

Systematic Innovation



e-zine

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The Systematic Innovation e-zine is a monthly, subscription only, publication. Each month will feature articles and features aimed at advancing the state of the art in TRIZ and related problem solving methodologies.

Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.

Readers' comments and inputs are always welcome.
Send them to darrell.mann@systematic-innovation.com

Innovation Systems

‘Successful step-change.’ That’s our usual definition of innovation. Especially if we’re trying to be succinct. ‘Successful realisation of new customer value,’ is the slightly less condensed form. Both represent innovation as an outcome.

And if innovation is an outcome, then the realization of that outcome necessitates the existence of a system. Which in turn means that the Law Of System Completeness must apply. Innovation, in other words, will only be delivered if and when the requisite elements are present:

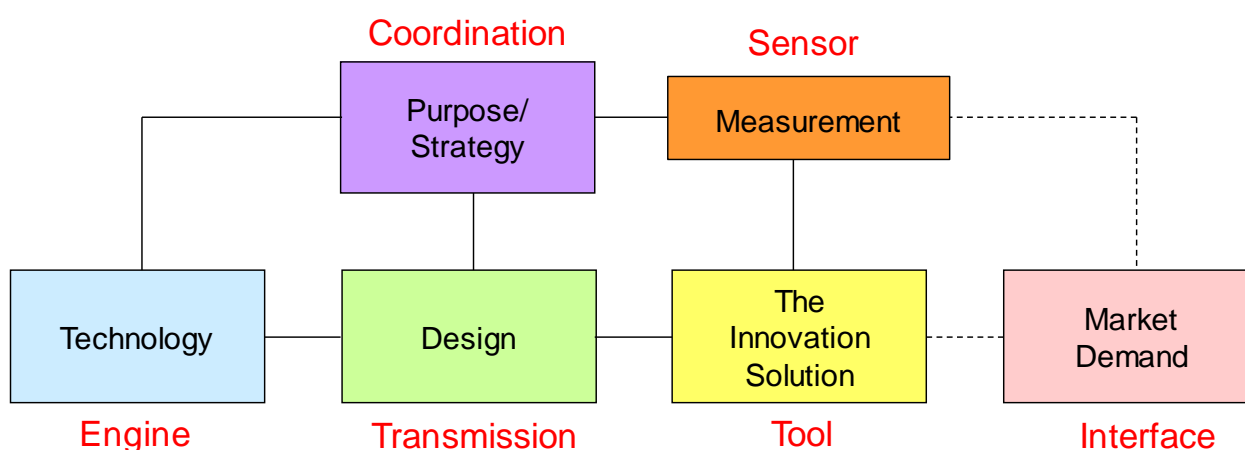


Figure 1: Law Of System Completeness Applied To ‘Innovation’

We mention this because it seems there is still considerable confusion as to the relationship between various different elements that managers and leaders have connected to the ‘innovation’ word. Not least of which being the word ‘design’. Everyone these days, it seems, needs to get involved in ‘Design Thinking’.

Well, according to Figure 1, that’s absolutely right. Everyone does need to get involved in ‘design’ if the seek to achieve successful step-change, or ‘new customer value’. ‘Design’ in the context of the Law Of System Completeness is the process by which the ‘technology’ is transformed into the eventual Innovation Solution. It is a necessary, but fundamentally insufficient aspect of new customer value.

This ‘insufficiency’ seems to be confusing to what feels like a majority of organisations that have embarked upon – usually expensive – ‘Design Thinking’ education programs. Great that they’ve been through the journey. Not so great that they were promised tangible outcomes that never arrived.

We can see a similar ‘necessary but not sufficient’ misunderstanding in many other organisations who embark on equally expensive ‘technology development’ programs. Specifically, Innovation Capability Maturity Model (ICMM) Level 2 organisations, who are in my ways characterized by their terrific ability to do R&D that results in elegant technological solutions that get to sit on a shelf waiting in vain for an opportunity to be picked up by a commercialization project team. We’re using the term ‘technology’ in its broadest possible meaning here. ‘New technology’ could be a new algorithm as much as it could be a novel turbine blade material, as much as it can be the discovery of a better way

to understand why customers tell us one thing and then behave in a completely different manner. 'Technology' in this broad sense is the 'Engine' of an Innovation system. It is the new knowledge that enables innovation to happen, but by itself, it is fundamentally no innovation.

Recently, we've taken to drawing this 'necessary but not sufficient' Innovation System story as a two-part Venn diagram. The first part is intended to try and overcome the confusion between 'technology', 'design' and 'innovation':

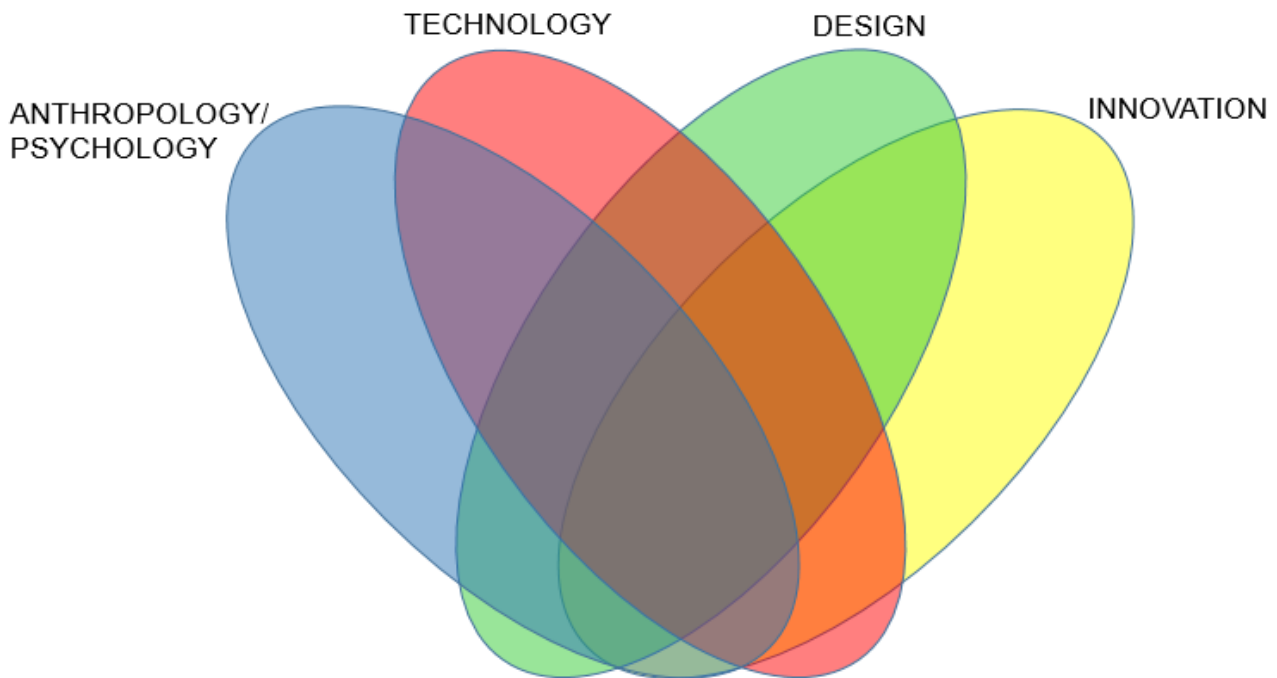


Figure 2: Innovation As A (Venn Diagram) System – Part 1: 'Core'

The first thing to notice about this picture is that we've added 'Anthropology/Psychology' to the Design, Technology, Innovation triad. Our ability or otherwise to understand the needs of customers ('Market Demand') is as fundamental at the core of any innovation activity. The 'Design Thinking' has in many ways try to subsume this kind of anthropology activity into how the 'design process' operates. The problem with that attempted absorption is that the Design Thinking world is much better at design processes than it is at understanding how and why customers behave in the way that they do. Dig into the guts of any Design Thinking curriculum, in other words, and you'll quickly begin to realise that their version of 'understand the customer' pretty much boils down to 'empathise with them, then get a prototype in their hands as quickly as possible so you can iterate as quickly as you can to a better solution'. Which isn't a methodology at all, it's merely a transmission process. If it was a methodology, it would contain some or all of the tools in our TrendDNA toolkit, and everyone would save themselves an awful lot of wasted time presenting customers with random ideas.

