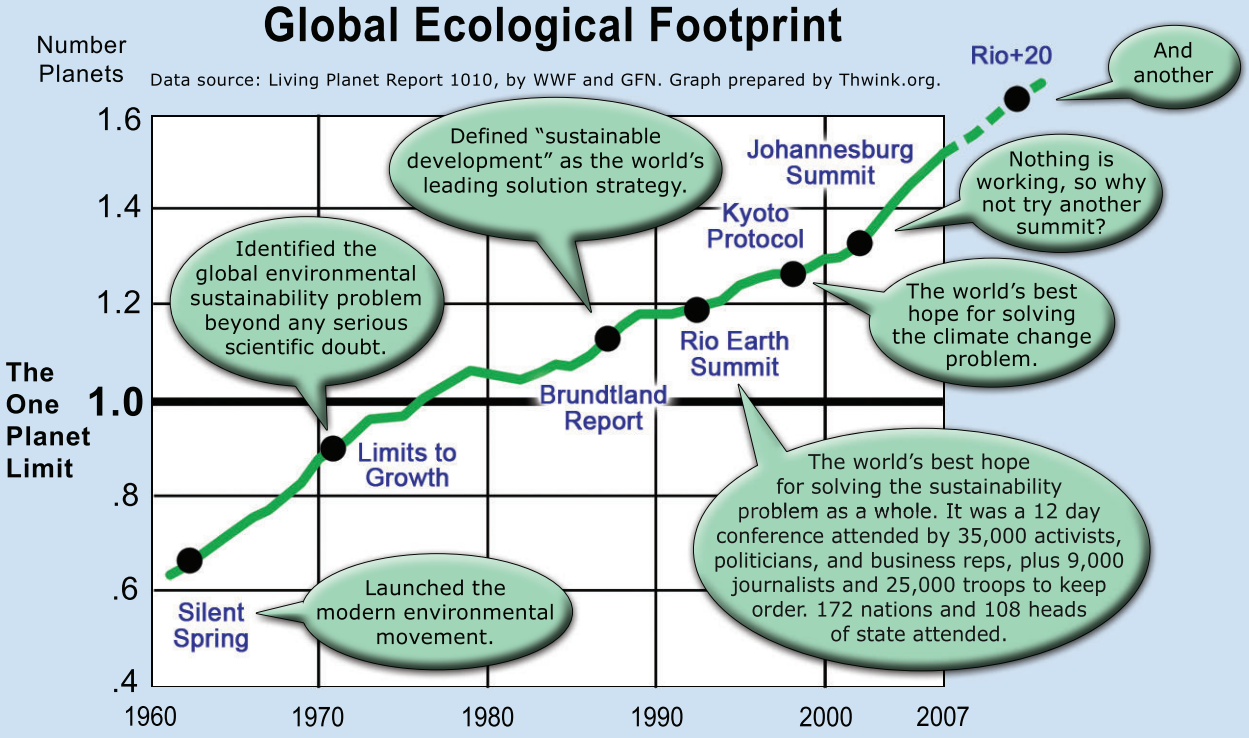
Root Cause Analysis

How it works at Thwink.org

Environmentalists Are Making a Difference.

But it's not *enough* of a difference to solve the problem.



The evidence is irrefutable. Despite over forty years of prodigious and often brilliant effort, problem solvers have failed to solve the sustainability problem. The footprint continues its relentless rise, as if we've done almost nothing.

WHY are solutions not working?

It's not because it's a hard problem.

It's not because it just takes a long time to solve.

It's because popular solutions do not resolve root causes.

Selected Footprints 2007 In Percent of Biocapacity	
Bolivia	14%
Latin America	47%
Canada	47%
Russia	77%
Africa	93%
World	**150%**
Europe	162%
India	180%
Mexico	200%
United States	205%
China	220%
Asia	225%
United Kingdom	377%
Saudi Arabia	638%
Japan	783%
Israel	1600%

Data source: www.footprintnetwork.org/en/index.php/GFN/page/methodology, the 2010 data tables.

The Ecological Footprint is a measure of human demand on the Earth's ecosystems. It is a standardized measure of demand for natural capital (the green line) compared to the planet's ecological capacity to regenerate (the black one planet line). When demand exceeds capacity a system is said to be unsustainable and in overshoot. Demand divided by capacity equals percent biocapacity in use, as listed in the table for selected regions. In 2007 the world's footprint reached 150% of biocapacity, which is 50% overshoot. For a graph of what collapse due to prolonged overshoot will approximately look like if we don't very quickly solve the sustainability problem, see page 14.

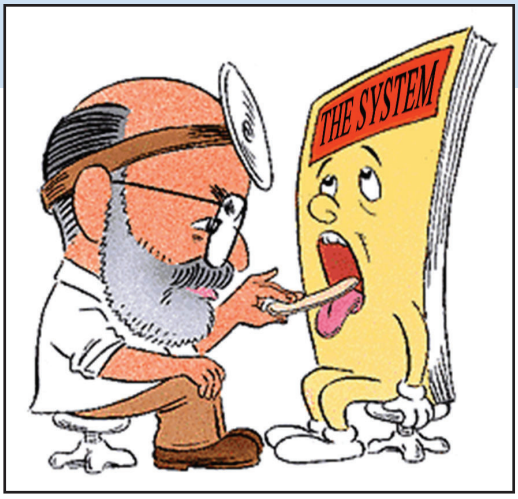
Forty Years of Common Sense Solutions

- Agenda 21
- Better Technology
- Biomimicry
- Cap and Trade
- Collective Management
- Conservation Parks
- Corporate Social Responsibility
- Cradle to Cradle Design
- Demonstrations and Marches
- Education on the Three Rs
- Energy Offsets
- Green Building
- Green Revolution
- International Summits
- International Treaties
- Natural Step Framework
- Organic Farming
- Permaculture
- Pollution Taxes
- Population Control
- Prescriptive Regulations
- Renewable Energy
- Sustainable Development

Modern environmentalism burst into the public sphere in 1962, when Rachel Carson's *Silent Spring* launched the movement.

Building on earlier sentiments expressed by activists like Henry David Thoreau, John Muir, and Aldo Leopold, *Silent Spring* led to action. Acts regulating chemicals and pollution were passed. In the 1970s the environmental movement picked up speed. Earth Day happened. Nations created environmental protection agencies. The UNEP was founded. Thousands of NGOs began to make a difference. A string of international summits put protecting the environment in the spotlight. The tide seemingly began to turn, as problems like acid rain and local pollution were reduced. One international problem, stratospheric ozone depletion, was solved.

Tremendous gains have been made. But it's not enough. Popular solutions like those listed help some but are not enough to cure the patient, because they put the cart before the horse.



Before we can design solutions we must first diagnose the patient. WHY is he or she sick? In other words, WHY is the human system unsustainable? What's the root cause of this pattern of behavior?

You would never dream of going to a doctor who jumped to conclusions about how to treat your illness without first diagnosing its cause. The sustainability problem is no different.

This line of attack, find the root causes first and design solutions second, is what distinguishes the work at Thwink.org. It can lead to an entirely new class of solutions that have never been tried.

So how can we find the root causes?

There's only one known way to find root causes:

Root Cause Analysis.

Motorola has a defect rate of .0015%.

History

Root Cause Analysis grew out of quality management engineering. As managers delved ever deeper into the causes of their quality problems, they converged on a discovery that explained everything: **all problems arise from their root causes.** Find the root causes, resolve them permanently, and your problem is solved.

The invention of Root Cause Analysis is credited to **Sakichi Toyoda** (1867 - 1930), the "King of Japanese Inventors," the "Japanese Thomas Edison," and the founder of Toyota. Toyoda called the method "The Five Whys." This asks WHY five times or until the root cause(s) of a problem is found.

The quality revolution, really the root cause revolution, began in Japan over a hundred years ago. And there it would have stayed, if not for the consulting work of **W. Edwards Deming**. He studied what they were doing, realized its importance, and made it the core of his own techniques. Then he went even further by creating his famous Fourteen Points. To his disappointment US companies were not interested. So he took his work to those who would listen. Ironically this was post World War Two Japan. There his ideas flourished.

