structures (Oliva, 2004)	- Simple loops are easier to experiment with than more complex loops - Inner loops will influence the behaviour of their containing loops - Isolated structures are more easily manipulated



What's happened since?

Meadows, D. (1997). Leverage Points: Places to Intervene in a System. *Whole Earth*.

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., Ives, C. D., Jager, N. W., & Lang, D. J. (2017). Leverage points for sustainability transformation. *Ambio*, *46*(1), 30-39. 10.1007/s13280-016-0800-y

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Murphy, R. J. A., & Jones, P. H. (2020). Leverage analysis: A method for locating points of influence in systemic design decisions. *FormAkademisk*, *13*(2), 1-25. https://doi.org/10.7577/formakademisk.3384

Yet, “Leverage Points: Places to Intervene in a System” …

Leverage Points:
Places to Intervene in a System

by Donella H. Meadows

Folks who do systems analysis have a great belief in “leverage points.” These are places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything.

This idea is not unique to systems analysis—it’s embedded in legend. The silver bullet, the trimtab, the miracle cure, the secret passage, the magic password, the single hero or villain who turns the tide of history. The nearly effortless way to cut through or leap over huge obstacles. We not only want to believe that there are leverage points, we want to know where they are and how to get our hands on them. Leverage points are points of power.

The systems analysis community has a lot of lore about leverage points. Those of us who were trained by the great Jay Forrester at MIT have all absorbed one of his favorite stories. “People know intuitively where leverage points are,” he says. “Time after time I’ve done an analysis of a company, and I’ve figured out a leverage point—in inventory policy, maybe, or in the relationship between sales force and productive force, or in personnel policy. Then I’ve gone to the company and discovered that there’s already a lot of attention to that point. Everyone is trying very hard to push it *in the wrong direction!*”

The classic example of that backward intuition was my own introduction to systems analysis, Forrester’s world model. Asked by the Club of Rome to show how major global problems—poverty and hunger, environmental destruction, resource depletion, urban deterioration, unemployment—are related and how they might be solved, Forrester made a computer model and came out with a clear leverage point: Growth.[1] Not only population growth, but economic growth. Growth has costs as well as benefits, but we typically don’t count the costs—among which are poverty and hunger, environmental destruction, and so on—the whole list of problems we are trying to solve with growth! What is needed is much slower growth, and in some cases no growth or negative growth.

The world’s leaders are correctly fixated on economic growth as the answer to virtually all problems, but they’re pushing with all their might in the wrong direction.

Another of Forrester’s classics was his urban dynamics study, published in 1969, which demonstrated that subsidized low-income housing is a leverage point.[2] The less of it there is, the better off the city is—even the low-income folks in the city. That is because subsidized housing without equivalent effort at job creation for the

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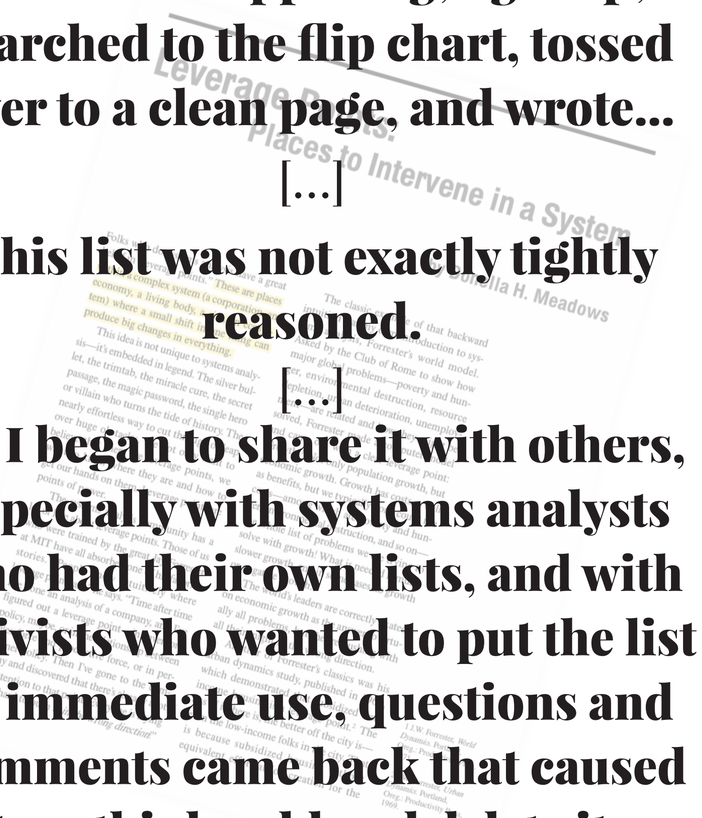
Suddenly, without quite knowing what was happening, I got up, marched to the flip chart, tossed over to a clean page, and wrote…

[…]

This list was not exactly tightly reasoned.

[…]

As I began to share it with others, especially with systems analysts who had their own lists, and with activists who wanted to put the list to immediate use, questions and comments came back that caused me to rethink, add and delete items, change the order, add caveats.