Second up, the idea behind the Venn Diagram analogy is to recognize several things:

- that it's perfectly possible for an 'innovation project' to exist in any segment of the Diagram so long as I don't expect it to deliver the desired 'new customer value' outcome. The point is to know which segment we're in, so that we know which ones we need to go to after we've finished our bit in order to get to the next bit.
- The relative amount of each of the four elements in any given innovation project will very likely change. Many projects, for example, will pay very little attention to 'new

technology' at least in the traditional sense. Whenever we create a new PanSensic lens, for example, we barely recognize that algorithm as a piece of technology at all, and it will usually feel like the 'easy' part of the overall process of turning it into 'new customer value'. Conversely, putting Man on Mars will likely require an awful lot of 'technology' and not so much Anthropological study of 'Market Demand'. Just so long as we remember before we finish, that we need to have spent some time and energy in each of the four elements of the Diagram.

- Although a 'typical' innovation project will tend to evolve from left to right across the Diagram – i.e. understand the customer and the technology before translating it into the Innovation - the temporal sequence of each of the four activities will also likely change from project to project. Some projects will start with a new piece of technology; others with a desire to keep a Design team active. Again, the ultimate point being that so long as we end up having 'done' all four segments, it doesn't particularly matter what order we do them in. In many ways, the 'Design' (Transmission) process is the thing that can help to guide the way.

Figure 2 still leaves us with two pieces missing from our 'Complete System' Law. Do the Anthropology, Technology, Design and Innovation jobs and we still won't achieve 'new customer value'. That's only going to happen when we integrate these four elements into a higher level 'Coordination' story, we typically call 'purpose' or, more pragmatically, 'strategy – Figure 3:

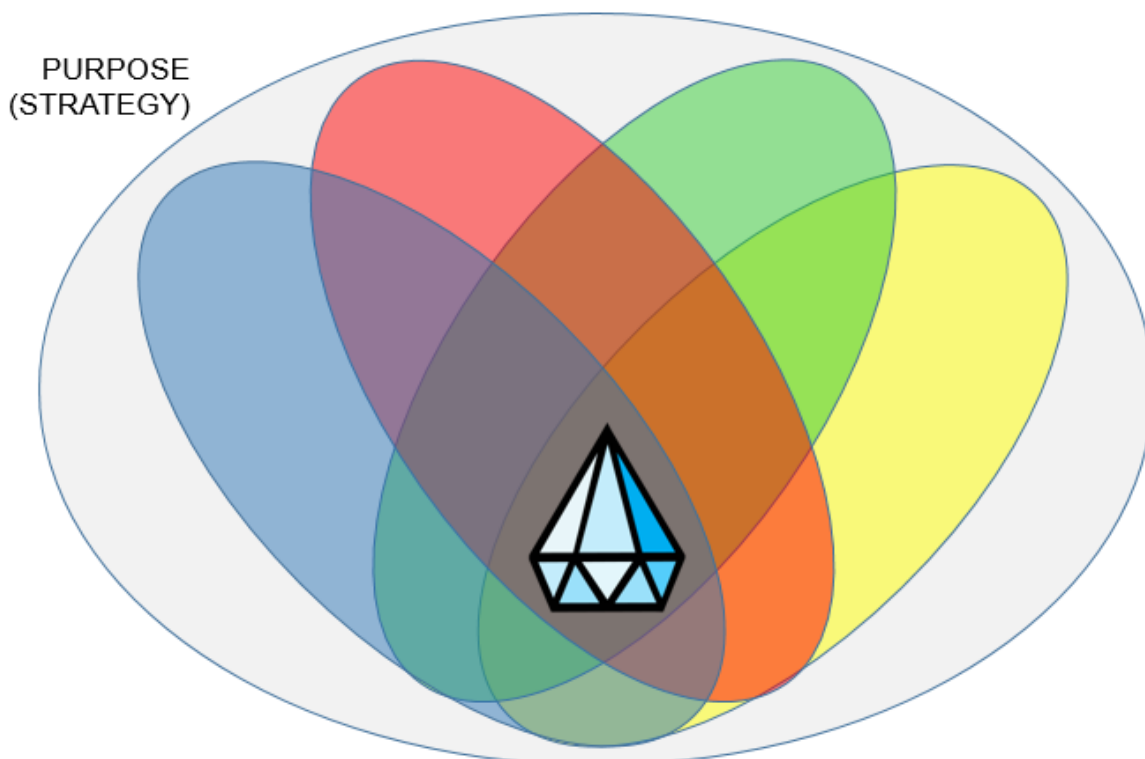


Figure 3: Innovation As A (Venn Diagram) System – Part 2: 'Super-System'

Finally, more difficult to draw than the other five elements is the sixth 'Sensor' part of the system. It's not possible to achieve 'new customer value' (the diamond in the centre of the Figure 3 image) if we're unable to measure all the things that are happening. The 'Sensor' part of the system sits between the overall Coordination and the other four elements, and as such it often gets absorbed into the 'Coordination' element. The further we get ourselves into the PanSensic story – a business that is completely about creating and

delivering 'sensors' – the more we see how dangerous it can be to make this element invisible. Most innovation ('new customer value') attempts fail, we now know, because the requisite measurement elements are not in place. Figure 3 very likely makes us guilty of the same invisibility error. Which doesn't make drawing the right picture any easier. Figure 4 is the best we've achieved so far – the sixth 'Sensor' element becoming the element that sits at the interfaces of the other five elements:

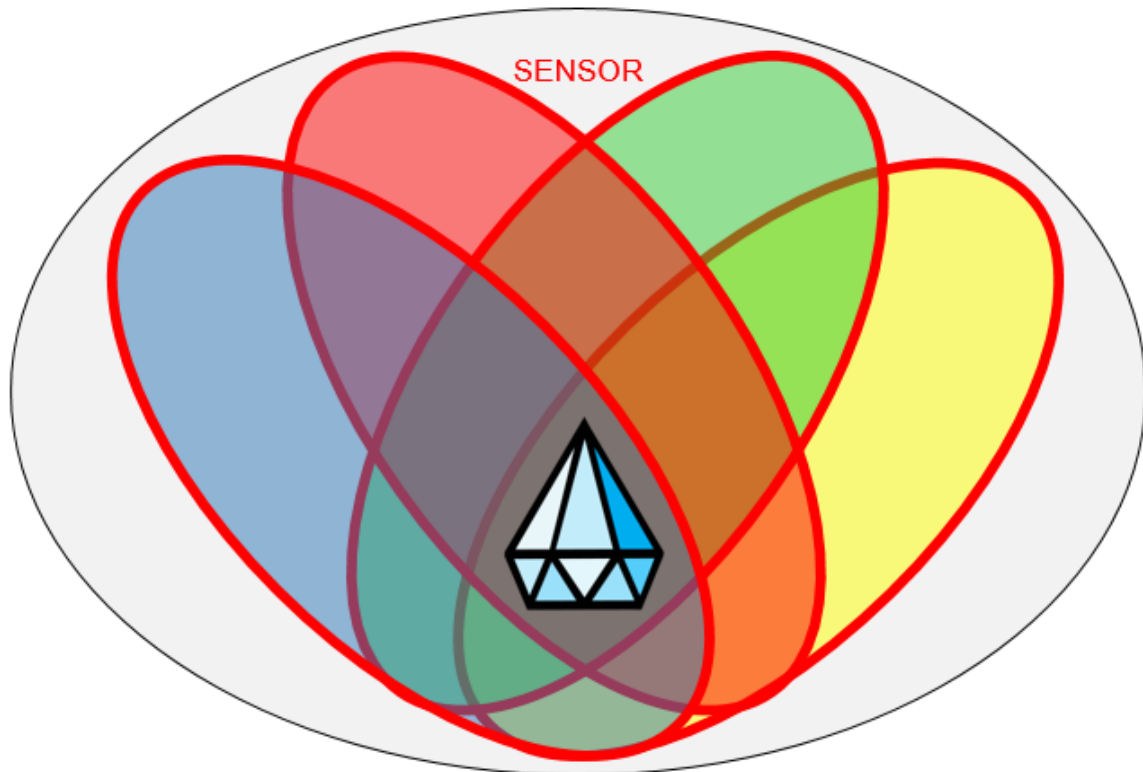


Figure 4: Innovation As A (Venn Diagram) System – Part 3: The Essential Sixth Element

The thing about the Law Of System Completeness is that it's a Law. If we have a desire to deliver a useful outcome, we know we need to abide by the rule of Law...

