Compression and Compression Thinking

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Compression is the art and science of maintaining quality of life while consuming far fewer natural resources doing it. That's a very different concept of economics from those prevailing today. Business analyses and perhaps our human instincts are to grow – to expand – so everyone has a bigger piece of pie, especially me.

As we shall see, the countermeasures for our situation entail Compression Thinking, changing how we think from expansion to coping with Compression. While this may be necessary, most of us like our comfort zones, and see no reason to change thinking. Our optimism bias is to keep working harder as we do now, and surely the economy will take off again. And it might, a time or two, but not forever, and for many reasons.

Common definitions of "compression" include squeezing anything mechanical, compacting redundancy out of data, and cramming for a test. It's an apt analogy to describe both our impending global situation and proposing what we can do about it:

- Population growth leads to densely packed populations to feed, clothe, and shelter.
- Squeezed resources; earth is a finite planet. Its resources are also finite, even if their limits cannot precisely be known.
- Compress unnecessary activity (waste) out of all work processes, eliminating everything unnecessary for the purpose.
- Compress resource footprints for all human activity.
- *Compress work organizations' learning cycles: Complexity is increasing, so we must collectively learn more, integrate the learning, and put it into action faster.*

The last bullet point is italicized because dealing with a difficult situation is seldom pleasant. Documenting a doomsday scenario is much easier than actually doing anything: First we must convince ourselves that we should. Second we have to learn what to do, and keep learning. Third we have to substantially change how we look at the world. Fourth we have to change our habitual actions. Anyone designing an election campaign would quickly rate the probabilities of this as near zero, but lets try anyway. Once people regard new goals as important, they are capable of amazing accomplishments.

The Case: Why We Need Compression Thinking

The case for Compression rests on no single, clinching thread of evidence. That for practical purposes the world is finite should be self-evident, yet optimistic bias in the simplest of financial formulas for compound interest presumes growth; perhaps unending growth. Presuming that a higher price will bring a greater quantity to market assumes that more can be had – somewhere, somehow. But if no more can be had at any price, a market in any conventional sense no longer is possible. That is, recognition that we live in a physically finite world turns many of our rules of economics, and for living, upside down.

We're not in that kind of world yet, and may not be for years, but humans keep globally consuming more resources at a faster rate. Humans do not change quickly, and unless we begin to act, the consequences of this will be on us before we learn to cope. Why?
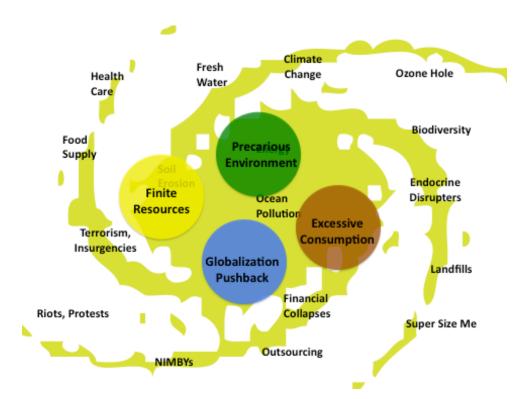
Figure 1. **More Global Issues Than a Single Mind can Absorb in Detail**

In Figure 1 the scattering of issue headlines on a fractal image is intended to crudely illustrate that all these issues interrelate. Exactly how things will play out is not precisely predictable. These issues have been classified in four headings in the four colored balls.

1. Finite Resources: Evidence is that at the present rate of growth in their use, we are near peak extraction for many sources of energy and materials. Peak oil has had the most attention. No one knows whether we are at peak oil now, or within another decade or so, but it does not have an infinite horizon. Peak does not mean that we run completely out. It means that we can no longer extract at an increasing rate. After hitting peak, the annual draw of any virgin material cannot support continued growth in its use. Indeed, assuming two percent annual growth in use, even iron ore will hit a peak within 50 years.

    Another key to understanding the nature of shortage is yield on energy. After rich natural sources of materials are worked out, subsequent ones are more dispersed, so it takes more energy and technology to get them. That is, it takes more energy

to obtain energy. This is obvious today in the deep drilling for oil, hydrofracking for natural gas, and so on.

The same is true of minerals; they take energy to obtain. Basic physics: the more dispersed any source is, the more energy it takes to concentrate it into useable form. Improved technology can improve this return, but it cannot beat nature's basic physics. And all known sources of fossil fuel alternatives have energy yields far below the 100/1 or higher of the first Spindletop oil gusher.