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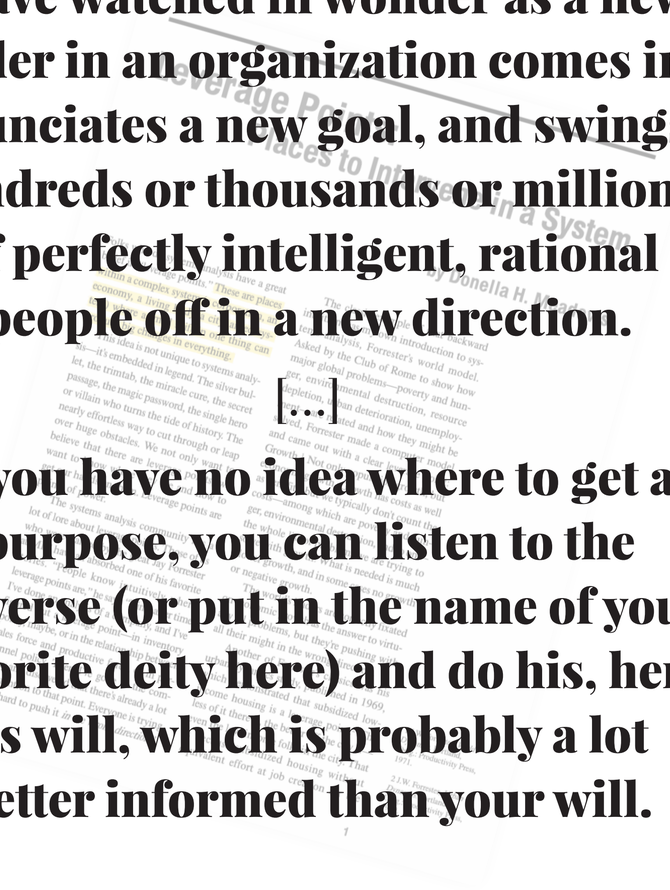
> I have watched in wonder as a new leader in an organization comes in, enunciates a new goal, and swings hundreds or thousands or millions of perfectly intelligent, rational people off in a new direction.
>
> […]
>
> If you have no idea where to get a purpose, you can listen to the universe (or put in the name of your favorite deity here) and do his, her, its will, which is probably a lot better informed than your will.



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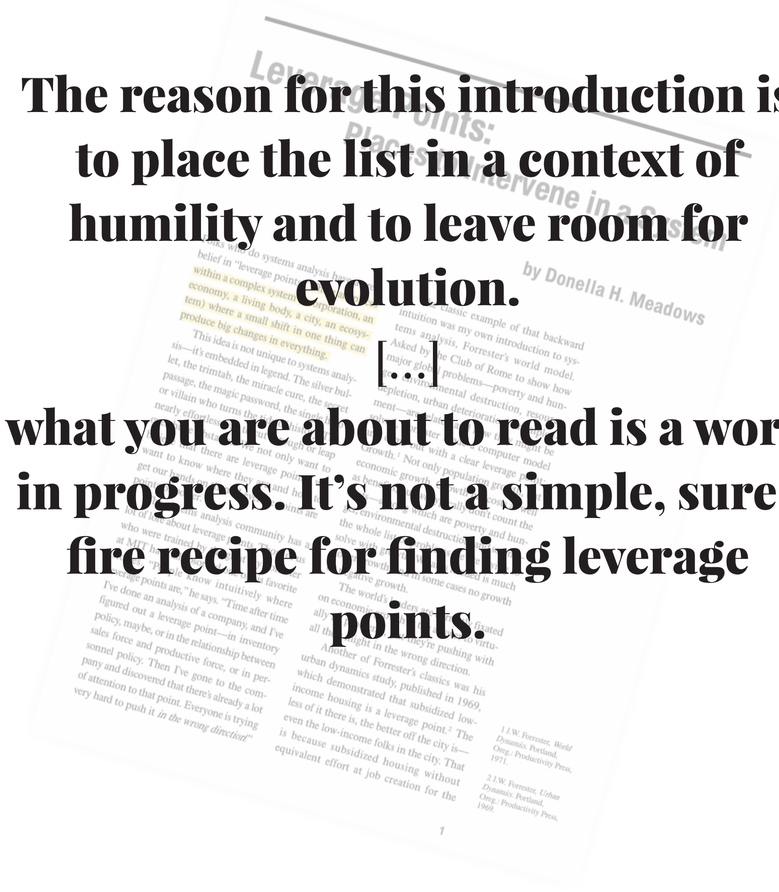
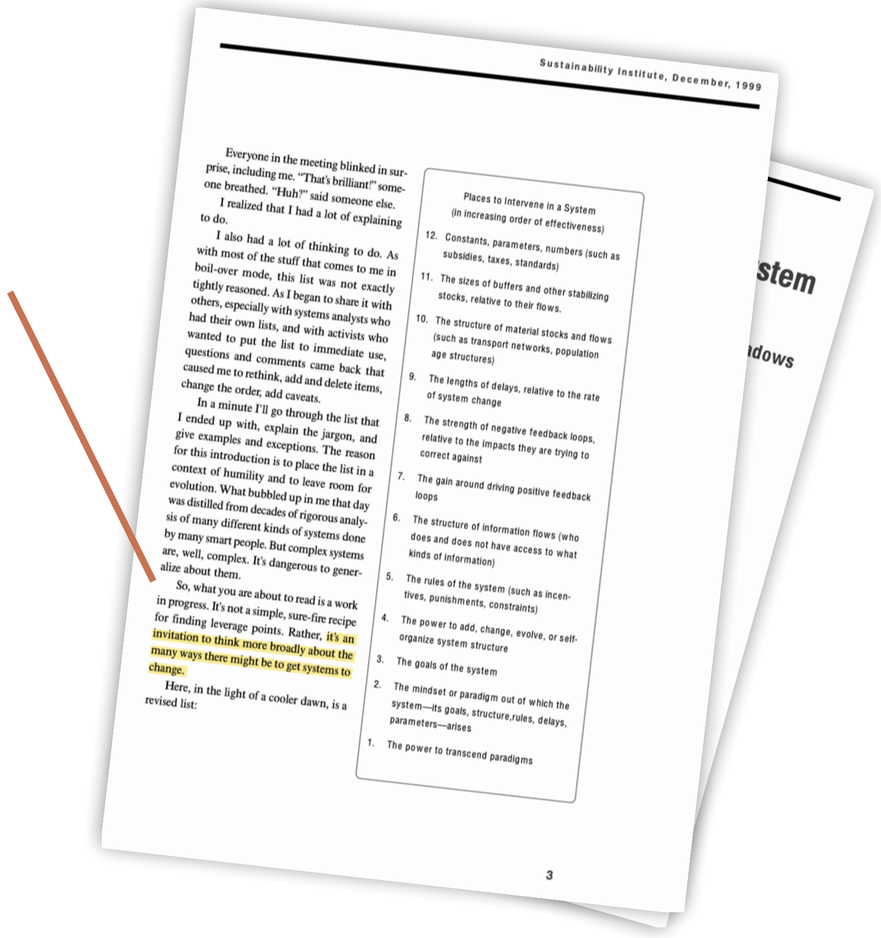
> “The reason for this introduction is to place the list in a context of humility and to leave room for evolution.
> […]
> what you are about to read is a work in progress. It’s not a simple, sure-fire recipe for finding leverage points.