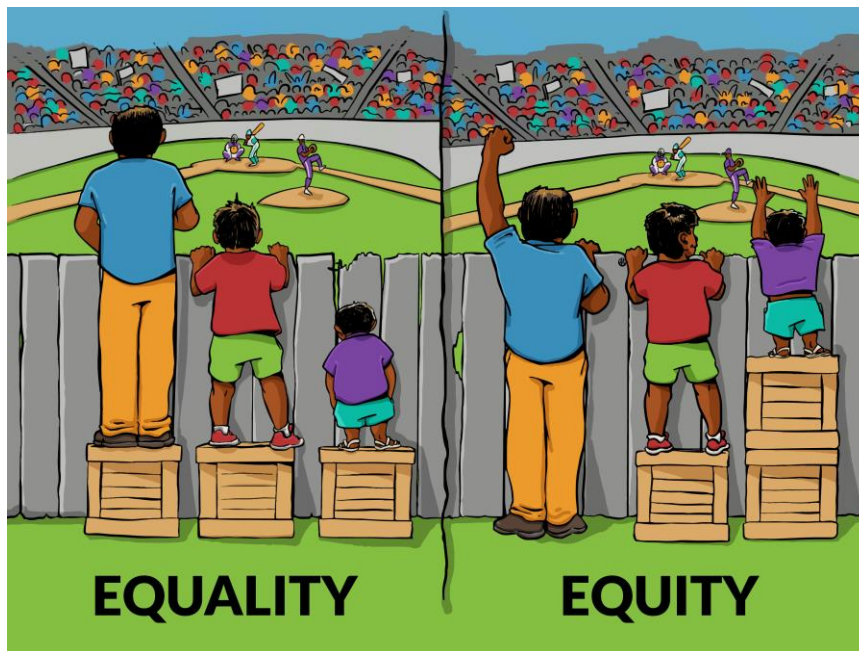
All enterprises need the ability to deliver
NEW CUSTOMER VALUE



This demands a coherent
system comprising a minimum
set of interacting elements

...something we'll see again in the next article...

Case Study: Equity (Or Not)



We've been doing quite a lot of work in the public sector this year. Which means enduring lots of noble-but-woolly thinking about concepts like equity. It usually doesn't take long for the above image to be brought into the discussion. And then we get into the typical conservative-versus-liberal debate about 'fair'ness. Both parties, sadly, seem equally stuck in their either/or world. And then – inevitably – matters descend into stalemate.

My first problem, I think, is with the baseball game metaphor. Sometimes we can use simple illustrations to explain more complex ideas. That is fine if the illustration is in fact used to explain the more complex idea. Often that's not what happens – often we're just shown the illustration, and because it's simple, we think we understand the more complex situation automatically.

On the left, the 'equality' metaphor, each person has a box, but still the short guy can't see. So, on the right, the tall guy gives him his box and all is well. That's justice, see? Simple.

Well, if I were at a game watching over the fence and some guy needed my box to stand on, and I didn't need it myself, of course I would give mine to him – I'm not a completely pleasant person, but I don't think my empathy-deficit is that bad. But of course, a baseball game is not what's really the issue here. We're talking about wealth, poverty, and social politics – much more complex issues.

How can we translate the simple illustration to the real complex problem?

We ask what each item in the illustration represents.

What do the boxes represent? Money? Power? Knowledge? All three? Something else? Why are there only three boxes? They can't get more? Why do they all start off with one box each? Why is one guy taller than the other? Do these guys always stay the same height over the course of their lives? How is time illustrated in this picture, if at all?

What does the fence represent? Why is it the height it is? Is it shorter in other places where the short guy could see over with only one box? Why are all three guys standing right next to each other? Can the short one sit on the tall person's shoulders? In the real world, does the tall guy even know the short guy exists? Could the tall guy simply pass his box over to the short guy without someone else getting involved? What if the tall guy doesn't want to give up his box? What if he's going to need it to look over a taller section of fence further down? What does the stadium owner think about matters? If these three haven't paid to be in the stadium, should they be allowed to watch the game at all if they haven't paid?

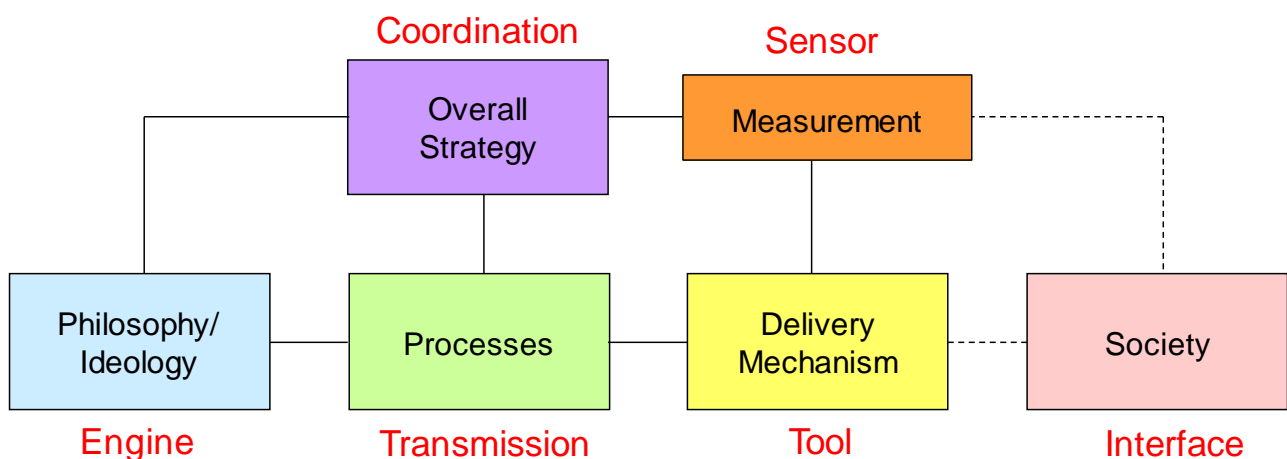
What does the baseball game represent? Happiness? A house, car, and a flatscreen TV? Or just basic living needs? Who determines what poverty is? What's being compared to what? Is the standard of living the same for all three guys? Is it essential to watch the game at all?

These are just starter questions. As they're answered more questions will come. As soon as we try answering any of the questions, we see that the real situation is much more complex than what the picture suggests.

'Complex' being the key word here. The level of equality (or inequality), the level of equity (or non-equity) we might observe in our travels are emergent properties of a complex system called 'society'.