When Japan began to trounce the rest of the industrialized world in the 1970s, US managers finally saw the light and asked Deming for help. Further events saw Root Cause Analysis and quality control evolve into codified practices like **Six Sigma**, developed by Motorola beginning in 1986. This allowed Motorola to reduce defect rates to an amazing .0015%, which gave them a tremendous competitive edge. [1]

Motorola's success with Six Sigma caused industry giants like General Electric to adopt the method. In 1999 Root Cause Analysis began to be applied to the health care industry. Today most major industries employ Root Cause Analysis in some fundamental way.

Definitions

A **root cause** is the deepest cause in a causal chain that can be resolved. If the deepest cause cannot be resolved, it's not a real problem. It's the way things are.

Root cause analysis is "a class of problem solving methods aimed at identifying the root causes of problems or events. ... The practice of root cause analysis is predicated on the belief that problems are best solved by attempting to correct or eliminate root causes, as opposed to merely addressing the immediately obvious symptoms." (Wikipedia October 24, 2011)

A **defect** is something that displeases the customer, such as a problem with a cup of coffee at Starbucks. Defects are produced by production processes. The **defect rate** of a process is the average number of defects produced per opportunity to please the customer.

Principles

For the class of problems we are concerned with, the core principles of Root Cause Analysis are:

1. All problems arise from their root causes.
2. A **high quality solution** is one engineered to resolve a specific *correct* root cause.
3. Only high quality solutions can solve difficult problems.
4. Only a formally defined process undergoing continuous process improvement can produce high quality solutions consistently, economically, and in a short amount of time.
5. Don't focus on solutions. Focus on the process. The right process will produce the right results.

These principles are the single most important thing in this booklet.

1. Source: *Achieving Total Customer Satisfaction Through Six Sigma*, by Jane Erwin, in Quality Digest, July 1998, www.qualitydigest.com/july98/html/sixsigma.html. Motorola's 5.7 sigma has been converted to a .0015% defect rate using the *Process Sigma Calculator* at www.isixsigma.com/process-sigma-calculator.

Results in Terms of Defects

Here are two examples:

"When a Japanese firm took over a Motorola factory that manufactured Quasar television sets in the US in the 1970s, they promptly set about making drastic changes in the way the factory operated. Under Japanese management [using their form of Root Cause Analysis and defect prevention], **the factory was soon producing TV sets with 1/20th as many defects** as they had produced under Motorola's management. They did this using the same workforce, technology, and designs, and did it while lowering costs, making it clear that the problem was Motorola's management." (*The Six Sigma Handbook*, 2003, page 4)

After Toyota took over management of a General Motors factory, introduced their approach to quality management, and retrained the workforce, these were the results:

"Full production began in 1985, and by year end 1986, [the plant] had the highest quality and productivity of any GM plant. **Quality defects dropped from 12 to 1 per vehicle.** Cars were assembled in half the time. Absenteeism dropped to 3% [from 20%]. Worker satisfaction and engagement soared. Operational innovation was on the rise, with employee participation over 90% and nearly 10,000 ideas implemented. Same people, same union, same equipment. Radically different outcome. All in under two years." (*The Elegant Solution: Toyota's Formula for Mastering Innovation*, 2007, page 65)

These examples show it's the process you use that makes all the difference. The more mature the process, the fewer the defects. The right process can take hold surprisingly fast. No process is a panacea, but the right process under the right management can work miracles.

Modern environmentalism has a defect rate of 91%.

Where We Are Today

Environmentalists find problems and solve them. Each unsolved problem is a defect produced by the problem solving process. The customer is humanity.

The defect rate of the process environmentalists are currently using is easily determined by the table. This lists the top eleven environmental problems as determined by the SCOPE study, published in the United Nations Environmental Program's *Global Environmental Outlook 2000*, page 339.

Only one problem is solved. This gives a **defect rate of 10 out of 11, which is 91%.** It needs to be near zero so that all 11 problems are solved.

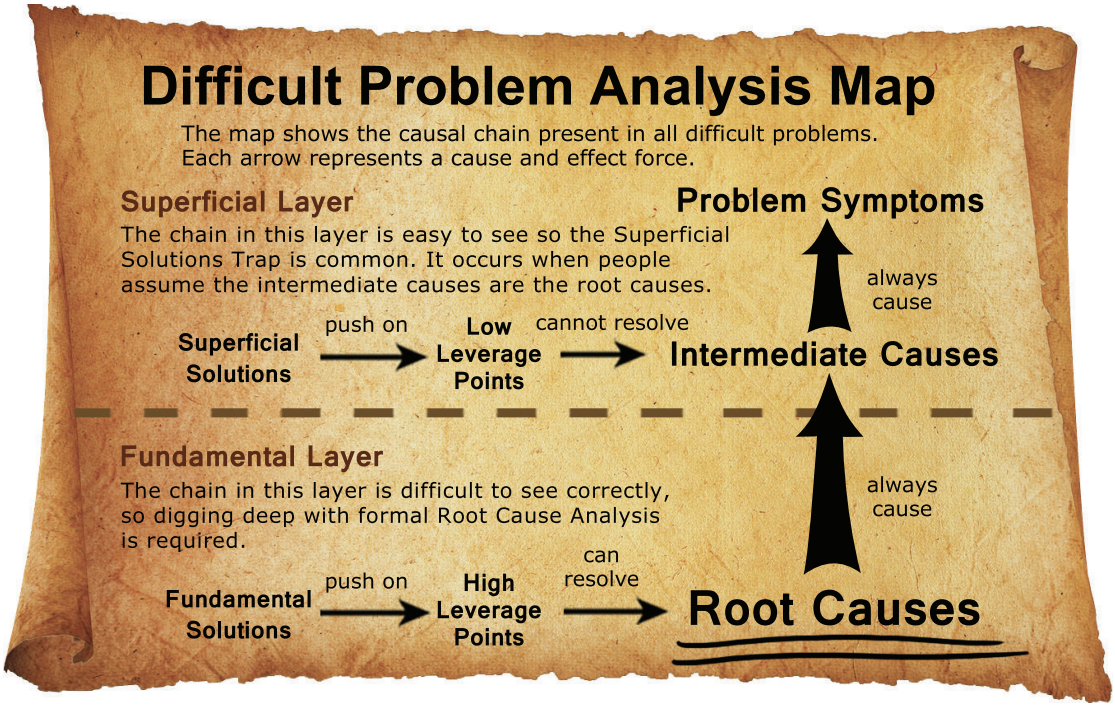
Environmentalism will not become *modern* environmentalism until it takes up Root Cause Analysis, ideally with the same passion Motorola took it up with. Motorola was so enthused at its potential that they **developed their own wrapper process** for Root Cause Analysis. This was Six Sigma. The wrapper allowed the business world to immediately swallow Root Cause Analysis hook, line, and sinker.

Environmental Problem	Solved
1. Climate change	No
2. Freshwater scarcity	No
3. Deforestation and desertification	No
4. Freshwater pollution	No
5. Loss of biodiversity	No
6. Air pollution	No
7. Soil deterioration	No
8. Ecosystem functioning	No
9. Chemical pollution	No
10. Stratospheric ozone depletion	Yes
11. Natural resource depletion	No

Let's see if we can do the same for environmentalism. This begins with understanding *exactly* why today's problem solving approaches are not working.

Conventional Approaches to Solving the Sustainability Problem Are Not Working

because without a map all problem solvers can see is the superficial layer.



Despite its best efforts for over forty years, environmentalism remains unable to solve the sustainability problem. The map explains why. It's because popular solutions operate only on the superficial layer. Without a map that's all problem solvers can see. This causes them to unknowingly fall into the **Superficial Solutions Trap** (explained on the map), which leads to common sense solutions like those listed on page 3. These *should* work but they don't. Why is this?

The most fundamental law in all of science is the Law of Cause and Effect: *every effect has a cause*. From that follows the Law of Root Causes: **all problems arise from their root causes**. This is the fundamental principle of Root Cause Analysis.

All problems arise from their root causes. If attempted solutions have failed to solve a problem for generations, then the only possible reason is the solutions have been incapable of resolving the root causes. No other explanation is possible.