This presentation is therefore an echo of that 25-year-old invitation — a call to again **"think more broadly about the many ways there might be to get systems to change."**



Ways forward:

Rethink leverage in the context of systemic design, not systems dynamics

Developing actionable design principles for the "design" and "intent" types of leverage (Abson et al., 2017)

Systemic design for high-leverage strategies

Leverage analysis: stopping rules? Evaluating relative leverage?

"You keep pointing at the anomalies and failures in the old paradigm, you keep speaking louder and with assurance from the new one, you insert people with the new paradigm in places of public visibility and power. You don't waste time with reactionaries; rather you work with active change agents and with the vast middle ground of people who are open-minded."

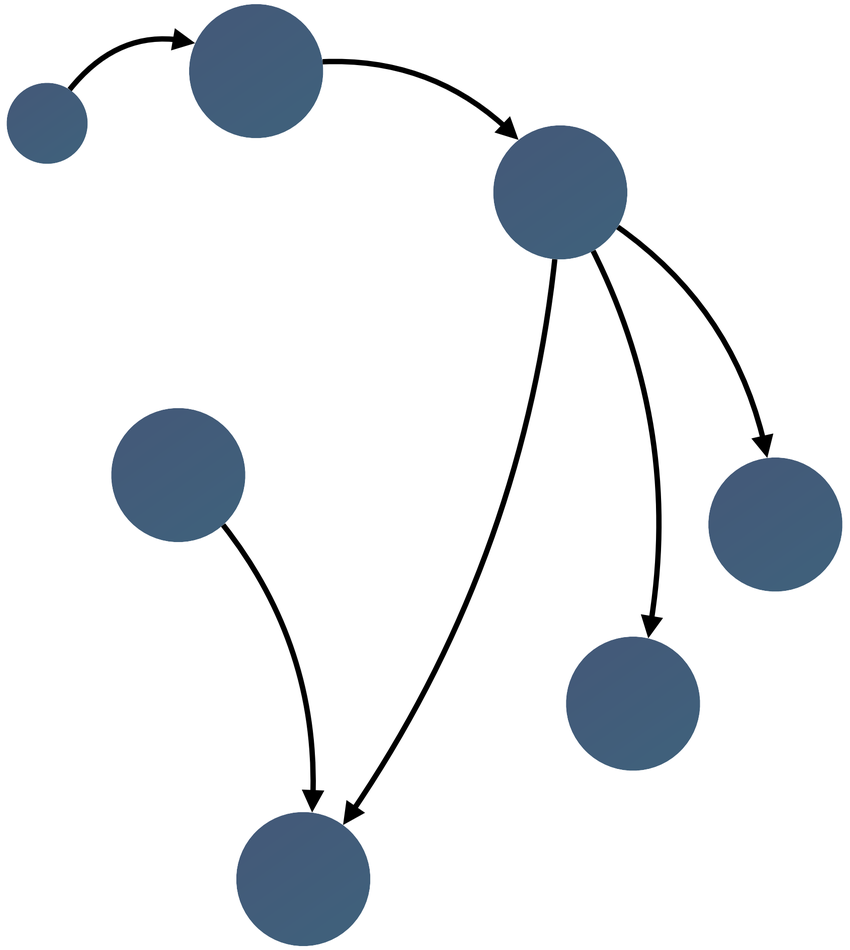
Murphy, R. J. A., & Jones, P. (2021). Towards Systemic Theories of Change: High-Leverage Strategies for Managing Wicked Problems. *Design Management Journal*, 16(1), 49–65. 10.1111/dmj.12068

Signals of possibility

Leverage is recursive

Leverage is relative

Beyond leverage points



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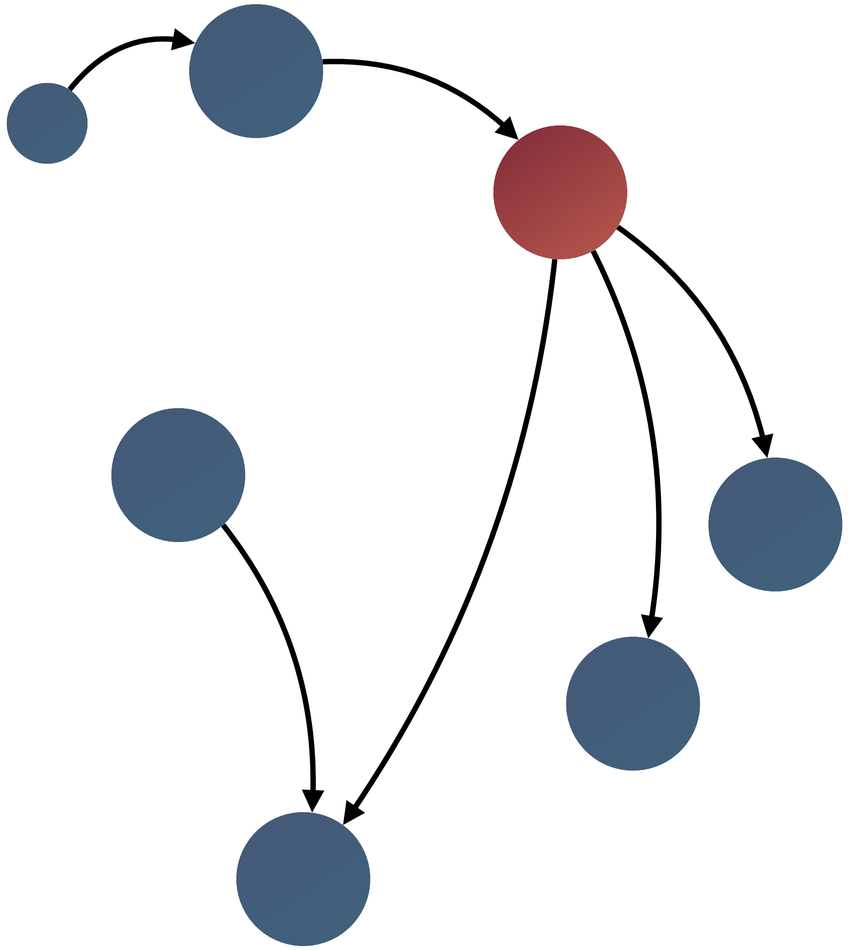