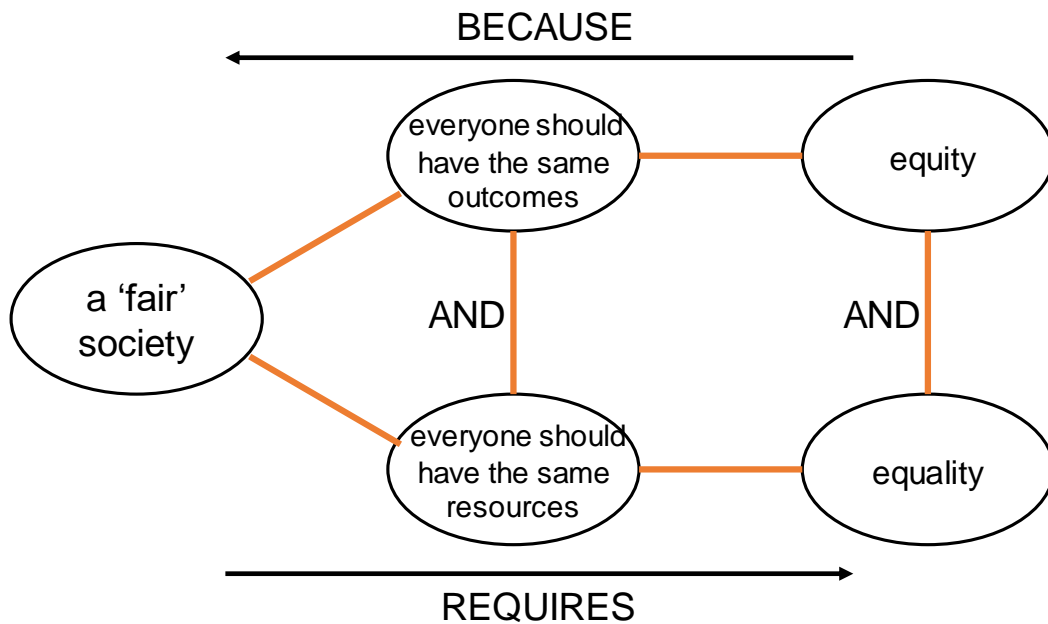
Unless there exists a specific system within society to deliver a desired level of equality or equity, then the levels we actually achieve will only ever be emergent. i.e. unless there is an 'equity system' and/or an 'equality system', we will never have any ability to exert any control over what result emerges.

And herein, I think, lies the heart of my frustration with these kinds of noble-yet-woolly discussions. As soon as we talk about 'systems' – whether we're in a complex environment or not – we're obliged to abide by the rules of the Law Of System Completeness. Which tells us that there are six essential elements that need to be present if we are to achieve the outcomes we seek:



Ask anyone in the public sector to help you to show you where any of these six elements are present as pertains to equality or equity issues, and the discussion quickly fizzles into a depressing haze. None of the elements exist. They don't exist at any level, across, up or down society. And until such times as they do exist, any and all discussions about how equitable or unequal society is are pointless, hand-wringing, self-flagellating charades.

Meanwhile, we are often heard to say, here in Systematic Innovation Land, that all contradictions can be solved. Equity-versus-equality is a contradiction. Something like this:



But, when we make these kinds of rash 'anything is possible' statement, we're making an implicit assumption: that there is a system we can utilise to enact the solution. In the case of fuzzy concepts like 'fairness', a simple System Completeness check reveals that there are no such systems in place. Which then forces us to have to revise our naïve heuristic:

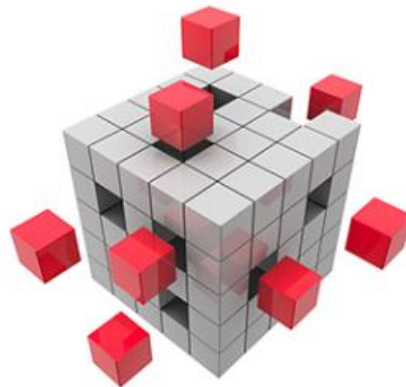
'Any contradiction can be solved provided we satisfy the Law Of System Completeness.'

By way of a simple illustration, we can very easily 'solve' the equity-or-equality contradiction using Inventive Principles 5 and 17: get everyone to cooperate and, when necessary, allow others to ride on their shoulders. We can design a solution, but we won't actually deliver it until such times as we introduce an Engine, Transmission, Tool, Interface, Coordination and Sensor to make sure the right things happen at the right time and for the right reasons.

Definitely Not Funny – TRIZ Crackpot Rigour #277

Sometimes, you have to laugh. If you didn't, you'd cry. The world of TRIZ is full of such moments. Probably none more so than the June edition of the newly revived TRIZ Journal, where I encountered this:

COMPLETING THE ALTSHULLER MATRIX: WHAT COULD BE THE PRINCIPLES IN THE EMPTY CELLS?



... to which my first thought was, 'what empty cells?' So much for the last twenty years work to re-think the Matrix – or 'Matrices' now that we have three different ones. A wise person would've gone about his day and ignored the article. I tried being wise. It lasted a couple of hours. Then a member of the SI research team told me I should take a look, 'they used our 2003 Matrix', they said, no doubt knowing this would provoke me into doing something stupid.

Like opening the file.

Put simply, I couldn't believe what I was reading. Several weeks later, I still have to kind of pinch myself. I've been all the way through my version of the Kubler-Ross Grief Cycle by now, so I know that no matter how bad something is, I'm supposed to take something positive out of it. 'Even the bad stuff is good stuff,' TRIZ tells me. Bad articles are resources too.

To do it justice, I think every reader of this ezine should go and take a look at the article. Read it. Weep.

Now, let me try and precis it for you.

First note the quasi-academic tone of the article. Everything properly referenced. Well, nearly everything. Even though Matrix 2003 is used as the basis for 'validating' the nonsense that follows, it doesn't merit a reference.

Next up we get a summary of the Classical TRIZ Matrix and learn that it has an 84.41% 'fill ratio'. This sounds kind of scientific, but of course really isn't. It means 'some of the boxes in the original Matrix are empty'. Whether calculating the level of emptiness to two decimal places is appropriate, I'm not sure.

Then we get to the heart of the matter. The purpose of the 'research' that has been conducted. With your permission, I'll paraphrase the authors' rationale: 'working out what numbers should go in each of the boxes of the Matrix requires an awful lot of hard work. Doing things like reading and dissecting several million patents. And therefore, what the world needs is an easier way to fill the boxes...'

(...I'm with the authors so far.... I would very happily have spent the last twenty years not spending hundreds of thousands of dollars doing the job...)

They continue... 'a much easier way is to simply fill the boxes with random numbers. But, no, wait a minute, this is not so good. Fortunately, we notice that some of the Inventive Principles appear in the 84.41% of filled boxes more frequently than others, so, rather than choosing the numbers at random, why don't we fill the empty boxes with random numbers weighted according to the frequency of appearance from the filled boxes?'

(I can feel a heavy weight pressing down on my head.)

Then... 'having now filled the empty boxes with less-random numbers, we can then validate what we've done by comparing our newly filled boxes with the actual data shown in Matrix2003. Let's do this, and then do another piece of quasi-scientific statistical horseshit and see how well our selection of random numbers has done. We'll draw a pretty process diagram to make everything seem sensible. And use expressions like 'xgboost' and 'data science'. Especially the second one, because, if we say it often enough, maybe people will believe it even more. Then we'll ignore the actual comparison and write-up a conclusion that the 'peak predicted accuracy' is 43.33%.

(2 decimal places – again, noted)

(By the way, here's what 43.33% precision looks like in actual Matrix box content terms:)

Matrix 2003	Data Science (DS) approach
<u>17</u> , <u>4</u> , 12, 3, 24, 14	1, 19, 18, <u>4</u> , 15, <u>17</u>
14, 17, <u>32</u> , 35, 24, <u>19</u> , <u>1</u>	<u>19</u> , <u>32</u> , 26, 16, 15, <u>1</u> , 28 ⁵
<u>35</u> , 7, 13, <u>1</u> , 4, 17, 12	32, 15, <u>35</u> , 2, 28, <u>1</u>

Now, at this point, I have to say I kind of commend the honesty of the authors. Kind of. 43.33% is not a fantastic result. They seem to recognize this too, so it only gets mentioned once, and after that they try and hide it a bit by saying things like, 'accuracy of 80.50% while scoring exceptionally high on specificity (89.15%)'. Specificity sounds really scientific too.