The key to grasping how Root Cause Analysis works at Thwink.org lies in understanding the causal chain behind all difficult problems. Here is THE key insight:

> **Superficial solutions fail on difficult problems because they cannot exert a greater force on intermediate causes than root causes can.**

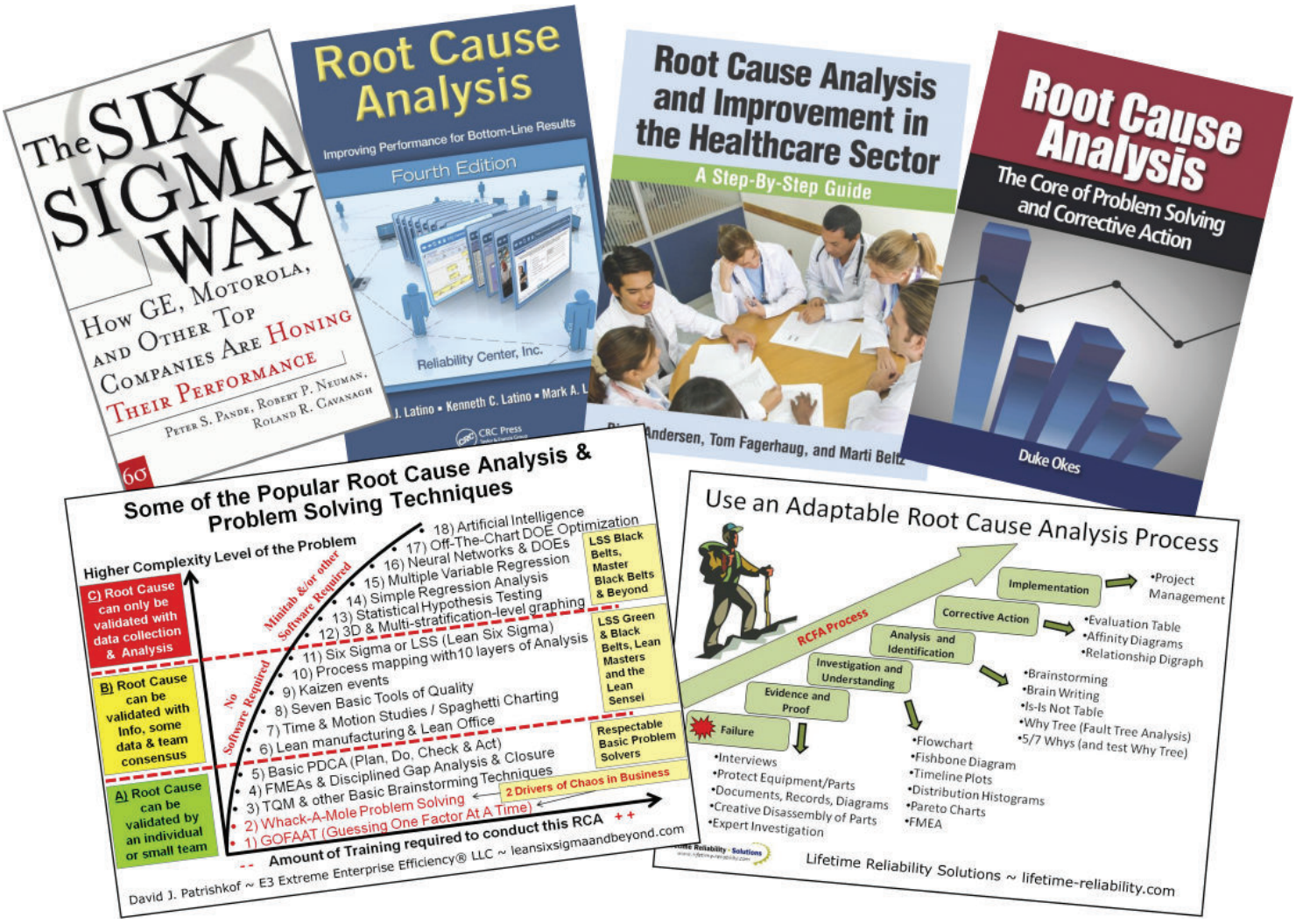
That's why the vertical arrow running from *root causes* to *intermediate causes* is huge compared to the small horizontal arrow running from *low leverage points* to *intermediate causes*. Grasp this point and you can see exactly why popular solutions don't work, no matter how well promoted or managed, and no matter how many clever and "better" variations are tried.

For example, one popular solution is consumer education on the Three Rs of reduce, reuse, and recycle. It's been promoted for decades by thousands of NGOs, magazines, movies like *An Inconvenient Truth*, etc, in countless "better" variations. But this hasn't worked. WHY? Because consumers are bombarded with far more messages to buy more stuff, bigger stuff, better stuff, and so on, in keeping with the modern fallacy of "He who dies with the most toys wins." This stronger message completely overwhelms the relatively puny message of the Three Rs. The result is massive overconsumption and solution failure.

Another example of a superficial solution is corporate social responsibility (CSR). It too has been heavily promoted. The idea is that corporate managers can be convinced they have the moral responsibility to help solve the sustainability problem and that doing so will benefit them as well as other stakeholders. But this too hasn't worked. The CSR message is a weak force compared to the much stronger root cause force of the corporate goal of maximization of short term profits. Until this goal is changed large for-profit corporations will continue to behave unsustainably because that's what they're programmed to do. As Upton Sinclair explained in 1935, "It is difficult to get a man to understand something, when his salary depends upon his not understanding it!"

Environmentalism Can Move Its Solutions to the Fundamental Layer

the same way the business world did: by developing a wrapper for Root Cause Analysis. If it works on business problems it will work on the sustainability problem.



A **wrapper** packages something and thereby makes it more transportable, cohesive, and useful. Root Cause Analysis in its raw form is only a small set of principles. To be applied it needs a wrapper. The business world has designed a number of wrappers for Root Cause Analysis like Six Sigma, Lean Six Sigma, Total Quality Management, Kaizen, and the ISO 9000 family of standards.

Without the right wrapper a process cannot be easily applied. While Root Cause Analysis was invented over a hundred years ago, it was not until 1986 that an easy-to-use wrapper with wide applicability was developed. This was Six Sigma. It's become so popular that "82 of the 100 largest companies in the US have embraced it." (Business Week, June 10, 2007, *Six Sigma: So Yesterday?*)

Root Cause Analysis has never been seriously applied to large-scale social system problems because no wrapper exists for problems of this class. **To fill this gap Thwink.org has developed the System Improvement Process.** Once problem solvers begin using an approach like this and perfect it they will enjoy the same results industry has long achieved, because all problems arise from their root causes.

If you're not working on root causes then you're not working scientifically.

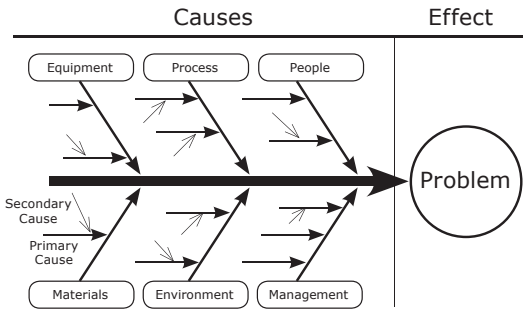
Divide and Conquer

Designing a wrapper for Root Cause Analysis in order to solve the sustainability problem begins with this observation:

Modern environmentalism is trying to solve four major subproblems simultaneously without realizing it—an impossible task. It's like the Wright brothers trying to solve the problem of manned flight without dividing it into many little problems. They didn't fall into that trap. Instead, from 1899 to 1903 they **identified and solved these formidable subproblems:**

1. How to achieve flight control via wing warping.
2. How to design an airfoil with a high lift to drag ratio.
3. How to test aircraft models without the expense and time of flying full size models. (They built their own wind tunnel and used miniature wing models.)
4. How to design a propeller with high efficiency.
5. How to build a lightweight high horsepower motor.

Orville and Wilbur Wright were so good at methodical decomposition that they solved every one of these little problems. **When all were solved so was the one big problem.** It was solved so well that on December 17, 1903 the brothers made four successful flights into a 27 mile per hour headwind. The final flight traveled 852 feet in 59 seconds.



Another example of methodical decomposition into subproblems is the Ishikawa (fishbone) diagram. The "primary cause" is the root cause. Note the six standard subproblems. Ishikawa diagrams have such broad applicability they have become one of the seven basic tools of quality control.