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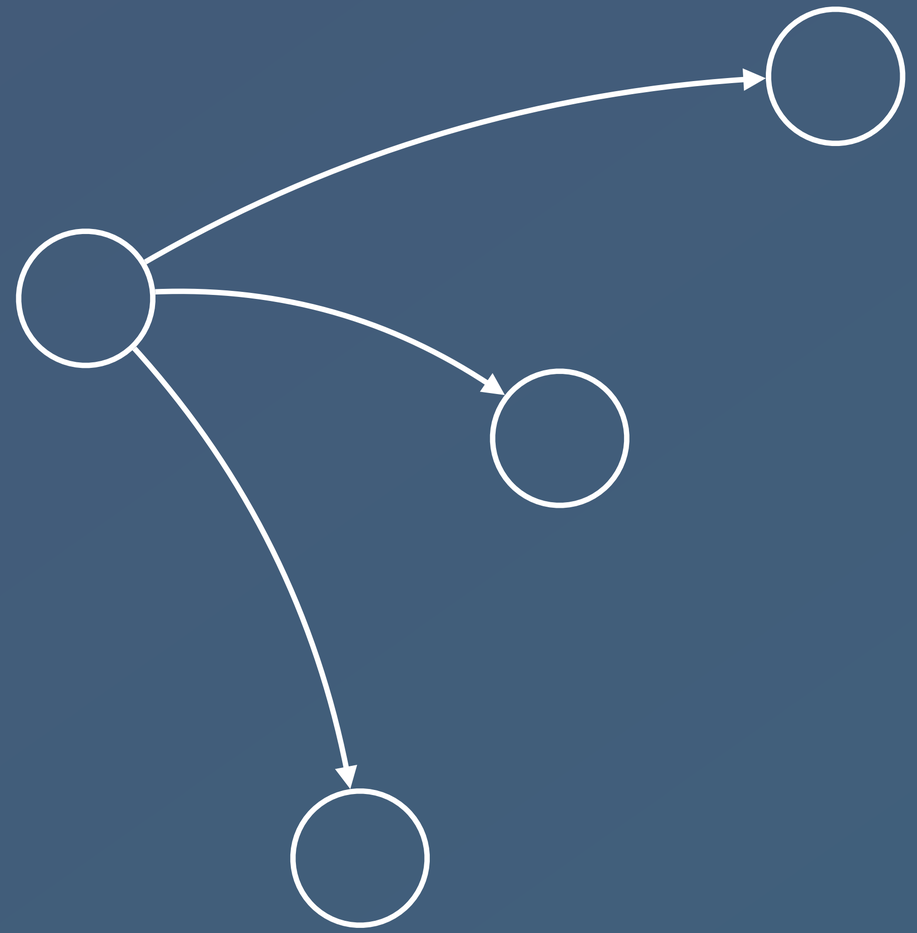

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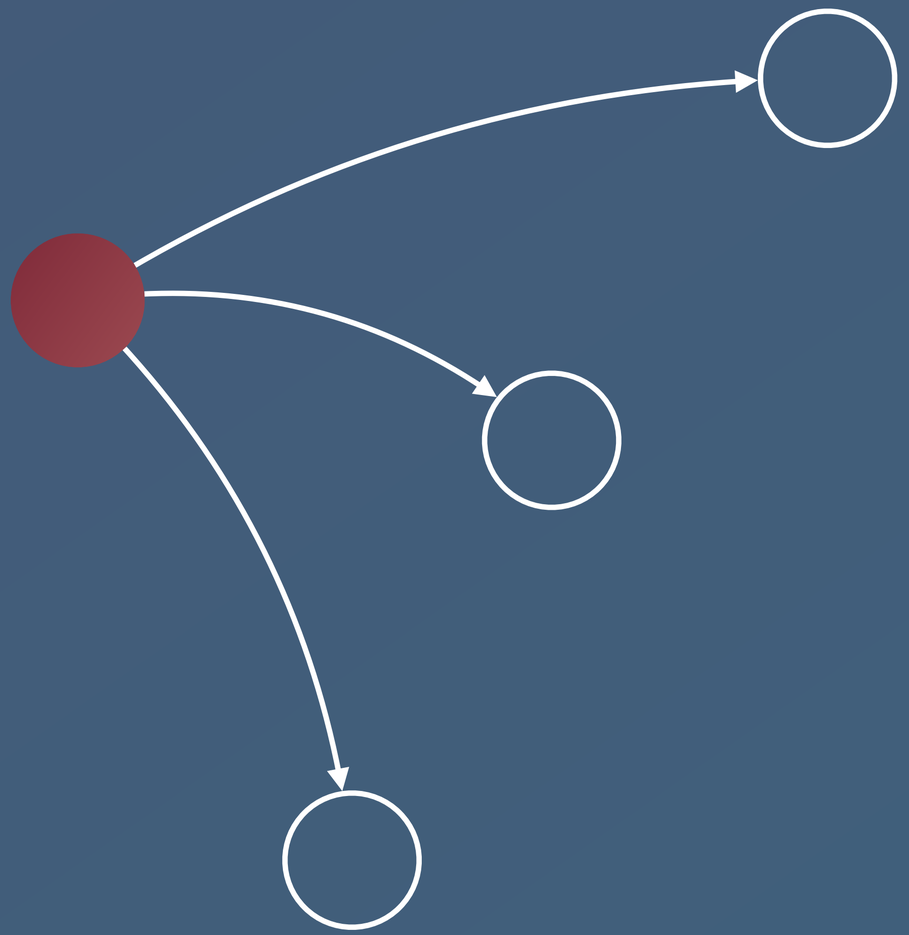

