Thomas Edison famously claimed that “Genius is one percent inspiration and ninety-nine percent perspiration.” What was he really saying? Perhaps we can find out from this popular urban legend:  

There’s the old tale of the ocean liner engine that broke down. The ship’s owner called in one expert after another, but none of them could fix the problem. Finally, they tried an old tinkerer who knew everything there was to know about ship’s engines, especially big, old, cranky steam engines. He brought in a great big bagful of tools, plopped them down, and began inspecting the engine from top to bottom, climbing all over it. He was, however, dead silent as he worked. The minutes ticked by. Eventually, after several hours he reached inside his bag, pulled out a hammer, and gently tapped the engine somewhere. The engine instantly roared into life.

A week later the old man sent the ship’s owners a bill for ten thousand dollars. The owners were so upset they demanded an itemized bill. Another week went by and the itemized bill arrived in the mail. Here’s what it said: “Tapping with a hammer, 2 dollars. Knowing where to tap, 9,998 dollars.”

Being the creator of the world’s first invention factory, inventor of the telephone, phonograph, and the first long lasting light bulb, and holder of 1,093 US patents, Edison knew where to tap. For an explanation of how he knew where to tap, let’s turn to this extract from Working at Inventing: Thomas A. Edison and the Menlo Park Experience, William Pretzer, 1992, p84: (italics added)

As Edison succinctly characterized this process [of inventing the telephone] in 1878, “I had to create new things and overcome many obscure defects in applying my principle.” As this quote suggests, invention may be seen as involving two elements similar to what Edison called his “principle” and “new things.”

First, an inventor has a principle or mental model of how he or she thinks his or her creation should work. Second, an inventor uses “things” or devices to express his or her mental model in physical terms, and these devices will be called building blocks.

In this way, the act of invention may be seen as the interplay of mental models and building blocks. In developing something new, an inventor may begin with a mental model. This model incorporates a general idea of how a
device might work and an awareness of its potential significance. By manip-
ulating and experimenting with a selection of building blocks, an inven-
tor explores variations and changes. Eventually, insights from the building
blocks may lead an inventor to modify his or her mental model. An inven-
tion may be complete when an inventor feels the fit between the mental
model and the building blocks device is close….

In the case of the telephone, the \textit{mental model} Edison used was the
\textit{principle} of variable resistance.

For the purpose of this book, the key takeaway here is “invention may be seen as
involving two elements:” mental models of a key principle and physical building
blocks to actualize the mental models. That was Edison’s unifying insight. It worked
so well it drove everything he did.

What can we do with that idea? This book has presented a comprehensive meth-
od for analyzing and solving difficult large-scale social problems. How can we take
that concept up to the next level and use it to birth a new field of engineering that can
broadly apply and improve this concept?

We don’t know for sure, but we suspect it can be done by doing what Thomas
Edison did. He invented the invention factory, aka the world’s first industrial re-
search laboratory. We can invent the new field of Social System Evolutionary Engi-
neering (SSEE) or \textit{evoengineering} for short. “Ecoengineering” stands for
engineering ecosystems. “Evoengineering” stands for engineering social systems by
applying \textit{evolutionary nudges}, which are carefully designed pushes on high lev-
verage points. Let’s explain.\textsuperscript{167}

\section*{How new fields of science are born}

All successful fields of science have, at their core, a small number of \textit{produc-
tive unifying principles} (PUPs) that drive production of everything else. If the
starting set of PUPs are productive enough, a newly born field will discover the rest
of what it needs as the natural result of thoughtfully applying the initial PUPs or
puppies, as they can more affectionately be called. We need the right puppies!

The starting set of PUPs is the \textit{critical mass foundation} necessary for the
successful birth of a new field. \textit{Our goal is to create the critical mass foundation for
the new field of evoengineering}. Insights on how to do that can be gleaned from ex-
anmination of how new fields of science are born. Simplifying only a little, we can
discern the PUPs in the five fields listed below.

1. \textit{Biology} began in earnest with the evolutionary algorithm and later added cell
theory and the structure and role of DNA. These intertwined concepts form a
single PUP, which spawned the further fields of ecology, genetic engineering,
and so on.
2. **Physics** has Newton’s three laws of motion and the universal law of gravity. In the *Principia*, Newton used these laws to create a single starting PUP, from which the rest of the book derived further principles and for the first time explained many important phenomena, including marine tides, why the earth is shaped the way it is (it’s not a perfect sphere), and derivation of Kepler’s laws of planetary motion.

3. **Chemistry** has molecular and atomic structure, plus the Periodic Table. Here the first two concepts are the building blocks and the third concept is the PUP.

4. **Ecology** has the building block concepts of species and niches. To this is added the PUP that all species live in an ecological niche. Everything else grows from there, such as many species and niches form an ecosystem.