But in trying to down-play the rubbishness of their random-number prediction, they miss the important point. And that is that in the terms of how they've done their 'science', 43.33% precision is worse than random. In other words, their 'Data Science (DS) approach' is worse than they would have achieved if they'd rolled a dice containing the numbers of the six most popular Inventive Principles the requisite number of times and filled the empty boxes with those numbers.

Under normal circumstances, I try and force myself to shrug my shoulders and laugh in these kinds of situation.

I blame the authors a little bit trying to inflict their bad science on the world. And I blame them quite a lot for trying to disguise a bad result to make it look and sound like a good one.

But mostly, I blame the 'editors' of TRIZ Journal that saw fit to publish the article. They're the ones – I thought – that had a vested interest in presenting TRIZ in a positive light. That this ill-conceived idiocy made it through their editorial process tells me one or more of four things:

- 1) They never read the paper enough to understand it, and were simply motivated to publish something that looked scientific with a view to making the Journal seem like an academic journal.
- 2) They never use TRIZ and so have no comprehension that randomly suggesting Inventive Principles is not what the Matrix is for. (Brainstorming around a random sequence of Principles is a perfectly valid strategy, but if you're doing that job, you don't need a Matrix of random numbers.) Filling a Matrix with scientifically-generated random numbers is called 'crackpot rigour'.
- 3) They have no comprehension of the difference between correlation (filling boxes of the Matrix with mathematically calculated random numbers) and causation (analyzing several million patents to know that when problem solvers solve a particular conflict, they use certain Principles more than others).
- 4) Their actual intention is to destroy the already pitifully low credibility of TRIZ.

Considering that they'd published my 'Does The TRIZ Community Use TRIZ' rant in the previous month's issue of the Journal, and I never received a single response, not from them, nor from any reader, makes me think it's 80% 2) and 20% 4). As if to prove the point, I noticed in the July edition their own piece of Classical TRIZ Matrix nonsense. 2) plus 4) plus their own crackpot rigour seems to me to add up to a whole other level of crackpoted-ness. Is there such a thing as Meta-crackpot-rigour? There is now.

Patent of the Month - Ultrasonic Water Purification

Patent of the month this month is awarded to a trio of inventors at FloDesign Inc in Massachusetts, a company we've been watching for quite a while now thanks to the broad range of very cool aerodynamic-y things they've been involved in. US9,410,256 was granted on August 9. The solution is fairly obvious from the title of the patent; the problem being solved is something like this:

There is great interest and need for water purification for developing countries. The world population is approximately 6.7 billion people and is expected to be over 8 billion by 2050. Roughly 1.1 billion people in the world lack access to safe drinking water. Available water sources can be contaminated by pathogens. Roughly 2.2 million die each year from consumption of pathogen contaminated water and 9500 children die each day.

Most of the work reported in the literature for pathogen removal from water involves replaceable filter units. These units generally consist of packed cartridges, filter membranes, or special filter papers. Though organisms over 10 micron can be easily captured by these techniques, smaller organisms including bacterial spores in the size range of 1 micron are typically not captured with sufficient efficiency.

A relatively easy one to map on to the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Amount of Substance (10)

WORSENING PARAMETERS YOU HAVE SELECTED:

Length/Angle of Moving Object (3)

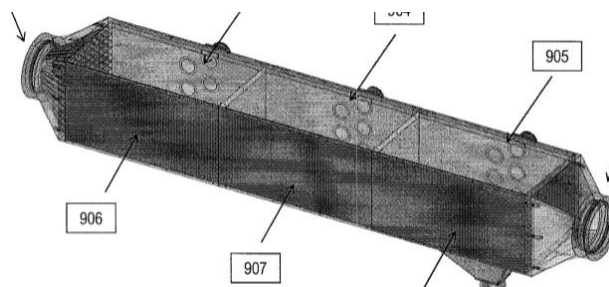
SUGGESTED INVENTIVE PRINCIPLES:

3, 29, 17, 35, 2, 18, 36, 7, 31

Principle 18, Vibration, offers up a pretty good pointer towards the ultrasonic solution. Good to see also how the invention offers up an illustration of other of the suggested Inventive Principles. Here's what Claim 1 tells us:

A method of separating particulate from a fluid comprising: flowing the fluid past two or more positions; and forming three dimensional (Principle 17) acoustic standing waves at the two or more positions, wherein each acoustic standing wave is maintained at a different ultrasonic frequency (Principle 3), wherein each ultrasonic frequency is optimized for a specific range of particle sizes (Principle 35), and wherein particulate of the optimized size is trapped in its corresponding acoustic standing wave against the flow of the fluid, thereby concentrating the particulate in its corresponding acoustic standing wave; wherein the two or more three dimensional acoustic standing waves are pulsed waveforms resulting in high intensity acoustic pressure.

Yet another step-change made possible using ultrasound. Makes you wonder if there's anything it can't help with.



Best of the Month – Unthink

Why you don't think the way you think you think

unthink
unthink
unthink
unthink

chris paley

“Plants aren’t conscious, but they still go on stretching up to the sky and scattering seeds. Worms probably aren’t aware of the pleasing squelch of mud, but they go on burrowing through it.

“Humans *are* conscious. We re conscious of seeing things, learning things, reaching out to touch things, deliberating ethical questions, making decisions, fancying someone, and setting goals. But consciousness isn’t *needed* for any of these things. In fact, when we do them, it generally isn’t consciousness doing them at all. Our conscious experience is separate from the processes in the brain that actually decide things, guide us as we reach out for things or set our goals. This explains why so many of the ways in which psychologists can manipulate us seem strange to us: if consciousness determined our behaviour, we’d already know that was how we worked; but as it doesn’t, we don’t.”

How about that as a representative chapter from Chris Paley’s 2014 contribution to the ever-growing world of your-brain-doesn’t-work-the-way-you-think-it-works popular science books. And, yes, it is a chapter. Not the longest one by any means – the longest one spans almost three pages – but at the very least indicative of Paley’s punchy stop-start style. Essentially each chapter acts as either a short summary of a piece of academic research proving that our brains don’t work the way we think they work (research not done by Paley, by the way), or it’s Paley’s pithy attempt to make the reader rethink all they think they know. That’s ‘pithy’ as in, here’s an author who’s convoluted, sarcastic take on life (Nomad-alert! And an ex-banker to boot) is as likely to alienate as many readers as he attracts.

There are, of course, already way too many books on the limbic-versus-pre-frontal-cortex brain story already. But I think Paley’s effort is worth your time and attention. To paraphrase the book’s sub-title, we really don’t think the way we think. And in proving that it is so, Paley ends up with a far higher than average insight quotient. You won’t agree with all he says (especially if you are a no-ambiguity-allowed, Blue Order person on the Gravesian Thinking Styles scale), and probably too often there are chapters that don’t seem to work, or are unconvincing in their quest for extreme brevity. But that’s probably just a lack of

patience on my part. The fact that the book is assembled in one or two page chunks, however, means that if you don't 'get' one chapter, it won't be long before another one smacks you across the face with a mini blockbuster of a radical thought. And that's why you should probably ignore the highly polarised reviews (probably another good sign... according to Paley) and get hold of a copy.

My conscious brain, Paley tells me, hasn't involved the way it has to help me understand how the world works, its evolved to help me understand how other people see me. So by recommending his book, does that mean... oh, wait, I see it now, there's no right answer to this one. Buy a copy. See for yourself.

Here, just in case you need a tad more persuasion are a few more teasers...

- If you want someone to fancy you, wear red and meet them somewhere frightening.
- When waitresses repeat customers' orders back to them instead of just saying 'yes' they receive bigger tips.
- To reduce your shopping bill, start at the beer and snacks end of the store and work backwards.
- If you sit someone in an upright chair when you give them good news they will be prouder of their achievements.
- Having a picture of your family on your desk might make you work harder, but you'll be rattier when you get home!