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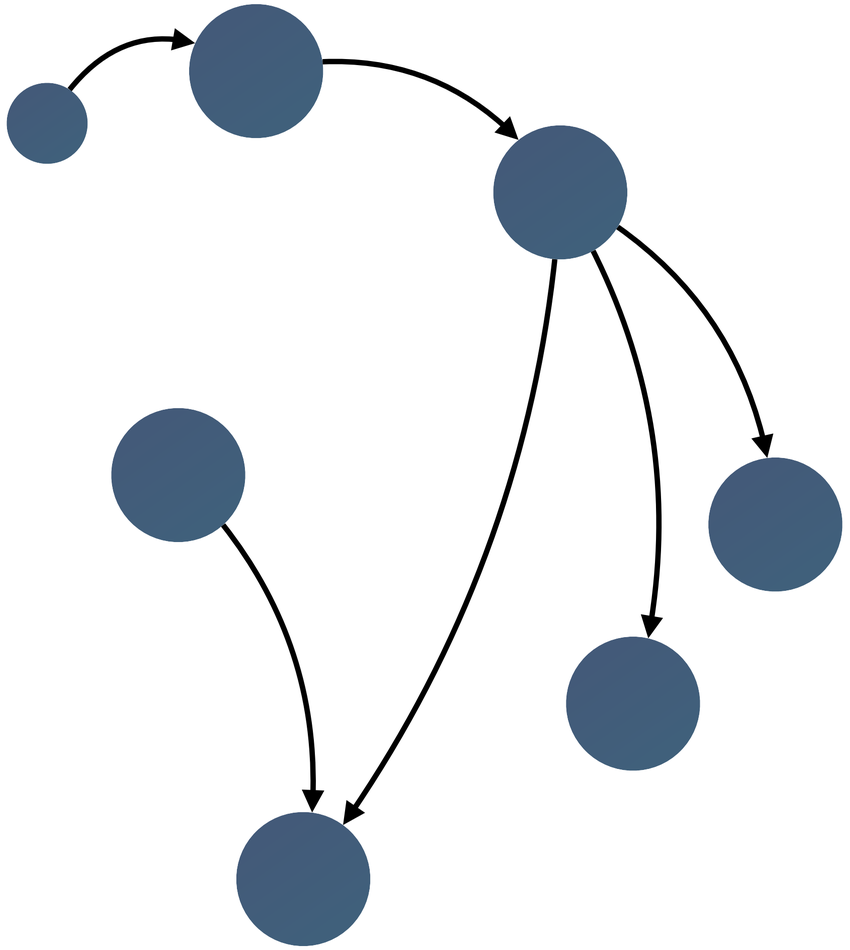

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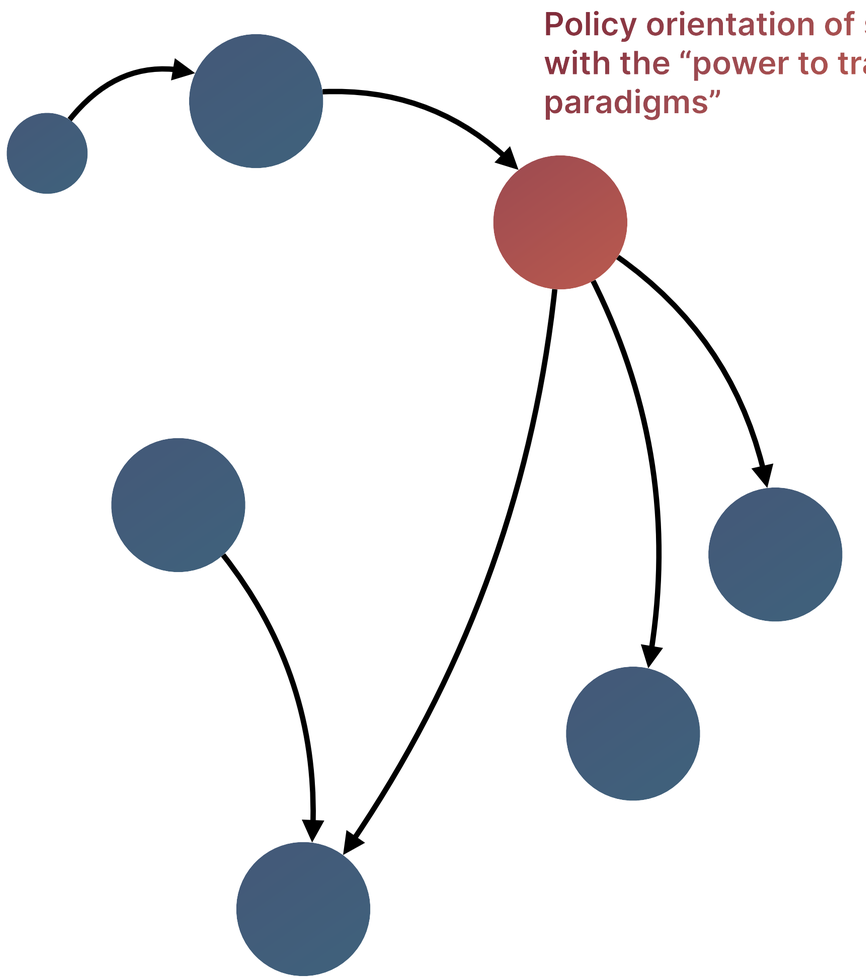