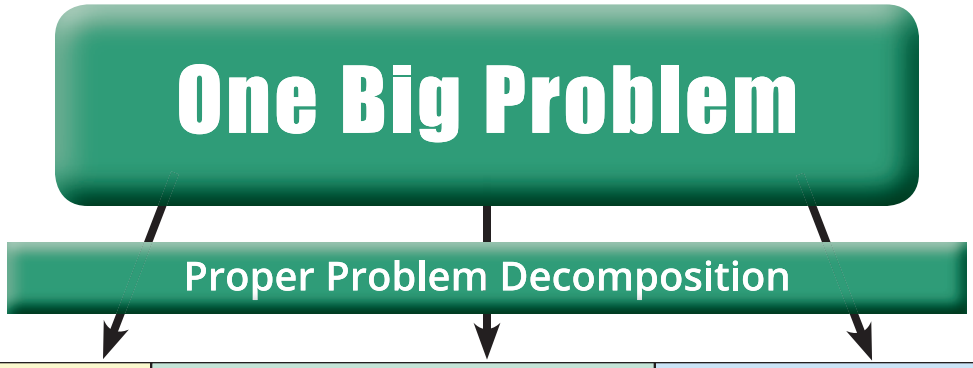
The right decomposition is an ancient strategy we know as

Divide and Conquer.

The System Improvement Process is generic. It first decomposes the one big problem to solve into the three subproblems present in all difficult large-scale social problems. These subproblems may in turn need further division. Once decomposition is complete, Root Cause Analysis is performed on each subproblem.

This works because it allows all the main root causes to be identified and resolved. In one stroke this can change a difficult problem from insolvable to solvable.

It's the same strategy the Wright brothers used. They were trying to fly a plane. We're trying to fly a planet.



Subproblem
How to Overcome Change Resistance

Change resistance is the tendency for something to resist change even when a surprisingly large amount of force is applied. Change resistance is present in all problems that have defied long attempts to solve them. Otherwise the problem would already be solved. Resistance may come from individual social agents, a group (an organization), or the system as a whole. The last is by far the strongest and is known as systemic change resistance.

Subproblem
How to Achieve Proper Coupling

Proper coupling occurs when the behavior of one system affects the behavior of one or more other systems in a desirable manner, using the appropriate feedback loops, so the systems work together in harmony in accordance with design objectives. For example if you never got hungry you would starve to death. You would be improperly coupled to the world around you.

This is normally seen as the only problem to solve because it's the symptoms of this subproblem that attract initial attention.

Subproblem
How to Avoid Excessive Model Drift

A **solution model** is what a social agent, such as a nation, uses to solve its problems. Solution **model drift** occurs when a problem and/or solution evolve away from each other. If excessive drift occurs the solution can no longer solve the problem.

Over the long term this is the most important subproblem. Social systems are always evolving, so a steady stream of new problems is normal. If a nation or planet cannot routinely solve new problems as they appear *and keep past solutions working*, it will eventually be overwhelmed by more unsolved problems than it has the resources to solve.

Above are the standard three subproblems. How they apply to the sustainability problem is discussed below:

The global environmental sustainability problem has resisted all attempts to solve it for over forty years. That effort started on a global basis around 1970, when Earth Day attracted over 20 million participants.

Overcoming change resistance is the crux of the sustainability problem *and must be solved first*. Once resistance is overcome the system will "want" to solve the problem just as much as it doesn't want to solve it now.

A stunning example of change resistance occurred in 1999 when the US Senate voted a shocking 95 to zero against ratifying the Kyoto Protocol. Not a single senator could be persuaded to support the treaty, despite the fact that Al Gore was vice-president at the time.

Analysis discovered that the sustainability problem contains two proper coupling subproblems:

The first is the **economic proper coupling** subproblem. The economic system is improperly coupled to the greater system it lives within: the environment. If it was properly coupled there would be no sustainability problem.

This subproblem is universally seen as the only problem to solve, so that's what popular solutions focus on. But they haven't worked. WHY? Because the one big problem of sustainability is made up of more than just economic proper coupling. It also contains the change resistance, life form proper coupling, and excessive model drift subproblems. *Analysis shows these three subproblem are causing this one.*

The second is the **life form proper coupling** subproblem. The top two life forms in the human system, *Corporatis profitis* and *Homo sapiens*, are improperly coupled. The symptom of this subproblem is that large for-profit corporations are destructively dominating political decisionmaking.

In social systems the goal of the dominant social agent determines the goal of the system. Today *Corporatis profitis* is dominant. Its goal is short term profit maximization. The end result is *the goal of the human system has become short term oriented,* which prevents solution of long term problems.

An example of excessive model drift was the Great Recession of 2008. What drifted was business regulation. So much lax regulation and deregulation occurred that huge amounts of unsustainable debt accumulated. When the bubble popped the recession begin, first in the US and later in Europe and elsewhere.

In the sustainability problem it's the world's overall ability to govern itself effectively that has drifted. As explained on page 14, modern democracy is broken. It's no longer able to solve its biggest problem: global environmental sustainability.

This gives us four subproblems. Like the Wright brothers, the right decomposition has changed the game completely. *Because we have four small tightly focused subproblems, they are orders of magnitude easier to solve.* How the four subproblems were analyzed is shown on the next six pages.

How Do We Operationalize Sustainability?

By wrapping Root Cause Analysis in a process that fits the problem and using the process to drive everything we do.

The four main steps of SIP

The five substeps of system analysis

The three subproblems of the main problem

Develop the Process

1. Problem Definition		The System Improvement Process (SIP)		
Subproblems		**Change Resistance**	**Proper Coupling**	**Model Drift**
2. Analysis Spend about 80% of your time here. The problem solving battle is won or lost in this step, so take the time to get the analysis right.	A	Find the immediate cause of the problem symptoms in terms of the system's dominant feedback loops.		
	B	Find the intermediate causes, low leverage points, and superficial (symptomatic) solutions.		
	C	Find the root causes of why the loops in A are dominant.		
	D	Find the feedback loops that should be dominant to resolve the root causes.		
	E	Find the high leverage points to make those loops go dominant.		
3. Solution Convergence				
4. Implementation				

Apply the Process

Continuous Process Improvement – The foundation of the entire process

SIP is a "fill in the blanks" framework that let's you separate the signal from the noise. The well formulated problem to solve is how to fill in the matrix cells. The basic SIP matrix contains 22 empty cells: 7 for each subproblem plus 1 for overall problem definition. This plus continuous process improvement gives a total of 23 steps, which is about the minimum for this class of problems. The process is generic. SIP was designed from scratch to solve any difficult large-scale social system problem. The process is flexible. Columns, main steps, and substeps can be added or changed as needed. SIP implements the core principles of Root Cause Analysis as listed on page 4.

The purpose of SIP is to help you ask the right scientific questions so you can produce high quality solutions, as defined on page 4. Solution hypotheses follow this format: *"For subproblem F, solution G will resolve root cause I by pushing on high leverage point J in structure K."* Solution hypotheses are generated and tested in Solution Convergence. When testing is complete Implementation begins.

There's an even greater benefit: Use of a formal comprehensive process like SIP allows you to continuously improve the process until it's good enough to solve your problem.

The five substeps of analysis are the heart of SIP. Each subproblem is analyzed to find its root causes and high leverage points. After analysis, steps 3 and 4 are relatively easy because they're based on informed knowledge of how the system will respond to solution policies. Compare that to today. Problems solvers basically don't know how the system will react to a new solution, so they are forced to resort to a long series of trial and error. This is taking too long to solve the sustainability problem.

The five substeps model the causal structure of each subproblem using feedback loops. This is crucial because:

"Positive feedback loops are the most powerful forces in the universe." (John Sterman, *Business Dynamics*, 2000, p268) In dynamic systems like seven billion people living on a single fragile planet, the driving forces are the system's dominant feedback loops at the fundamental level of the problem. Finding those loops requires building models of the relevant structure of the system. Not large complex models, but ones just big enough to capture the essential structure of the dominant feedback loops. This results in models that are understandable to most everyone.