Water is another impending shortage, water we can use, that is. Fresh water is scarce in many places around the world. The Colorado is not the only river nearly tapped out. How climate may affect this is not precisely predictable, but in most places we can use water far more frugally and still maintain quality of life. But we may not able to maintain lush golf courses in the middle of deserts. And to maintain supplies of fresh water, we had best be careful with toxins. Don't dump them in rivers or pump them into the ground to contaminate water tables.

2. <u>Precarious Environment</u>: While it's always possible that a sudden tipping point could dramatically wreak environmental Armageddon, so far a steady diet of human abuses has only made nature's balance ever more precarious. Even environmentalists cannot keep up with all the threats in detail. Dig into a few, and unknowns are of more concern than the problems already mapped. One reason is delayed effects. For example, the slow build up of dioxins in tissue was not discovered until well after they were widely dispersed (as from incinerators), which made large-scale remediation much more disruptive.

An illustrative issue now is the size of the Pacific Gyre garbage patch, and whether the tiny subsurface plastic particles that constitute nearly all of it contain plasticizers that are endocrine disruptors adversely affecting sea life. Several unknowns factor into clarifying this possibility: how much stuff is out there, what is in it, and will it seriously affect sea life or the carbon cycle? This will take a while. In the meantime, skeptics want to see evidence no one can ignore to believe that a patch "bigger than Texas" even exists. Debates on this are now limited to "crying wolf" arguments vs. "boiling frog" arguments. Without resolving every detail, however, one course of action is possible. Stop growing the garbage patch. Whatever problems it contains, why keep making them bigger?

The media cannot front-page many old issues that are still with us; like the ozone hole, or dead zones at the mouths of rivers. When not kept in consciousness, and when consequences appear in places far removed in time and distance from potential causes, both problem solving and remedial action are delayed.

Of all these concerns, ocean acidification and the carbon cycle are two with catastrophic potential. About half of all atmospheric oxygen is from the ocean, and here also, too much knowledge remains "gray box." However, it is known that acidification damages coral reefs and inhibits calcification of zooplankton. Seriously depleting the activity of all oceanic plankton would not only disrupt the food chain at the bottom, but could start shutting down our own supply of oxygen.

Without the related uncertainties of climate change, plenty of evidence suggests how human activity could nudge the global ecosphere out of a Goldilocks zone. By conventional wait and see thinking, we will take little preventive action, and waiting for scientific investigations to be conclusive is like experimenting with the fuse of a bomb while sitting on it. We'll never be able to foresee every unintended consequence coming. However, we can keep our problems to a minimum by making them smaller. Just produce and use a lot less stuff.

3. Overconsumption: The mere existence of a global population of 9-10 billion people might not overtax the resources of the planet, but living in the industrial society style to which are accustomed will. We use too much.

    All industrial economies have high consumption rates, but the United States remains the world's consumption champion. On average, Americans drink 50 gallons of cola per year. We burn more than our body weight in petroleum every week. While we may not think that we consume much, everybody has seen such numbers, plus health warnings about obesity and sedentary living, all suggesting that we consume more than is good for us. Nonetheless, cutting back is hard when the companies persuading us to buy don't want us to cut back either.

    Measured by GNP, mining, agriculture, and manufacturing are small parts of the economy. The lion's share of it consumes. Governments consume resources. Service companies consume resources internally, and most of them encourage their customers to consume more and more besides.

    However, the growth of our trash trails has slowed. During the last decade American solid waste leveled off at about 4.5 pounds per capita daily. Because of recycling and incineration, only about half of it goes to landfill, but total solid waste still grew 6 percent during the decade, equal to the increase in population. Waste disposal has stabilized, but it remains a big, messy problem.

    Industrialized regions having less than 20 percent of the world's population burns about 75 percent of the world's energy. The remaining 80 percent of the global population can better use what is available to them, but can't be expected to reduce the use of resources that they are barely using now. It's pretty clear from whence the heaviest cuts and greatest imagination must come, but industrial societies can also apply more advanced technology to these goals.

    Were there no real shortages, why anyone would want to use resources just to be using them makes no sense.

4. Pushback: Environmentalists push back on wasteful commercialization, some quietly and some noisily, but when personally pushed, others squawk too. Almost anyone whose property or mode of living is degraded by grubbing for resources is apt to affiliate with a NIMBY (not-in-my-backyard) movement, even if a project has a purpose like alternative fuels. Most of us like the benefits of an industrial society. Few of us like to absorb its costs in our pocketbooks. Some of us don't like its costs to nature either.