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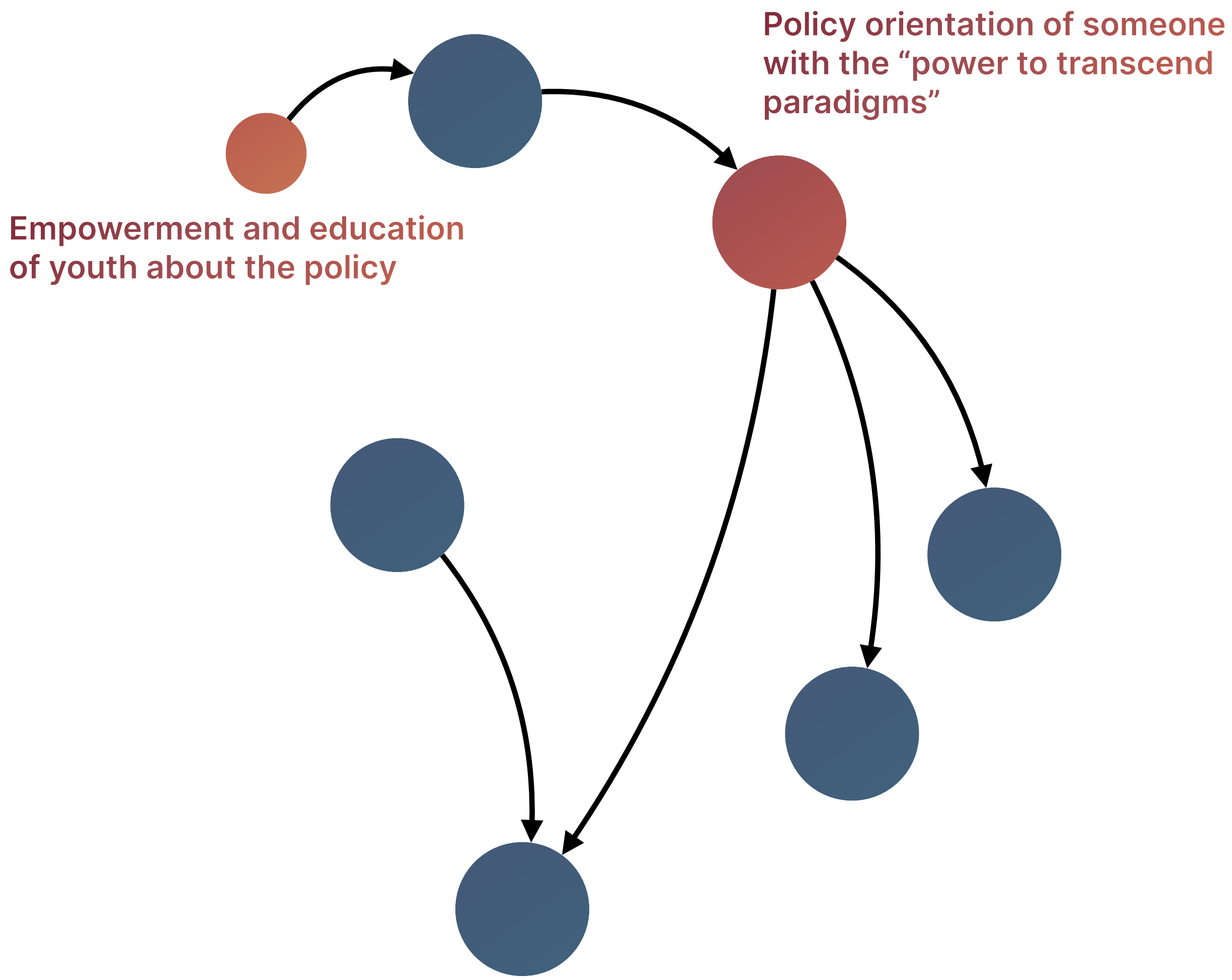

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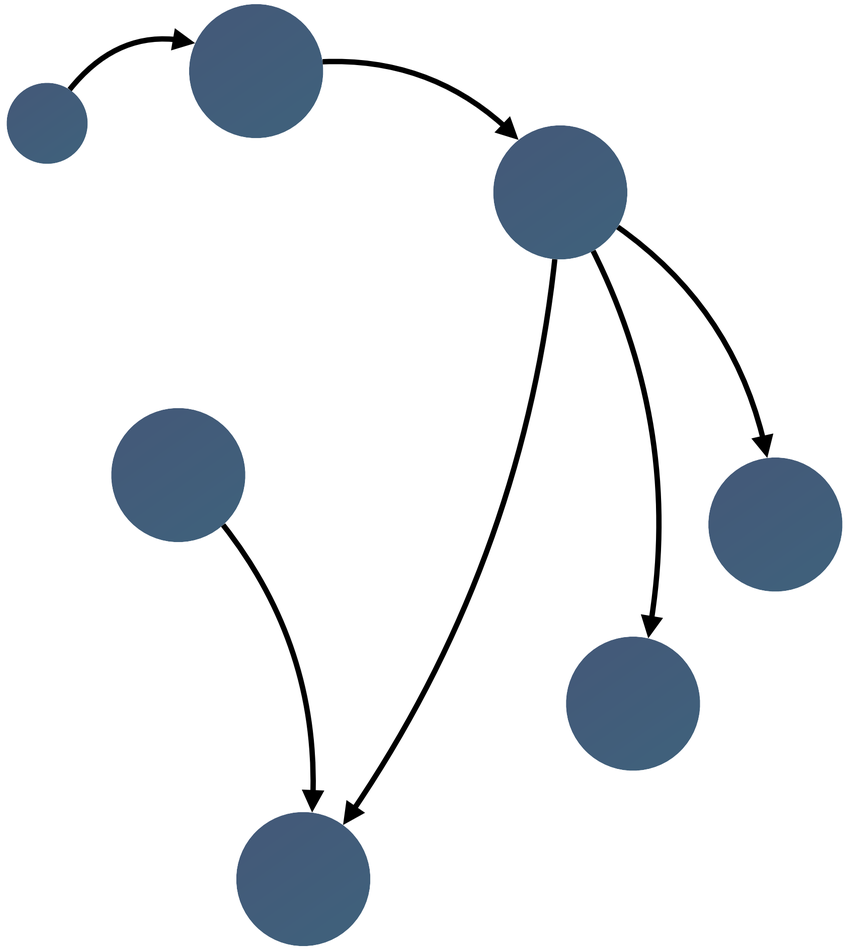