Wow In Music – Stairway To Heaven



The famous song "Stairway to Heaven" by English rock band Led Zeppelin is known for a number of controversies, including a copyright infringement lawsuit and claims of backmasking. The former has been recently ruled out by Los Angeles district judge Gary Klausner who determined that the similarities (mainly the opening guitar arpeggios) with "the 1968 instrumental "Taurus" by the Los Angeles-based rock band Spirit, written by guitarist Randy California ... did not amount to copyright infringement".

The latter (backmasking) helped to spread the Led Zeppelin 'bad reputation' as it allegedly contained the hidden messages "Here's to my sweet Satan" and "I sing because I live with Satan" when the middle section of the song ("If there's a bustle in your hedgerow, don't be alarmed now...") is played in reverse. "Robert Plant expressed frustration with the accusations in a 1983 interview in Musician magazine: "To me it's very sad, because 'Stairway to Heaven' was written with every best intention, and as far as reversing tapes and putting messages on the end, that's not my idea of making music."

Released in late 1971 (officially the pinnacle year for rock music*), Stairway to Heaven was "composed by guitarist Jimmy Page and vocalist Robert Plant for the band's untitled fourth studio album (often called Led Zeppelin IV) (and) is often referred to as one of the greatest rock songs of all time. The song has three sections, each one progressively increasing in tempo and volume" (Principle 3): beginning "in a slow tempo with acoustic instruments (guitar and recorders) before introducing electric instruments", it progresses to the final section, "an uptempo hard rock arrangement highlighted by Page's intricate guitar solo accompanying Plant's vocals that end with the plaintive a cappella line: "And she's buying a stairway to heaven."

Elaborating on the reasons behind the success of this song, Dr. Robert Walser explains that "Musically, "Stairway" fuses powerful "authenticities" - which are really ideologies. On the other hand, a fold/pastoral/mystical sensibility; on the other, desire/aggression/physicality. The song begins with the gentle sound and reassuringly square phrases of an acoustic guitar, complemented by the archaic hooting of recorders, suggesting a preindustrial refuge of the folk. Soon, Jimmy Page trades in his acoustic for the twangy punch of an electric and, eventually, the raucous roar of heavy distortion. After a Hendrix-like guitar solo (blues-based, mildly psychedelic), Robert Plant's voice rises an octave, wailing over countless repetitions of a two-measure pattern, propelled by the band's frantic (Principle 2) syncopations. The apotheosis/apocalypse breaks off suddenly, and the song ends with Plant's unaccompanied voice, a return to the solitary poignancy of the

beginning. This narrative juxtaposition of the sensitive (acoustic guitar) and the aggressive (distorted electric guitar) has continued to show up in heavy metal, from Ozzy Osbourne to Metallica. It combines contradictory sensibilities without reconciling them, as to Led Zeppelin's lyrics and cover art.

We might better understand the associative powers of the lyrics by breaking them up into categories. We are presented with a number of mysterious figures: a lady, the piper, the May queen. Images of nature abound: a brook, a songbird, rings of smoke through the trees, a hedgerow, wind. We find a set of concepts (that pretty much sum up the central concerns of all philosophy): signs, words, meanings, thoughts, feelings, spirit, reason, wonder, soul, the idea that "all are one and one is all." We find a set of vaguely but powerfully evocative symbols: gold, the West, the tune, white light, shadows, paths, a road, and the stairway to heaven itself. At the very end, we find some paradoxical self-referentiality: "To be a rock and not to roll." (Principles 13 and 25)

The words provide a very open text; like those of Don McLean's "American Pie" (also released in 1971 – told you!), they invite endless interpretation. Yet they are resonant, requiring no rigorous study in order to become meaningful (Principle 25 again). Like the music, they engage with the fantasies and anxieties of our time; they offer contact with social and metaphysical depth in a world of commodities and mass communication. "Stairway to Heaven," no less than canonized artistic postmodernism, addresses "decentered subjects" who are striving to find credible experiences of depth and community. It strains at mystery and promises utopia: "A new day will dawn," and "If you listen very hard/The tune will come to you at last."

If you want to know more about one of Led Zeppelin's most famous tracks, check these sources:

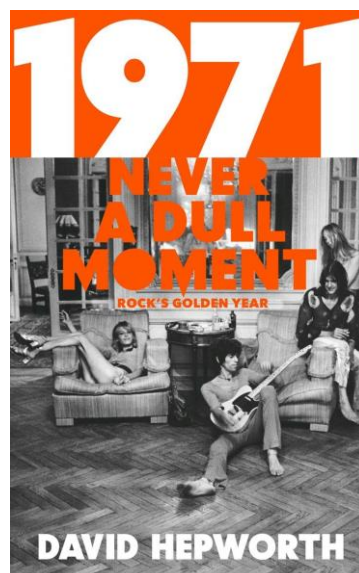
<http://www.superseventies.com/stairway.html>

<http://www.nme.com/blogs/nme-blogs/led-zepellin-stairway-to-heaven-plagiarism-trial>

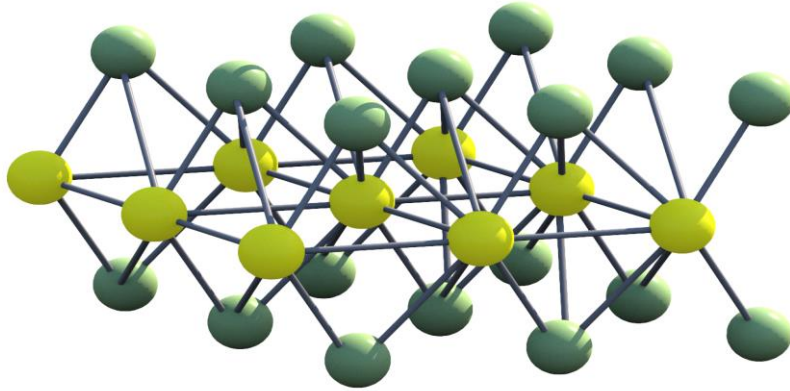
And also this article:

Drummond, K. (2006). Climbing a stairway to heaven: Led Zeppelin's Celtic embrace. *Journal of Strategic Marketing* 14, pp. 35-43

* And, if you want to see the 'proof' that 1971 is indeed popular music's pinnacle year, you'd do well to get hold of a copy of this:



Investments – Carbon Dioxide As Fuel



As scientists and policymakers around the world try to combat the increasing rate of climate change, they have focused on the chief culprit: carbon dioxide.

Produced by the burning of fossil fuels in power plants and car engines, carbon dioxide continues to accumulate in the atmosphere, warming the planet. Trees and other plants do, of course, slowly capture carbon dioxide from the atmosphere, converting it to sugars that store energy. There have been and continue to be lots of human research on so called 'artificial photosynthesis' technologies that seek to mimic nature's ability to do this conversion. None, so far, have made significant progress. Perhaps because they're trying to directly mimic nature rather than using it as inspiration.

In a new study from the U.S. Department of Energy's Argonne National Laboratory and the University of Illinois at Chicago, however, it seems that researchers have found an alternative, much more practical way to convert carbon dioxide into a usable energy source using sunlight.

One of the chief challenges of sequestering carbon dioxide is that it is relatively chemically unreactive. "On its own, it is quite difficult to convert carbon dioxide into something else," said Argonne chemist Larry Curtiss, an author of the study.

To make carbon dioxide into something that could be a usable fuel, Curtiss and his colleagues needed to find a catalyst -- a particular compound that could make carbon dioxide react more readily. When converting carbon dioxide from the atmosphere into a sugar, plants use an organic catalyst called an enzyme; the researchers used a metal compound called tungsten diselenide, which they fashioned into nanosized flakes to maximize the surface area and to expose its reactive edges.