5. **Geometry** has the 5 postulates, 5 common notions, and 23 definitions of Euclid’s *Elements*. The book presented these items first and all else followed, using a long series of proofs. Euclid’s PUP was the principle that all of geometry can be deduced from a small number of starting axioms.

Note the small number of components (3 or 4) in all but geometry. But even that field has only 3 groups plus 1 PUP.

**A possible PUP for Social System Evolutionary Engineering (SSEE)**

Since 2001 the Thwink research has been resolutely closing in on the formidable task of how to solve the global sustainability problem. Recently, in 2018 and 2019, our core research team has grown. So have our insights as a team. It now appears that we have enough accumulated insights to propose a possible starting PUP for SSEE.

Following in the pattern set by the birth of other new fields, the work presented in this book suggests that our very young PUP looks like this:

The **three laws of social systems** are:

1. The behavior of interest in a social system is driven by a small number of root cause forces. We estimate “small” to mean 1 to 5.

2. Root cause forces can only be correctly identified by root cause analysis, using a wrapper like the System Improvement Process.

3. Social systems are not designed. They evolve.

These laws form our initial building blocks. From them follows a single PUP, the **principle of evolutionary nudges**:
The best way to analytically “solve” difficult large-scale social problems (or to engineer large-scale social systems in general) is by identification of the root cause forces involved, followed by use of that knowledge to design the appropriate evolutionary nudges. If these nudges arise from deep glass box analysis from a Systems Engineering viewpoint, the result is SSEE.

An **evolutionary nudge** is a carefully designed push on a high leverage point for the purpose of resolving a connected root cause. We expect that sometimes one **evonudge** will be enough, but more often a long series of evonudges will be required to gently and precisely steer a system in the desired direction.

We use the term **evonudge** rather than **nudge**, since **nudge** is a behavioral economics term meaning “positive reinforcement and indirect suggestions as ways to influence the behavior and decision making of groups or individuals. Nudging contrasts with other ways to achieve compliance, such as education, legislation or enforcement.”

Note the third law, “Social systems are not designed. They evolve.” Unlike the other two laws this one was not explained earlier in this book, so let’s explain it here.

The reason social systems can’t be designed is high complexity and sensitive starting conditions. A striking example occurred in the year 1800 when the Industrial Revolution was just beginning. How could anyone have designed the system that emerged two hundred years later, not to mention the thousands of intermediate steps along that path, each of which also needs to be designed? That’s an impossible task. The global human system is so sensitive to starting conditions that tiny changes at one time point lead to enormous, unpredictable changes later. As time goes by, these changes evolve still further and interact. Then end result becomes totally unpredictable over a long period of time.

As another example, consider weather prediction. No matter how much information they have been able to collect, weather forecasters have hit a wall. They are unable to produce accurate forecasts beyond about 7 to 10 days. After that the best they can do is resort to using previous years data, such as “This fall will be about like last fall, adjusted for the El Nino effect.”

An outstanding example of an evonudge was invention of modern democracy, first in the US Constitution of 1787, followed by the French Declaration of the Rights of Man and of the Citizen of 1789. While this evonudge was intuitively designed instead of engineered, it worked. The system evolved away from autocracy and toward democracy, though that evolution is backsliding recently.

Social systems, like weather systems and forms of government, evolve. But that doesn’t mean we can’t influence the evolution of social systems. All that’s required is the right information about how a system would respond to pushing on its high leverage points. That’s how captains steer giant ocean liners. They gently push the
steering wheel this way and that, to steer toward their preferred destination. Lately this has become automated.

Likewise, once we understand a social system problem as well as we understand an ocean liner, we will be able to steer the evolution of that system towards its preferred destination. And once we’ve perfected that ability, we can automate it. This last step, automated solution management, solves one of the problems present in all difficult large-scale social problems: How to avoid excessive solution model drift.

Will what we have proposed here work? We don’t yet know. It’s an untested hypothesis. But it does give us a central strategy, a central productive unifying insight, to focus and guide all our work forward to success.

We close with what we hope the new young PUP of SSEE and the body of work described in this book will lead to. What we are about to describe should not come as a surprise. It’s the logical outcome of what the book has covered so far.

The tantalizing potential of a permanent Race to the Top

Allow us to share an important observation. The dueling loops structure is generic. It applies to many problems, not just environmental sustainability. Thus, the successful exploitation of the Race to the Bottom by the modern corporation and its allies is the fundamental reason progressive activists are encountering such strong resistance in achieving their objectives. If progressive philosophy is defined as promotion of the objective truth for the good of all, then progressives (no matter what party they belong to) are rationalists at heart, and thus eschew falsehood and favoritism in its many forms. Progressives may not realize it, but their central strategy is the high road of winning the Race to the Top.

The chapter on Politician Decision Ratings explained how creating the right feedback loops can dramatically improve the quality of group decision making at all levels of politics. The system will now have automatic accountability. Imagine what the beneficial effects might be. And imagine what problems would already be solved if Politician Decision Ratings already existed.