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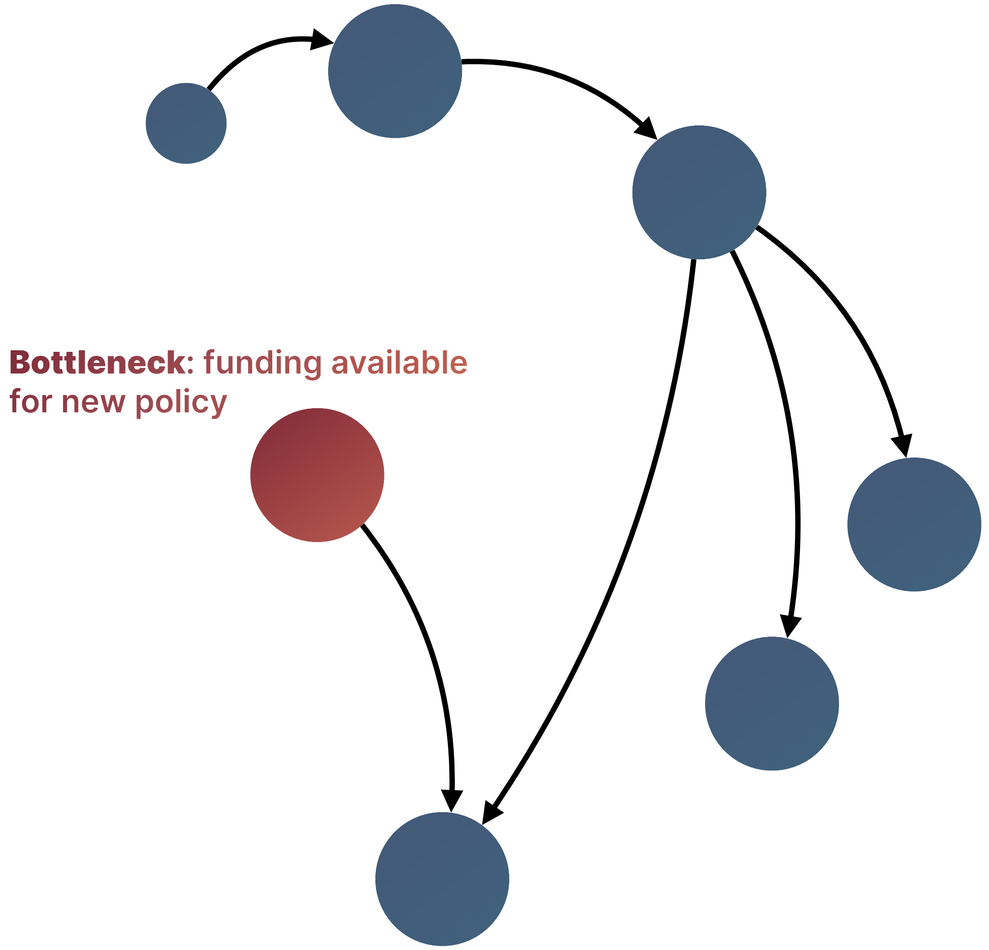

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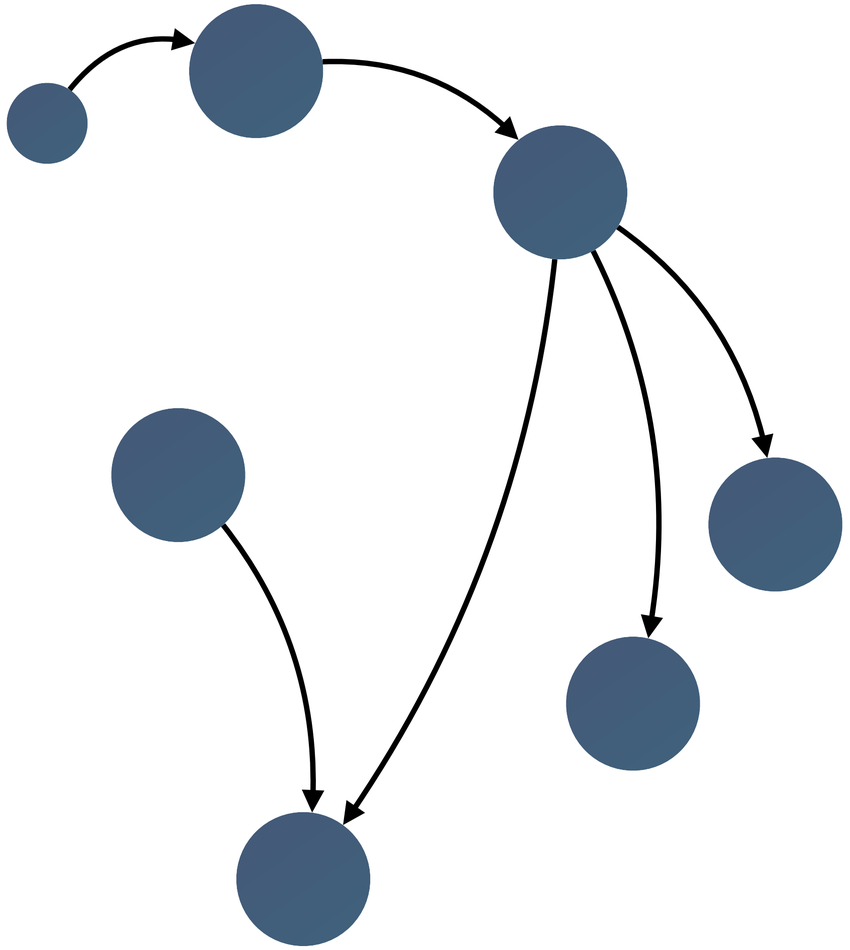