Structure refers to the feedback loop paths that form the "shape" of a system and reveal how it works. Once you can see that structure you have the same power Galileo had after he built his own telescopes. Suddenly he could *see* the structure of the universe, like the four moons of Jupiter and the phases of Venus. His discoveries proved the Copernican system was correct. Yours will help *see* the true structure of the sustainability problem, which will allow solution at last!

These two pages present an overview of the process research program at Thwink.org. Process results are met to serve as an example of what's possible with a method like SIP and should not be interpreted as *the* process, *the* analysis, or *the* solution.

Process Results

Summary of Analysis for Executing the System Improvement Process on the Global Environmental Sustainability Problem

1. Problem Definition		How to achieve global environmental sustainability in terms of the desired system state				
	Subproblems	A. How to Overcome Change Resistance	B. How to Achieve Life Form Proper Coupling	C. How to Avoid Excessive Model Drift	D. How to Achieve Economic Proper Coupling	
2. Analysis	A. Find immediate cause loops: Subproblem symptoms	Successful opposition to passing proposed laws for solving the problem	Large for-profit corporations are destructively dominating political decision making	Failure to correct failing solutions when they first start failing	The economic system is causing unsustainable environmental impact	Superficial Layer
	A. Find immediate cause loops: Improperly coupled systems	Not applicable	Corporate and human life forms	Not applicable	Economic and environmental systems	
	A. Find immediate cause loops: Analysis model	Basic Dueling Loops of the Political Powerplace	Complete Dueling Loops model. This adds the Alignment Growth loop.		The World's Property Management System	
	A. Find immediate cause loops: Immediate cause dominant loops	The Race to the Bottom among Politicians		Intelligent Adaptation loop in evolutionary algorithm model	Growth of Industrial Technology and Limits to Growth (the IPAT factors)	
	B. Find intermediate causes, LLPs, SSs: Intermediate causes	The universal fallacious paradigm, primarily Growth Is Good	Pressure from corporate proxies for business friendly legislation	Laws giving corporations advantages over people	Externalized costs of environmental impact	
	B. Find intermediate causes, LLPs, SSs: Low leverage points	More of the truth: identify it, promote it, magnify it	Logical and emotional appeals and bargaining with corporations	Trying to directly reverse laws that favor corporations	Internalize costs	
	B. Find intermediate causes, LLPs, SSs: Superficial solutions	Technical research, environmental magazines and articles, awareness campaigns, sit-ins, marches, lawsuits, lobbying, etc.	Corporate social responsibility appeals, green investment funds, NGO/corporate alliances, etc.	Use of the media, campaigns, lobbying to get old laws repealed	Main solutions at system level: command and control regulations and market-based mechanisms, like pollution taxes and tradable permits. At agent level main solutions are 3 Rs and collective mgt.	
	C. **Root cause** of why loops in A are dominant	High political deception effectiveness	Mutually exclusive goals between top two social life forms, *Corporatis profitis & Homo sapiens*	Low quality of political decisions	High transaction costs for managing common property sustainably	Fundamental Layer
	D. Names of feedback loops that should be dominant to resolve root cause	You Can't Fool All of the People All of the Time	Goal Alignment Growth		Growth of Sustainable Technology and Impact Reduction	
	E. **High leverage point** to make loops in D go dominant	General ability to detect political deception. This needs to be raised from low to high.	Correctness of goals for artificial life forms. The goal of corporations needs to be changed.	Maturity of the political decision making process. This needs to rise from low to high.	Allow firms to easily be established in order to lower transaction costs for managing common property sustainably	
3. Solution Convergence		Nine solution elements	Corporation 2.0, *Corporatis publicus*	Politician Decision Ratings	Common Property Rights	
4. Implementation		Not yet ready for implementation because process execution is incomplete.				

Continuous Process Improvement

Process development and execution ran from 2003 to 2009. Process results, the process that produced them, and 12 sample solution elements have been written up in a book at Thwink.org. See *Common Property Rights: A Process Driven Approach to Solving the Complete Sustainability Problem*.

This booklet is a high level summary of the ideas in the book. Because these ideas are so novel and complex there's no way this booklet can explain them well, so see the book and Thwink.org for further information.

Apply the Results

Process Results Can Serve As

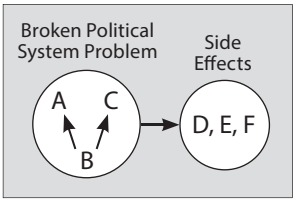
1. A clear example of how you can move your work from the superficial to the fundamental layer.
2. A source of ideas for solutions that resolve specific root causes. The sample solutions may also be used as starting points.
3. A starting point for your own work using Root Cause Analysis.
4. A reference for rough evaluation of the probable effectiveness of alternative solution strategies. (See last page.)
5. An example of how a wrapper like SIP can be the core of a research program's overall architecture, thereby making the research radically more productive. This is exactly what business has long done.
6. The endless complexity of the sustainability problems staggers the mind. *Process results can serve as proof that such a problem can reduced to an integrated set of conclusions that, once understood, make sense at a glance.* Process results all just "click" together. Because they are so cohesive they can be summarized on a single page.

Once your first iteration of the first two main steps is fairly complete you have the big picture of the *complete* problem. The matrix is good for hours of penetrating discussion.

All work on the environmental sustainability problem fits in the matrix. What NOT TO DO fits in superficial solutions. What TO DO fits in the fundamental layer plus continuous process improvement.

The original problem to solve is subproblem D. D is caused by A, B, and C. B is causing A and C, so B's root cause is the deepest cause of the entire sustainability problem.

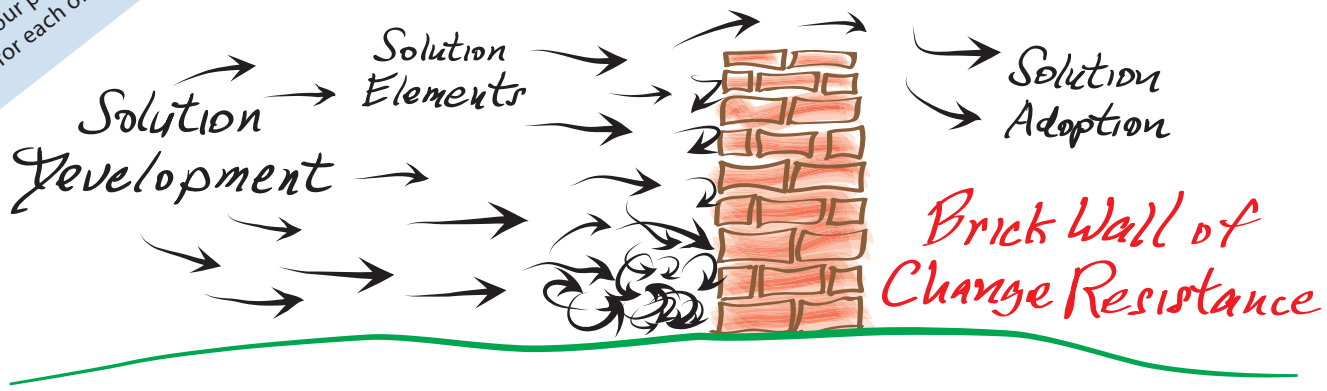
Subproblems A, B, and C make up the **Broken Political System Problem**. Its discovery was the biggest surprise of the analysis. *This is the real problem to solve* because D, environmental unsustainability, is a side effect of this problem. Additional side effect subproblems, E and F for economic and social unsustainability, could be added to the matrix.



These four pages summarize analysis results for each of the four subproblems.

Subproblem A

How to Overcome Change Resistance



Overcoming Change Resistance Is the Crux of the Problem

because we know *what* to do to be sustainable. We're just not doing it.

SUPERFICIAL LAYER

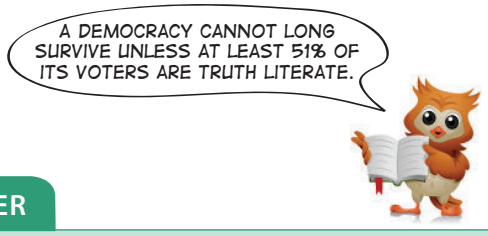
Subproblem Symptoms - Millions of sustainability advocates have promoted solution after solution for decades. But due to **successful opposition to passing proposed laws for solving the problem**, most solutions bounce off a brick wall of change resistance. Only a few are adopted. The rest pile up at the bottom of the wall, perfectly good solutions going unused.