While plants use their catalysts to make sugar, the Argonne researchers used theirs to convert carbon dioxide to carbon monoxide. Although carbon monoxide is also a greenhouse gas, it is much more reactive than carbon dioxide and scientists already have ways of converting carbon monoxide into usable fuel, such as methanol. "Making fuel from carbon monoxide means travelling 'downhill' energetically, while trying to create it directly from carbon dioxide means needing to go 'uphill,'" said Argonne physicist Peter Zapol, another author of the study.

Although the reaction to transform carbon dioxide into carbon monoxide is different from anything found in nature, it requires the same basic inputs as photosynthesis. "In

photosynthesis, trees need energy from light, water and carbon dioxide in order to make their fuel; in our experiment, the ingredients are the same, but the product is different," said Curtiss.

The setup for the reaction is sufficiently similar to nature that the research team was able to construct an "artificial leaf" that could complete the entire three-step reaction pathway. In the first step, incoming photons -- packets of light -- are converted to pairs of negatively-charged electrons and corresponding positively-charged "holes" that then separate from each other. In the second step, the holes react with water molecules, creating protons and oxygen molecules. Finally, the protons, electrons and carbon dioxide all react together to create carbon monoxide and water.

"We burn so many different kinds of hydrocarbons -- like coal, oil or gasoline -- that finding an economical way to make chemical fuels more reusable with the help of sunlight might have a big impact," Zapol said.

Towards this goal, the study also showed that the reaction occurs with minimal lost energy -- the reaction is very efficient. "The less efficient a reaction is, the higher the energy cost to recycle carbon dioxide, so having an efficient reaction is crucial," Zapol said.

According to Curtiss, the tungsten diselenide catalyst is also quite durable, lasting for more than 100 hours -- a high bar for catalysts to meet.

The study, "Nanostructured transition metal dichalcogenide electrocatalysts for CO₂ reduction in ionic liquid," is published in *Science*. Much of the experimental work was performed at the University of Illinois at Chicago, while the computational work was performed at Argonne.

From a TRIZ/SI perspective, the Carbon Monoxide 'Intermediary' solution represents a lovely illustration of Principle 24 in action. Here's what the basic contradiction being overcome is:

IMPROVING PARAMETERS YOU HAVE
SELECTED:
Energy used by Stationary Object (17)
WORSENING PARAMETERS YOU HAVE
SELECTED:
Stability (21)
SUGGESTED INVENTIVE PRINCIPLES:
35, 4, 24, 40, 17, 14, 18, 1

Read more about the project here:

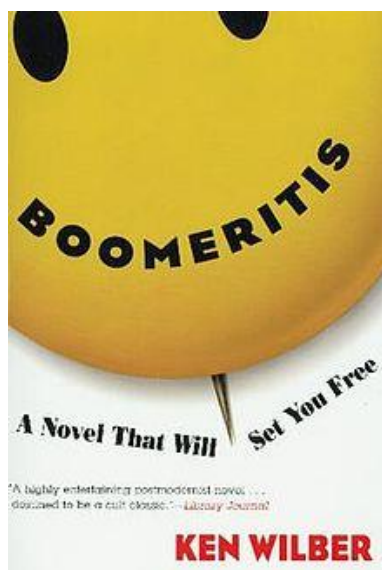
M. Asadi, K. Kim, C. Liu, A. V. Addepalli, P. Abbasi, P. Yasaei, P. Phillips, A. Behranginia, J. M. Cerrato, R. Haasch, P. Zapol, B. Kumar, R. F. Klie, J. Abiade, L. A. Curtiss, A. Salehi-Khojin. **Nanostructured transition metal dichalcogenide electrocatalysts for CO₂ reduction in ionic liquid.** *Science*, 2016; 353 (6298): 467 DOI: [10.1126/science.aaf4767](https://doi.org/10.1126/science.aaf4767)

Generational Cycles – Getting Stuck

As any readers familiar with our TrenDNA work will know, there is a lot of synergy between the Strauss & Howe originated Generation Cycles model and the 'Mental Gears' psychology research of Dr Clare Graves. The two pieces of work indeed form two of the key strands of the 'DNA' defining where societal and market trends come from. In this regard they represent two orthogonal (i.e. independent) axes. Understanding one axis doesn't really tell us anything about the other.

Almost true. We know that during the Gravesian thinking style journey we all embark upon through the course of our lives, the transition from one level of thinking to the next (the addition of a new 'gear' in our mental gearbox) involves overcoming a contradiction. We also now know that each of the different generation archetypes finds some of these contradiction-solving jumps harder than others.

The clearest evidence we have of this kind of Generationally-triggered Mental Gear 'stuckness' comes via the book 'Boomeritis' by Baby-Boomer icon of choice, Ken Wilber.