Much pushback is an exacerbation of age-old resentments fueled to flash point by shortages. For example, "Arab Spring" uprisings began where food costs were high and water short. Tunisian and Algerian unrest began with food riots. If shortages are long-term, not temporary price spikes, whether new governments can deal with this is questionable. (Food riots factored into the French Revolution. Louis XVI could not repress hungry peasants for decades, but some governments do; North Korea is a case in point.)

When doomsday possibilities remain abstract concepts, they are hard to concentrate on. If they begin to affect us personally, human reactions shift rapidly, but then we have little time to grasp Compression in a holistic way. Doing that easily meanders off into economics, business, philosophy, psychology, and a few other topics. Trying to do this while people are still civil is a noble objective, if a bit of a stretch. For most action-oriented executives the first challenge is just taking breaks to personally give thought to a long-term future.

5. Complexity. Almost everything in business is more complex than 50 years ago: taxes, regulations, international competition, financial systems, software… An all-mechanical car became a rolling network of computers. Anyone using all the burgeoning social networking channels available has no time to do anything else. Add the earth's problems to this mix, and complexity overwhelms us.

What we have done is concoct a great deal of human system complexity in addition to that which nature serves up to us. Uncertainty about the future is probably the most confounding aspect of this complexity. Executives keep looking for the "new normal," meaning a different stable state from which they can resume conduct of business in a predictable way. But suppose that never happens? Worse, suppose that, given our mindsets today, the business world will never again be simpler than it is right now. Then the only way to find a "new normal" is to create it ourselves by looking at our situation differently.

Compression Thinking

Since the world is obviously finite, expecting to use more and more resources forever is unreasonable. Even if a breakthrough like solar power lets us maintain a high level of energy consumption, always expecting to use more and more of it, or to consume more and more other virgin resources indefinitely makes no sense. However, that is exactly what the simplest of formulas used in business, like compound interest, implicitly assume. They are growth formulas.

If we dump the growth assumptions, our rules go upside down. Bigger is not necessarily better. At some size, economy of scale starts becoming diseconomy of scale.

If we pursue that old Toyota ideal of lot-size one, the concept runs outside the bounds of production for volume markets. Why not give a customer what she needs, designed to her real needs, where the customer is, or very close? Doing so is no longer attempting to

"win" in a volume market. It revolutionizes business models; operations and production become the enabling side of a service business model focused on one customer at a time.

Keep going with this logic, and one questions why our processes are designed to use low concentration ores when the customer is discarding high concentration refined product? Yes, there are all kinds of problems with metallurgy and materials separation, and with reverse supply chains to pull this off, but posed simplistically, the question begs us to fundamentally rethink what we do, on what scale, and why.

All the issues in the case for Compression are global, but each has roots in actions we take locally. Nonetheless, translating grand global issues into working level action is an intellectual exercise. To help, Compression Thinking poses an arbitrary global challenge:

By the year 2040, globally improve quality of life to an industrial society equivalent using no more than half the energy and half the virgin raw materials as in the year 2000, and with virtually no known toxic releases.

Sounds impossibly idealistic, doesn't it, but posing a challenge in an operational way simplifies a great deal of complexity about what to do:

1. Using a lot less stuff is a tough goal to execute, but easy to understand. With thought, almost any work organization can figure out how to start.

2. Improving quality of life is harder to quantify; it's subjective, depends on each person and their culture, and many people conflate quality of life with having more stuff. But to make headway on the Compression challenge, paying attention to quality of life may move us along much quicker reducing our use of stuff.

3. Goals with dates start to become an operating plan. Most work organizations can set up goals and work plans related to this outrageous challenge.

4. However, these goals are glaringly inconsistent with how we have thought in the past, so our biggest challenge is our old nemesis – us. We begin using different kinds of tools, but we end with a different view of life, a change in values.

OK, how do we start? Can we follow principles, rules, tools, or road maps?

Yes, one can devise general "principles." These can extend endlessly, but even more than with lean, quality, or any other difficult-to-digest mouthful, thinking and learning are the digestive juices for absorbing them. Do that and you too will soon devise "principles."

Space being insufficient for endless lists, the compressed tabulation in Figure 2 is only a starter kit. Even more than lean, Compression Thinking is a practice. (The author is still practicing – awkwardly.) With no fixed body of knowledge, there is no stopping point. The idea is to greatly reduce resource consumption by greatly expanding our learning.

Much of the thinking attempts to reconcile the obvious clash between goals 1 and 2 in Figure 2. Going on down to goals 3 and 4, the use of tools gradually leads to a shift in values.