Intermediate Causes - Problem solvers sense the underlying cause centers on **the universal fallacy of Growth Is Good**. Nations, politicians, and business managers all promote maximum economic growth as the highest priority. A rising tide lifts all boats.

Low Leverage Points - If we know what to do but most people aren't doing it, then what to do is obvious: people need **more of the truth** about what to do. Once people know the truth they will make the right decision. So we need to identify the truth (R&D), promote it (media, campaigns, lobbying), and if that doesn't work magnify it with inspiration, exhortation, and bargaining.

Superficial Solutions - **Technical research, environmental magazines and articles, awareness campaigns, sit-ins, marches, lawsuits, lobbying, etc.**

These solutions change one mind at a time.



FUNDAMENTAL LAYER

Root Cause - Root Cause Analysis teaches us to ask WHY until we find the root cause. WHY do so many citizens believe Growth Is Good and nothing else should come first, not even environmental sustainability or quality of life? WHY do they believe so many other fallacies, like climate change is a hoax and a carbon tax would be bad for business? Because of **high political deception effectiveness**. Political attack ads, corporate financed think tanks, "fear, uncertainty, and doubt" (FUD) campaigns, an endless stream of spin, and so on fool the public into supporting the positions of those behind the deception. The Dueling Loops of the Political Powerplace simulation model shows the reason political deception works so well is *The Race to the Bottom among Politicians* feedback loop contains an inherent advantage. Until activists understand this advantage they will remain powerless to counteract it.

High Leverage Point - Raise **general ability to detect political deception** from low to high. After that the average person will be *truth literate* and cannot be fooled. The importance of reading literacy has long been known. In a democracy truth literacy is even more important.

Fundamental Solutions - This subproblem is so crucial that nine sample solution elements have been designed. These are **Freedom from Falsehood, the Truth Test, Politician Truth Ratings, Politician Corruption Ratings, No Servant Secrets, Corporation 2.0 Suffix, Servant Responsibility Ratings, Sustainability Index,** and **Quality of Life Index.**

These solutions change the system.

In social problems, **systemic** means originating from the structure of the system in such a manner as to affect the behavior of most or all social agents of certain types, as opposed to originating from individual agents. *Easy social problems are non-systemic*, so they can be solved by "change one mind at a time" solutions. By contrast, *difficult social problems are systemic* and can be solved only by fundamental solutions that change the system by changing its structure.

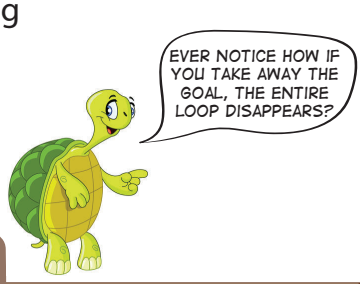
Thus what makes a social problem difficult is presence of *systemic root causes*. Because they're systemic, the root causes can lie anywhere in the deep dark tangled web of feedback loops that form the structure of the system. That makes the correct root causes so difficult to find that problem solvers routinely fall into the *Superficial Solutions Trap*. They falsely assume the intermediate causes are the root causes, which guarantees perpetual solution failure.

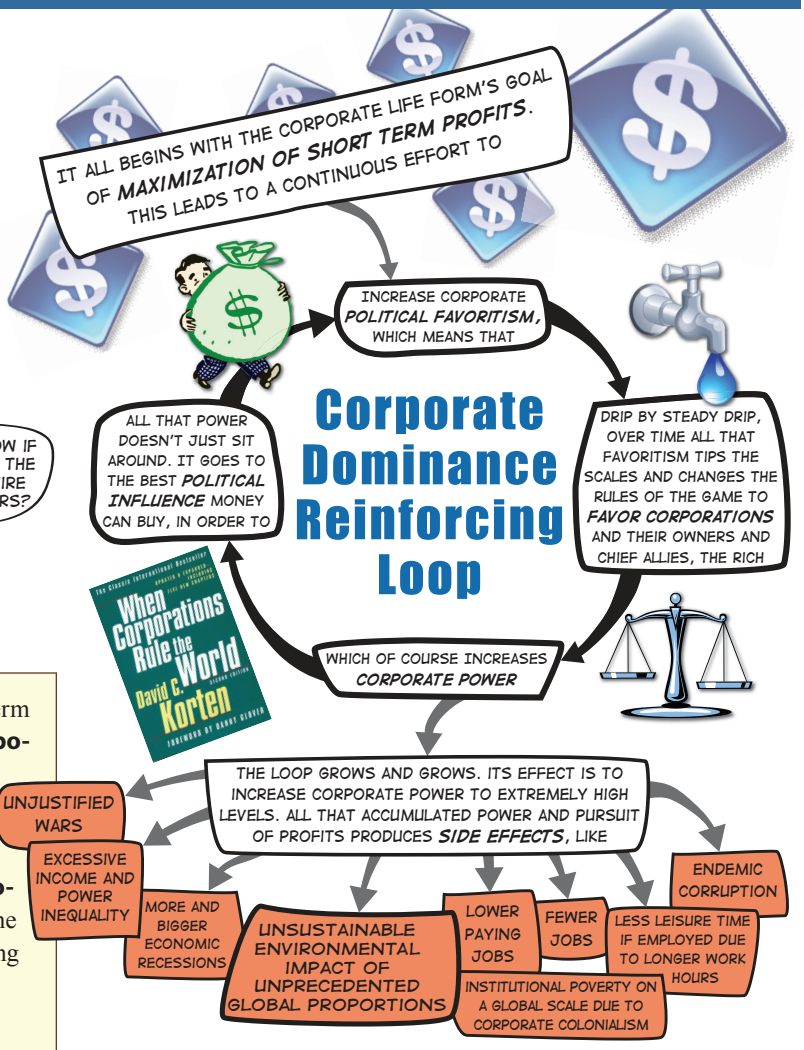
Subproblem B

How to Achieve Life Form Proper Coupling

A Funny Thing Happened on the Way from the Industrial Revolution to the 21st Century.

Corporatis profitis appeared and he's now dominating the system.





SUPERFICIAL LAYER

Subproblem Symptoms - The most ominous short term symptom of the sustainability problem is **large for-profit corporations are destructively dominating political decision making.** That's driving the human system over the cliff of environmental, economic, and social disaster.

Intermediate Causes - Centuries of **pressure from corporate proxies for business friendly legislation** has caused the feedback loop shown to grow to alarming levels, with devastating consequences.

Low Leverage Points - Activists sense the loop is there. They can see all those terrible side effects. So why not try a little more of the truth with **logical and emotional appeals and bargaining with corporations?** That should work.

Superficial Solutions - The exact solutions are things like **corporate social responsibility appeals, green investment funds, NGO/corporate alliances, etc**. Conferences on business sustainability are common. Businesses are invited to world summits, into alliances, and to input on legislation. Books like *When Corporations Rule the World, Unequal Protection: The Rise of Corporate Dominance and the Theft of Human Rights,* and *Global Spin: The Corporate Assault on Environmentalism* are published to awaken the people. And so on.

These solutions change one mind at a time.

FUNDAMENTAL LAYER

Root Cause - Consider the intermediate cause. WHY does all that pressure from corporate proxies exist? Because of **mutually exclusive goals between the top two social life forms, *Corporatis profitis* and *Homo sapiens***. *Corporatis profitis* (large for-profit corporations) has the short term goal of maximization of profits. *Homo sapiens* has the long term goal of optimization of quality of life for those living and their descendents. Each life form is competing for control of the same niche, the biosphere, to achieve their goals. The Competitive Exclusion Principle of ecology states that when two competing life forms attempt to occupy the same niche, only one outcome is possible: one life form will drive out the other. If any members of the other remain, it is only because they have adapted and are now living in a slightly different niche. The principle applies to all kinds of life forms, whether genetic or memetic. In this case *Corporatis profitis* is winning. Most humans have adapted to the role of compliant corporate serf.

High Leverage Point - **Correctness of goals for artificial life forms**.