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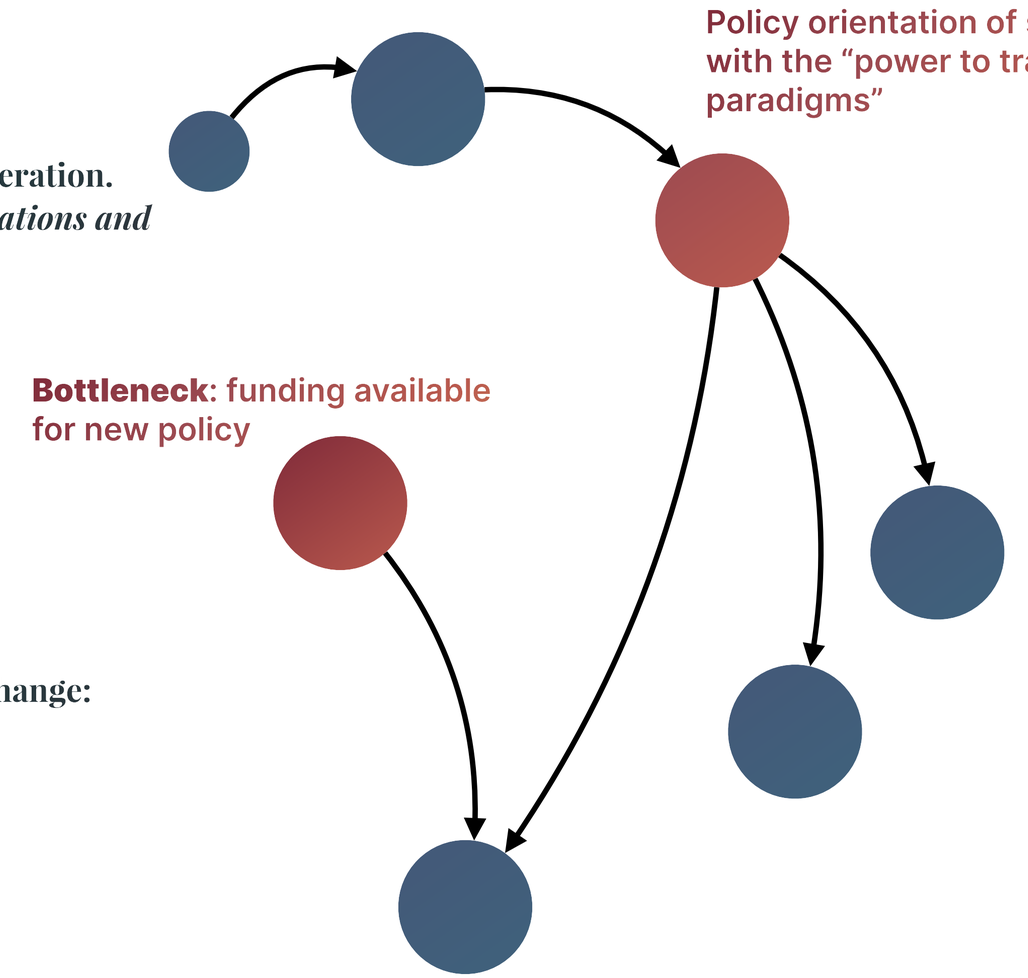

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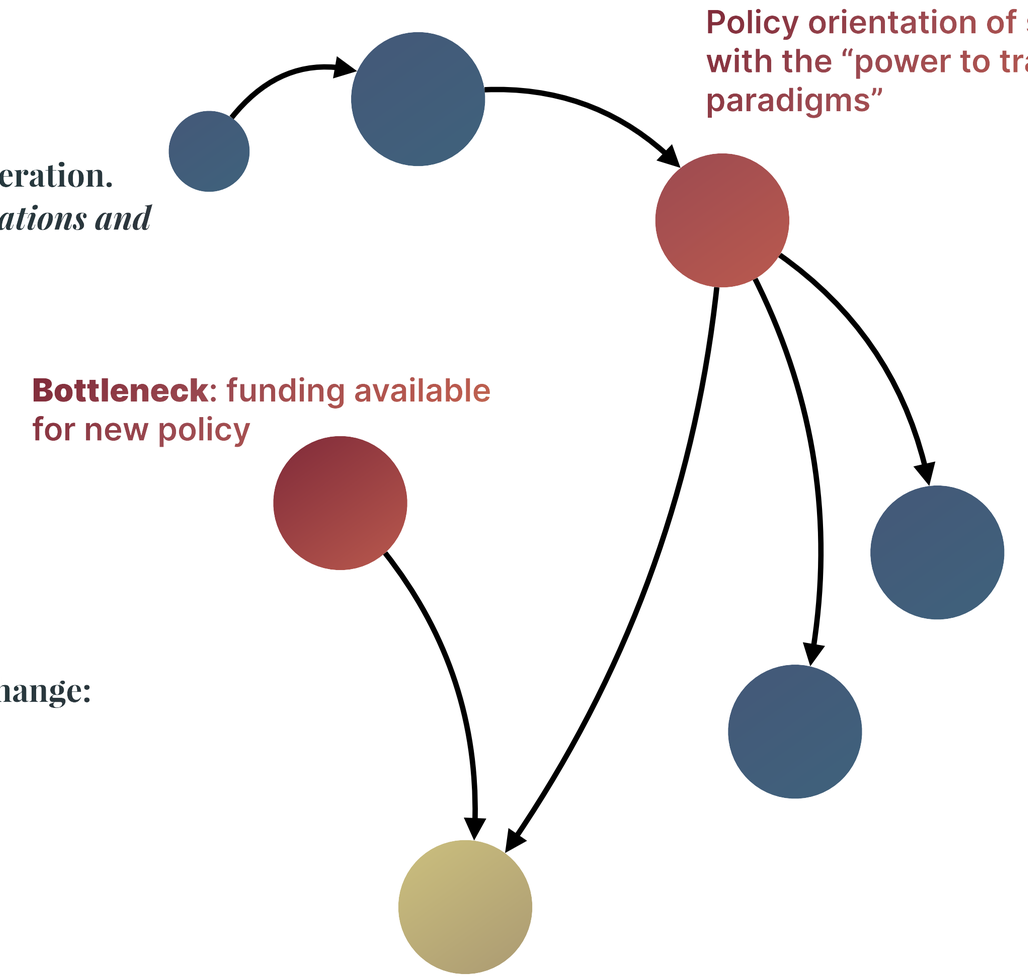

OUR LEVERS ARE LONG ENOUGH!

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We just don't know where to put them.

How does leverage *actually work* in systems change?

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We need a modern theory of leverage for systemic design.

Let’s get to work:

ryan@fulcra.design