Figure 2. **A Few "Principles" of Compression Thinking**

Goal/Premise	Thinking Guidelines	Tools
1. Drastically reduce use of resources	See what both you and your customers do physically and measure that before doing so financially. Design your future. Seek the lowest energy state for all life cycle processes (that's kaizen squared). Eliminate toxins or at least the volumes of them used.	All lean tools. Most quality tools. Life cycle analysis. Mass-energy balance. The R's: Re-man, recycle… Resource ratios, like energy yield, without $ multipliers.
2. Improve quality of life	Question ALL assumptions regularly. Precautionary principle: First, do no harm. Strive to serve all stakeholders well. Quality over quantity, always.	Ethnography: Systematically study the needs of each customer. Help customers use less to get better outcomes. Coach them; don't just sell to them. Evaluate what you can do more than what you have.
3. Create vigorous learning enterprises	Work to a mission. Purpose of the organization is more performance than profit. Regard every project, program, and work cycle as a learning cycle. Develop collective learning capacity.	Formal behavioral rules for learning (A3 is an example). Behavioral rules for meetings. Rigorous learning systems, including an actively used records system.
4. Holistic, systems thinking	Look at how your organization is a node in bigger networks (like earth or a human supply networks), not as an independent entity served by them. If it helps transform thinking, regard earth as one big spaceship that we have to "manage."	PDCA plus Methods to work through "wicked problems" embedded with human conflict. Global-scope knowledge seeking.

Compression Thinking attempts to overcome a shortcoming of lean and quality thinking in practice. All too often, we remediate processes, that had we been wiser, should not have been designed. Improvement of existing processes is commendable, but Compression Thinking attempts to elevate our thinking so that we design a better future.

Vigorous Learning Enterprise

The ideas for a vigorous learning organization are a composite of the best seen in a number of companies over a 25-year span, so it is possible for real people to do these things. Migration of an existing organization to this state would take years, so it is not easy, but it seems possible.

The operational objective of a vigorous learning organization is to create that elusive ability to be both highly disciplined and highly flexible – not an easy match. In an attempt to become highly efficient, most 20th century organizational successes became too rigid to adapt quickly. Henry Ford vs. GM in the 1920s is a classic case. GM did not try to beat Ford building Model Ts, from which everybody (including Ohno) learned a lot. Instead, GM flat out-innovated Henry, who could not adapt quickly enough to hold his market. But all that was from an earlier era, and we are entering a very different one.

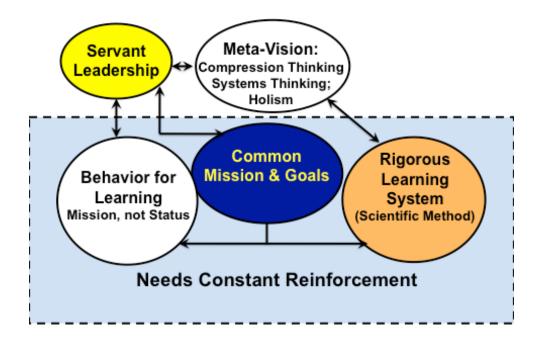Figure 3. **Vigorous Learning Organization**

Figure 3 shows five major aspects of a Vigorous Learning Organization. All parts interrelate, so development of such an organization is not by independent structured projects that stack up like bricks in a wall. Instead, begin initiatives to develop people, including leaders, and use systemic structure as a framework on which human capabilities can grow. (A concept of developing people in that way is why TPS senseis, if they tried to articulate development of TPS at all, used some verb like "create" and never one like "install" as if one were wedging in another software package.)

Meta-Vision: This philosophical term means the ability to see a picture of any organization from an outside-in perspective. It includes the ability to see yourself

somewhat as others see you, which is not implied in the trite phrase, "seeing from the 40,000 foot level." While no one can completely master this, the ability of leadership in particular to stop and think about a bigger picture than the P&L statements is necessary to comprehend the issues in Compression. Change starts here.

Common Mission and Goals: In the sense used here, a mission is not a goal like making a record profit, nor even a vision of some future state. It's a statement, or common understanding of what the organization exists to do, which could be as simple as "help people dig dirt." If they consider it socially vital, people will unite around a common mission, and some will dedicate themselves to it. Sometimes, as with health care, a mission is so obvious that it hardly needs stating. Other times it's not obvious, so a stated mission inhibits people from flying off in multiple directions. Of course, they will not always agree on everything, but it helps if all are working for the same cause.

Missions don't change very often. Goals change regularly. They are statements of overall transformations or improvements that everyone can work toward in the course of a few months or a few years. Two to four of these will do. Multiple people can't keep too many in mind at once. If you are familiar with annual strategic plans developed by hoshin kanri, the upper level objectives would be goals in this sense.

Why is all this important? People can unite around common missions and goals. Throw many monetary incentives in the mix and the carping about fairness starts.