Fundamental Solutions - Large for-profit corporations and their managers are basically good. *They just have the wrong goal*. For-profit Corporation 1.0, *Corporatis profitis*, needs to be reengineered into non-profit **Corporation 2.0,** *Corporatis publicus*. This life form is designed to serve people rather than itself. Its new role would be a trusted servant whose goal is providing the goods and services needed to optimize quality of life for people in an environmentally, economically, and socially sustainable manner.

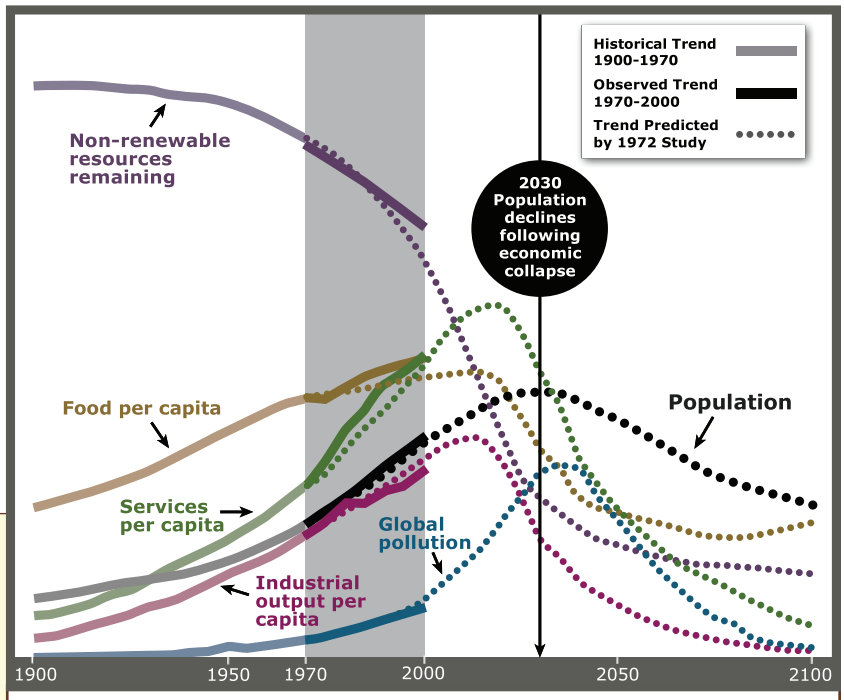
This solution changes the system.

Subproblem C

How to Avoid Excessive Solution Model Drift

It Used to be Democracy Worked.

It worked so well that since the invention of modern democracy in the United States in 1788 and France in 1789, it has swept the world. But it no longer works. Global ecocide appears unstoppable. Democracy is broken.



Source: *Looking Back on the Limits to Growth*, Smithsonian magazine, April 2012. The graph is based on a paper by Graham Turner, which plotted actual data from 1970 to 2000 against projected behavior. The paper concluded that "The analysis shows that thirty years of historical data compares favorably with key features of a business-as-usual scenario, which results in collapse of the global system midway through the 21st century." The historical and predicted trends are from the business-as-usual simulation run graph in *The Limits to Growth*, 1972, page 124. Graph reconstructed by Thwink.org.

SUPERFICIAL LAYER

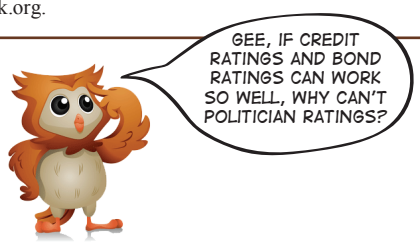
Subproblem Symptoms - *The Limits to Growth* sounded the alarm in 1972 but the human system as a whole, governed mostly by democracy, didn't heed the call. The plotted actual data shows **failure to correct failing solutions when they first start failing** has occurred. Democracy itself has failed. Starting two centuries ago modern democracy gave free market capitalism a home, made the miracle of the Industrial Revolution possible, and steered the world through the perils of two world wars, the depression, and the cold war. It worked then. But now democracy no longer works. Something deep within it is broken.

Intermediate Causes - Many sense that **laws giving corporations advantages over people** is the ultimate cause of these symptoms. Corporate takeover of government, the revolving door, regulatory capture, replacement of the aristocracy with a corporatocracy, one dollar one vote—common use of these terms points to the consensus.

Low Leverage Points - If the problem is laws favoring corporations, then it's obvious we must **directly reverse laws that favor corporations**.

Superficial Solutions - This is done with **use of the media, campaigns, lobbying to get old laws repealed** (like Citizens United and personhood), and so on. This should work because politicians are elected by the people so they should listen to the people. That's how democracy was designed. What the people want, the people will get.

These solutions change one mind at a time.



FUNDAMENTAL LAYER

Root Cause - But despite the rational that democracy *should* work that way, it doesn't. All that effort on the superficial layer hasn't worked. Corporations are on a roll, especially since the Citizens United US Supreme Court decision of 2010 opened the door to corporations spending unlimited amounts of money to influence elections.

WHY is the system letting all those laws giving corporations advantages slip through? WHY is the system favoring corporations when it should instead be favoring citizens? WHY is democracy not working? Because of **low quality of political decisions**. They are so low they are letting corporations run the system instead of citizens. The fox is guarding the hen house, due to bad political decisions.

High Leverage Point - Every bad decision is a defect. Persistent defects always have the same high leverage point: improve the process. Thus we need to raise **maturity of the political decision making process**.

Fundamental Solutions - This process is so poorly engineered it needs a top to bottom overhaul. **Politician Decision Ratings** can do the job. This works by giving people accurate feedback on how well each politician is doing in terms of the quality of his or her decisions. The higher the quality, the higher the rating. Voters will naturally start electing politicians with higher ratings. That in turn will cause politicians to compete among themselves to see who can make better promises while campaigning and better decisions while in office.

This solution changes the system.

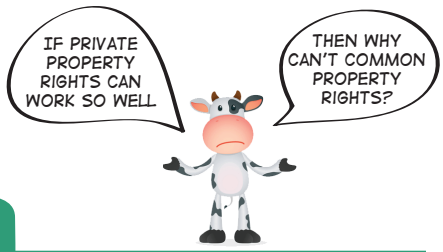
Subproblem D

How to Achieve Economic Proper Coupling

"We have a market failure, indeed the biggest market failure the world has ever seen."

Quote source: *The Economics of Climate Change: The Stern Review*, 2007.

No we don't. It's not a market failure. It's a *barrier to market entry* failure.



SUPERFICIAL LAYER

Subproblem Symptoms - Finally we arrive at what most people consider the only problem to solve: **the economic system is causing unsustainable environmental impact**. But we must remember it's the other three subproblems that are causing this one!

Intermediate Causes - To economists, market failures are always ultimately due to externalized costs. The above quote from the Stern Review reflects the consensus: the cause of not just climate change but the entire sustainability problem is **externalized costs of environmental impact**.

Low Leverage Points - If that's the cause then what to do is obvious: **internalize costs**.

Superficial Solutions - The main solutions at the system level are **command and control regulations and market-based mechanisms**, like pollution taxes and tradable permits. At the agent level the main solutions are the **Three Rs and collective management.** The solutions listed on page 3 are all superficial. The most popular solution of all, sustainable development, promotes Growth Is Good more than sustainability. It's a fine example of successful change resistance.

Command and control regulations and agent level solutions change one mind at a time. Market based mechanisms mostly change one mind at a time because they only *partially* change the system.

FUNDAMENTAL LAYER

Root Cause - WHY are there so many externalized costs? The yellow graph below shows it's because when activists try to solve a problem and thus internalize costs, they fail due to high transaction costs. What's unsustainable is the world's common property, like the air we breath and the water we drink. Therefore the root cause is **high transaction costs for managing common property sustainably**.

High Leverage Point - The world's private property is well managed but its common property is not because firms can easily appear to manage private property. All they have to do is incorporate. But the same does not hold for common property. Therefore the high leverage point is **allow firms to easily appear to lower transaction costs** for managing common property sustainably. They can't do that now because of the *barrier to market entry* caused by high transaction costs.

Fundamental Solutions - Like the way the world's existing system of Private Property Rights allows traditional corporations to appear to manage private property, **Common Property Rights** allows stewardship corporations to appear to manage common property. Stewards incorporate, file claims on common property needing sustainable management, and then manage those claims through the power of the market with fees and buys. Stewards don't own common property. They own the right to manage it for the common good.