Decision ratings would cause a sea change in the way bills are developed. High ratings would require sound analysis of the causes of a problem, deep understanding of how people and systems behave, a thorough look at all reasonable alternatives, lots of synthesis to create new ideas, a method of picking the best solution path, and techniques to prove that all this is correct and not just highly plausible. Undue personal bias would not be allowed. This of course is exactly how successful corporations have worked for a long time.

If you are a politician and your government is making less than excellent decisions, then the most important item on your agenda should be to help create something like Politician Decision Ratings. Or this short sketch may give you even better ideas. Start simple. For example, start with only the most important bills, only one
legislative body, and only a few key objectives. Consider passing this deceptively short new law:

Congress shall install a formal decision-making process on itself that, in its first iteration, follows the process map for The Political Decision Making Process. The process shall include, as its topmost and permanent sacrosanct objective, optimizing quality of life for all living people and their descendants.

Once this deep structural change is made, democracy will have the foundation it needs to achieve what has never been possible but has long been dreamed of.

In 380 BC Plato conveyed an indelible vision of what was possible in *The Republic*, where he examined whether or not the just man is happier than the unjust man, and proposed a peaceful, beneficial-to-all society ruled by philosopher-kings and guardians. *The Republic* used the ancient device of dramatic philosophical dialog, with Socrates questioning the arguments of others to make a point. The most famous of these was the *Allegory of the Cave*, where:

Plato imagines a group of people who have lived chained in a cave all of their lives, facing a blank wall. The people watch shadows projected on the wall by things passing in front of a fire behind them, and begin to ascribe forms to these shadows. According to Plato, the shadows are as close as the prisoners get to seeing reality. He then explains how the philosopher is like a prisoner who is freed from the cave and comes to understand that the
shadows on the wall are not constitutive of reality at all, as he can perceive the true form of reality rather than the mere shadows seen by the prisoners.

In 1516 Sir Thomas More revived Plato’s dream in *Of the Best State of a Republic, and of the New Island Utopia*. More’s world had few laws, no lawyers, and tolerance of all religions, as well as satirical and symbolic elements. The book contrasted what was desirable and possible with what was happening in Europe at the time.

In 1888 Edward Bellamy kept the dream alive with *Looking Backward: 2000-1887*. According to the forward in a later edition, “It is one of the few books ever published that created almost immediately on its appearance a political mass movement.” Interestingly, a major point was the dangers of the stock market.

These works had one central theme in common: a well-formed vision of a good world, one abundantly filled with examples of quality of life. Starkly missing were the evils that plagued people’s lives, like bad rulers, war, poverty, famine, pestilence, crime, greed, and endemic corruption. These good worlds never dipped into evil. They were always basketfuls of near perfect goodness, which seemed perpetual.

Can it be done in the real world? Is it possible to engineer the right evonudges necessary to evolve society to a good world and keep it there perpetually, even if we don’t know exactly what the outcome will look like?

If the right new feedback loops can be installed, why not?

Hidden deep in the system’s structure is the loop whose dominance matters most. It’s the second one added to the Dueling Loops model: **The Race to the Top among Politicians**. This is the loop of goodness. It’s the loop each of the best-of-all-possible-worlds writers was fantasizing about without consciously knowing it. The loop explains why their plots centered on good and bad rulers. Rulers are politicians. What each writer was actually describing was what might happen to a human system if a political Race to the Top became dominant and stayed that way. They were all essentially describing what a permanent Race to the Top would look and feel like. Their dream, our dream, and I hope your dream, is for this universal dream to soon come true.

For that to happen requires something like the four pushes (evonudges) presented earlier. One of those pushes must install something like Politician Decision Ratings. Perhaps the short new law described above will be part of that change.

Each nation has thousands of laws already. But this one is totally different. As short as it is, it will quickly be seen as the most important law of all, because it maximizes the chance of achieving all the others over the long term. Let’s repeat the law here:

> Congress shall install a formal decision-making process on itself that, in its first iteration, follows the process map for The Political Decision Making Process. The process shall include, as its topmost and permanent sacrosanct objective, optimizing quality of life for all living people and their descendants.
The last words in that carefully designed new law are “and their descendants.” Those three words are the ones that historians, ten thousand years from now, are going to thank us for the most.

Is all this too good to be true? We think not, because unlike the other visions of a better world, this one is based on the tried-and-true tools of root cause analysis, process driven problem solving, model based analysis, and above all, sound engineering.
Chapter 23. Moving Forward with Evolutionary Nudges

The story of tapping with a hammer is widely available on the internet. I’ve read several versions of it and am unable to find the one I based this version on. That’s the way it is with urban legends.

The concept of birthing the new field of Social System Evolutionary Engineering arose in a two-day work session with Montserrat Koloffon, Michael Hoefer, and Jack Harich on March 2 and 3, 2019 in Atlanta. The chief insight from the weekend was the principle that “Social systems are not designed. They evolve.”