Rigorous Learning Systems: This begins with problem recognition and problem resolution using some version of scientific logic, like PDCA. It includes asking 5 whys or 500 whys, going to the gemba (which may be with a customer, etc., not just a factory), and learning how to think critically. That's a start; there's more.

Common issues using such frameworks are not probing deeply or widely enough to frame a problem in context, whether it is important or symptomatic when deciding where to invest learning power. A second is not retaining what we learn so that we rework the same problem time and again. That is, *collectively* absorbing what individuals learn so that it is shared and becomes standard practice is not as easy as it sounds.

A learning system is incomplete without a way to capture what is learned so that it is easily accessible when new situations are faced. The filing system need not be complex; it's better if it is simple. A3 paper files are a form of such a system, but files are useless repositories if unused. And use of a record system is two-way; as input to it as well as output from it, expected as a regular part of work. Human psychology factors in because we do not like to report negative findings or failures in detail, but that is some of our most important learning.

To explain why design and development of this system is important, consider a description of a university library, used to explain to graduate students why they should know the history of their field. "The library is our past speaking to our present so that you can make our future better than today."

Behavior for Learning

Vigorous learning refers to collective learning by an active working organization, which can extend to big external networks. It is more than individual learning just for self-interest, although that can be a valuable source of innovative ideas. Collective learning implies sharing what we learn that is relevant to our mission or to immediate challenges. Some of us like to hide what we know. Indeed a company's reward system may perversely encourage this by overemphasizing individual performance.

Thus behavior for learning digs into the worm cans of organizational culture, the composite of "how we do things around here." Culture is influenced by everything, but notably history, reward systems, and leadership behavior. Changing it may be like restructuring noodles, but it can be done.

So what behavior encourages collective learning? Just developing people for teamwork, for starters. Many people have been through forming, storming, norming, and so on. Beyond that, three factors seem to help:

1. Encouraging the reporting of negative outcomes. Before people will do this, they have to actually experience that doing so is not a career impediment. They are still valued.

2. Set up a code of behavior. Better yet have employees from all areas devise one. That may take time, but the outcome is thought out from many angles, and it is theirs. Even better, have some form of organizational recognition that people actually commit to abiding by the code; like they put their John Hancock on a big thing on a wall that everybody else can see.

3. Devise a code used in meetings to straighten up someone straying off, especially if discussion is degenerating to personal attacks, or a hidden agenda is sensed. It could be a code phrase like "Are we going below the belt here?"

For most of us, behavior for learning – collective learning – is not normal. Neither Mother nor schooling fully prepared us. Instinct is to revert to form because conflict may be more fun. So once a code of behavior is in place, leaders need to be exemplars of it, and little "ceremonies" should regularly reinforce it, sort of like standing for the national anthem every time you go to a ball game.

Servant Leadership: The foundation of servant leadership by that name is a book with that title by Robert Greenleaf. However, the military version of it is short, no-nonsense, and equally applicable to any organization. In military organizations, the mission has to be the primary motivation, not money. Few people go into combat because of immediate financial incentives, so leadership has to be of the people.

The nub of this kind of leadership is recognizing that an organization's purpose is to carry out a mission with excellence. It's not to maximize profit. A military commander developing troops has to be aware that the next mission may be something unexpected. Versatility and preparedness are important. Finally a good commander realizes that in any tough situation, the welfare of everyone depends on top performance as a unit.

So the key ingredients of becoming this kind of leader are personal attitude, integrity, and priorities. Four simple rules of behavior sum this up:

1. Mission comes first.

2. Welfare of the troops comes second.

3. My personal welfare is third.

4. Always tell the truth (good, bad, and ugly).

(Because of this, ex-military commanders usually make good lean leaders too.)

The Compression Institute

This fledgling organization is in the process of being incorporated. It's puny compared with the global challenges presented, and it's busy with the simple tasks necessary to get any movement started, but one must start somewhere.

Its mission is *to create learning action groups to make Compression Thinking a common practice*.

Of course, this is a leap into the unknown. Few people, if any, have done anything like it, but if you know of an exemplar case, we'd love to hear about it.

To learn a little more, visit www.compression.org. If you sign on for the newsletter there, about every two weeks you will get an update, and we hope to be reporting some progress soon.

Most of all, if you are eager to join this adventure, e-mail Doc Hall: doc@compression.org.

And yes, Compression paints a scary scenario, but if you follow global news, scenarios that are even scarier are pretty easy to concoct. We're not pessimistic. If we wake up to the situation that we are in and take action, there's reason to be optimistic.