This solution changes the system.

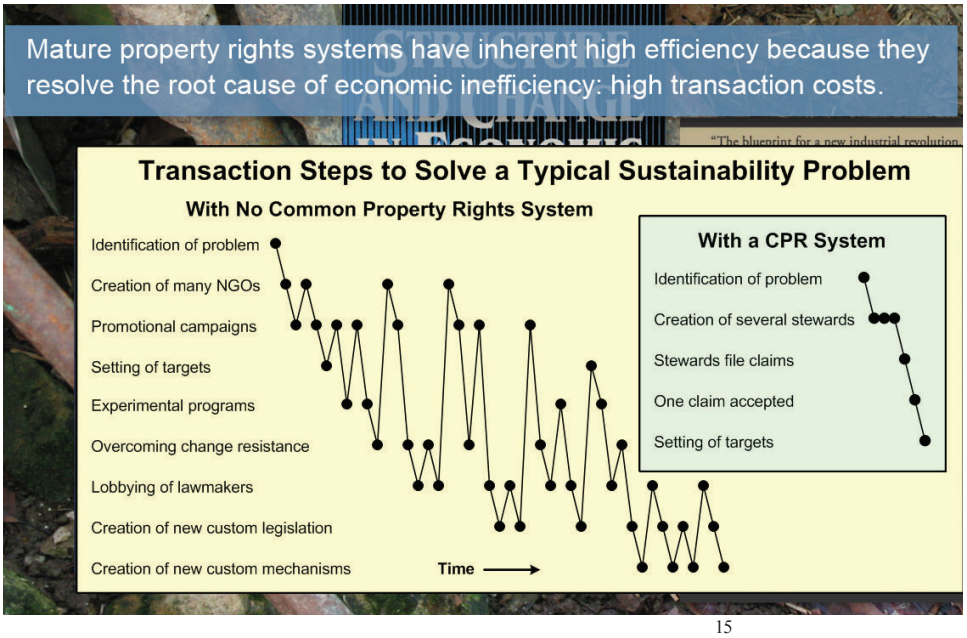


Image source: *Introduction to Common Property Rights*, video 1, from Thwink.org. The yellow graph plots an example of the mind boggling number of steps required to solve a typical problem. These steps are so many, so expensive, and take so long they explain why high transaction costs are preventing routine solution of sustainability problems.

The green graph plots what would happen under Common Property Rights. This would have such low transaction costs that sustainable management of common property would work, because it's now affordable.

Transaction costs are the costs of arriving at a buying and selling decision so a market transaction can occur. Examples are the costs of persuasion, bargaining, fees, contracts, and finding desirable sources. **Externalized costs** are costs borne by others who are not part of a market transaction, such as the health costs of pollution.

How Conventional Solutions Fit into the SIP Analysis

They all fit somewhere, into one of the four subproblems and then into the superficial or fundamental layer.

	Subproblems	A. How to Overcome Change Resistance	B. How to Achieve Life Form Proper Coupling	C. How to Avoid Excessive Model Drift	D. How to Achieve Economic Proper Coupling
Superficial Layer	**Low Leverage Point**	More of the truth: identify it, promote it, magnify it	Logical and emotional appeals and bargaining with corporations	Trying to directly reverse laws that favor corporations	Internalize costs of environmental impact
	Superficial Solutions These usually fail for difficult problems because the solutions attempt (in vain) to resolve intermediate causes.	This subproblem is seen as minor and treated as an afterthought so little work occurs here. Solution examples are magazines, educational campaigns, stakeholder involvement, and efforts "to effectively communicate the story of the good work we do and more importantly, the impact it has made." [1]	A small amount of work occurs here, like corporate social responsibility appeals and NGO/corporate alliances.	An extremely small amount of work occurs here, like lobbying to repeal laws that overly favor large for-profit corporations.	This subproblem is universally seen as THE problem to solve, so the vast majority of the work by the world's EPAs, NGOs, scholars, and scientists occurs here. Main solutions are regulations, market based solutions, the Three Rs, and collective management.
Fundamental Layer	**High Leverage Point**	General ability of citizens to detect political deception. This needs to be raised from low to high.	Correctness of goals for artificial life forms	Maturity of the political decision making process	Allow firms to easily appear to lower transaction costs for managing common property
	Fundamental Solutions These will work if the analysis is correct because the solutions will resolve specific root causes.	Examples of intuitively trying to push on this high leverage point are FactCheck.org, PolitiFact.com, and the growing "fact checking" we see in the news. "We do have evidence that we're making voters harder to fool — and that's our real mission." [2]	An example of intuitively trying to work here is the work of Corporation 20/20. This tries to redesign corporations "to serve the public interest." [3]	We've detected no significant work here, though there must be some.	There have been some attempts to reach this level, like Common Assets Trusts and collective management. But these solutions are not based on Root Cause Analysis so they are low leverage compared to Common Property Rights. [4]

The point of this table is to show why conventional solutions are not working. It's because they're not targeted toward resolving specific root causes. This flaw cannot be corrected by any amount of solution tweaking or cleverness.

In difficult social problems, root causes generate forces as real and as strong as gravity. Mere mortals can tame these forces only by pushing on high leverage points.

A **high leverage point** is a place in the structure of a system that when pushed on by solution elements resolves a connected root cause. Like all dynamic systems, social systems are attracted to modes of equilibrium (the basins of attraction phenomenon). Once the causal structure of a social problem at the fundamental level is known, the structure may be reengineered so that a new mode is more attractive. In that new mode the system "wants" to solve the problem. This is how SIP resolves root causes.

Pinpoint knowledge of a problem's low and high leverage points allows quick evaluation of solution candidates. The right solutions applied at the right *high* leverage points will tip the system into a new mode, *because the solutions have changed the system.*

Nearly all of today's solution work lives on the superficial layer. Due to lack of Root Cause Analysis any work on the fundamental layer occurs *intuitively*, so it's not focused on specific root causes and is largely ineffective. But change is in the air. Environmentalists are weary of decades of winning little battles but losing the war. Activists sense that they must go deeper and *strike at the root.* Solutions are spontaneously evolving toward more work on the fundamental layer. Imagine how much more effective that work will be once it's informed by Root Cause Analysis.

Which layer do your solutions live on?

1 – Quote from *The Path Forward*, Paul Anastas, March 4, 2010, US EPA Office of R&D, www.epa.gov/ORD/htm/anastas/path-forward.htm.

2 - Quoting Brooks Jackson, director of FactCheck.org, in *Fact-checking makes voters 'harder to fool'?*, Erik Wemple, The Washington Post, November 7, 2012.

3 – Quote from http://www.corporation2020.org.

4 – Common Property Rights (CPR) is a comprehensive system for managing the world's common property sustainably. CPR is a solution element developed by Thwink.org to resolve the root cause of economic improper coupling. When compared to CPR the Vermont Common Assets Trust lacks stewards, claims, and commitment of 100% of fees to buys, while collective management lacks enabling legislation, claims, and a standard efficient approach to fees and buys.

Thwink.org is a small independent "thwink" tank founded in 2001. Our focus is analyzing how to solve the global environmental sustainability problem as a whole using the most effective methods available, particularly those from the business world. This line of attack has led to some novel and perhaps penetrating results. These consist of: (1) A formal problem solving process for applying Root Cause Analysis to the sustainability problem, (2) Our analysis findings, which are extensive, and (3) Our flagship solution element of Common Property Rights.

This booklet is the best overall introduction to the core of our work. The front cover shows a prop we use during meetings to explain how Root Cause Analysis can work on the sustainability problem. The prop is small boards linked together with carabiners. The links form a causal chain. The group of three boards (symptoms, causes, and solutions) represents conventional approaches, which are solutions oriented and relatively simple. The other eleven boards illustrate the Thwink approach, which is Root Cause Analysis and process oriented. Approaches like this are analytically complete and thus far more likely to solve the problem.

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THERE ARE A THOUSAND HACKING AT THE BRANCHES OF EVIL TO ONE WHO IS STRIKING AT THE ROOT.

Henry David Thoreau, *Walden*, 1854