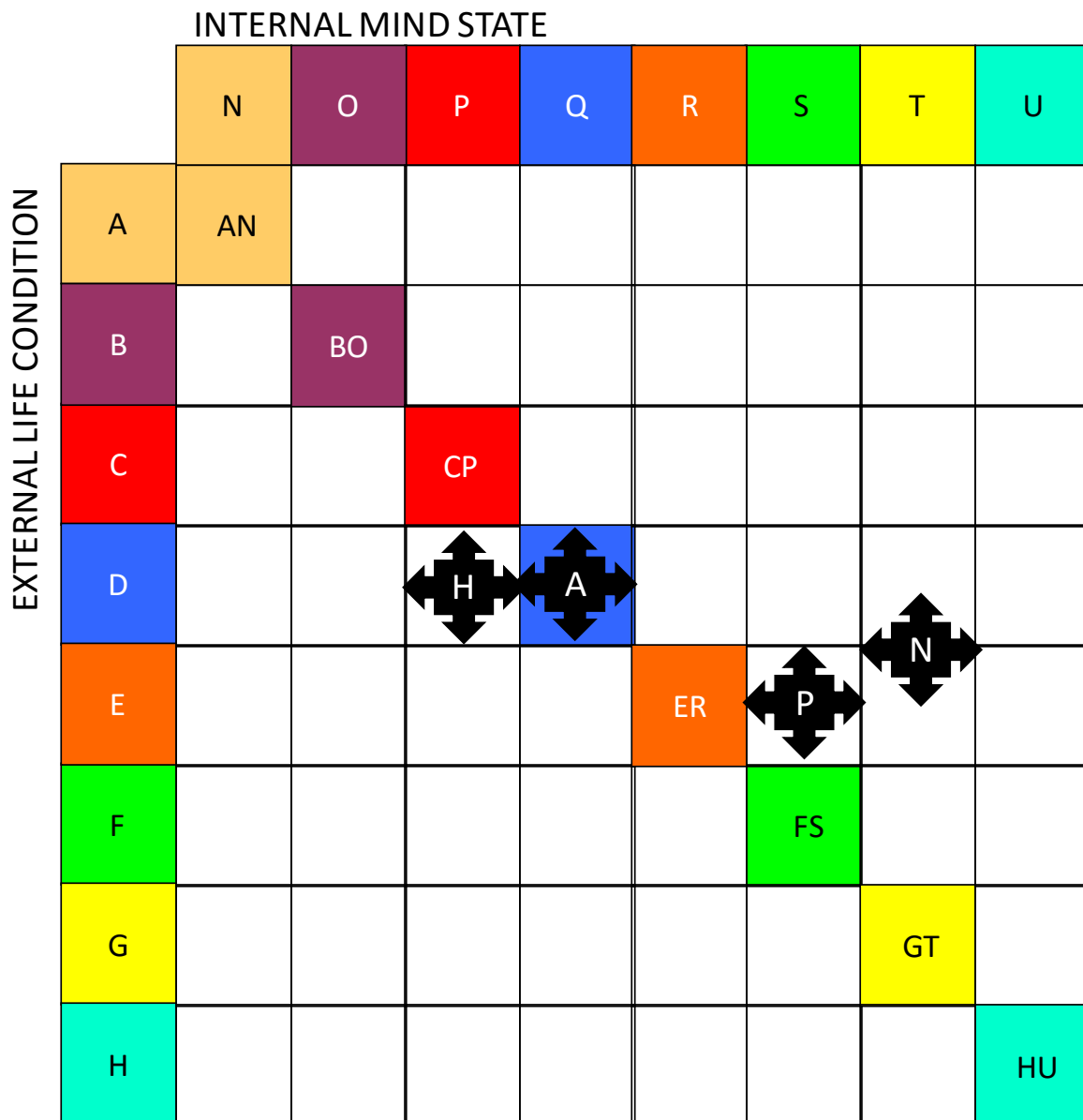



Wilber was an early student of Graves, so he certainly understands the Gravesian Thinking Styles model. Boomeritis is a Baby-Boomer (i.e. Prophet generation) disease. It is all about Prophets getting themselves stuck in the sixth, (Green) 'Communitarian' level. More specifically, Wilber also understood the distinction Graves made between the internal Thinking Style of an individual and the prevailing external environment in which the person finds themselves. More specifically, when we recognize this distinction, Boomeritis is a condition whereby Prophets get stuck in a situation where their internal Communitarian Thinking Style is in tension with the fifth level, 'Scientific' (Orange) environment they created around themselves.

The following graphic is one of the key images from our forthcoming Thinking Styles textbook, 'Everything'. Its main purpose is to make clear the distinction between internal Thinking Style and external context. It also uses the same terminology Graves used when he was formulating the model – the letters A through H representing the 'Thinking Styles' of the external environment, and the letters N through U representing the internal Thinking Style of a given individual.

What we end up with, looking at the graphic, is the more complete idea that, for example, the full Level 6, 'Communitarian' Thinking Style carries the title, 'FS'. Meaning a situation in which the external environment ('F') is congruent with the internal 'Communitarian' Thinking Style ('S'). AN, BO, CP, DQ, ER, FS, GT and HU – the boxes shown in the top-left-to-bottom-right diagonal on the picture – thus represent Graves' full denominations for each of the Thinking Styles.

Complicated, maybe, but ultimately the best way we've found to show where the different Generation archetypes tend to 'get stuck'.



Stuckness is signified in the graphic with the  symbols.

The symbol marked with the 'P' signifies the above described, Prophet-generation, 'Boomeritis' stuck position – Communitarian ('F') Thinking Style individuals stuck in a Scientific ('E') world.

The three other symbols, respectively represent where the other three Generation archetypes tend to get the stuck most as they advance (or not) through their respective lives:

(N) Nomads (Generation X) – are the most individualistic of the four Generation archetypes, so they are most prone to get stuck at the ‘me’-oriented Thinking Styles (N, P, R, T). The one they tend to have most trouble with is the (yellow), Hierarchy Thinking Style, which finds life in the (Blue/Orange) Order/Scientific-dominated society they have to live and work in full of many uncomfortable tensions. Listen to Nomads talk about their work life and very often you’ll hear the phrase, ‘putting on a mask’. Hierarchy Thinkers love freedom above all else, but their need to work and the need to support a (precious) family often mean significant tensions that are very difficult to solve at the best of times. Hierarchy Thinkers, are highly prone to walk away from difficult situations: If there is a more interesting problem to solve somewhere else, that’s where all their instincts tell them to go. But the needs of a family mean that too often ‘walking away’ is not an option. Result: a painful stuck-ness.

(H) Heroes (Generation Y) – have been raised in a highly Protected environment and have been promised by their parents that they can ‘be whatever they want to be’ and don’t have to compromise. This kind of helicopter-parenting means that Heroes tend to get stuck in the very child-like (childish) Feudal (Red, P) Thinking Style. This stuck-ness then becomes compounded when they find themselves in the Order (Blue, D) world of work. A world which tells them there are rules and lots of very non-Heroic jobs that have to get done. The Hero’s mind tells them to escape from such environments and go find a job somewhere else. Their quarter-life crisis tells them that no matter how much they might want to avoid Order-dominated environments, there are ultimately no short-cuts in life.

(A) Artists (Silent Generation and the emerging Generation Z) – get through their (Red) Feudal years thanks to Suffocating Parents that basically tell them to shut up and do what they’re told. As such, in early adulthood, Artists tend to be the most compliant of any of the Generation Archetypes. The (Blue, D) Order world that tends to prevail in the Crisis period that also coincides with the Artists’ early adulthood tends to suit the thin-skinned, no-life-skills Sensitive Artist. The problem comes when they try to break out of this Order. Stuck-ness in the other Generations comes from a tension caused by a mismatch between internal and external Thinking Styles. With the Artists the stuck-ness comes from precisely the opposite: it’s the lack of tension that tends to keep them quietly and comfortably numb.

Biology – Soaring Birds



Migratory birds often use warm, rising atmospheric currents to gain altitude ('Length of Stationary Object') with little power usage when flying over long distances. When glider pilots first learned to 'thermal' it was perhaps one of the earliest examples of biomimicry, and it's definitely a good illustration of a Principle 8 ('Anti-Weight') solution to a clear contradiction. One that looks something like this:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Length/Angle of Stationary Object (4)

WORSENING PARAMETERS YOU HAVE SELECTED:

Power (18)

SUGGESTED INVENTIVE PRINCIPLES:

17, 19, 35, 12, 13, 8, 3, 31

Now, thanks to some recently completed research at the University of California in San Diego, we can take the contradiction story one step further: Thermalling requires complex decision-making within the turbulent environment of a rising column of warm air from the sun baked surface of the earth. Here's how we might map that problem:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Length/Angle of Stationary Object (4)

WORSENING PARAMETERS YOU HAVE SELECTED:

Control Complexity (46)

SUGGESTED INVENTIVE PRINCIPLES:

25, 10, 37, 3, 24, 28, 23

But exactly how birds navigate within this ever-changing environment to optimize their thermal soaring, and what types of Feedback (Principle 23) was unknown until the San Diego team took an exacting computational look at the problem.

In a recent issue of the journal *Proceedings of the National Academy of Sciences*, the scientists demonstrated with mathematical models how glider pilots might be able to soar more efficiently by adopting the learning strategies that birds use to navigate their way through thermals.

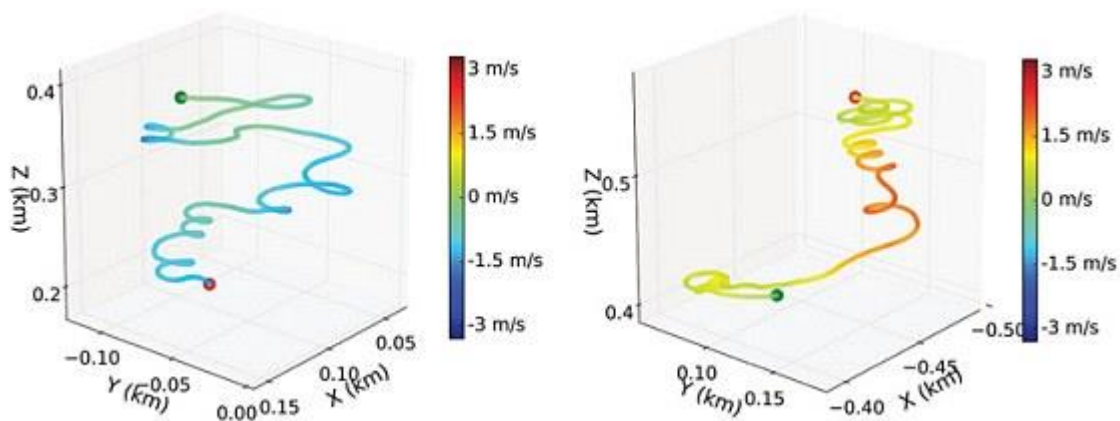
"Relatively little is known about the navigation strategies used by birds to cope with these challenging conditions, mainly because past computational research examined soaring in unrealistically simplified situations," explained Massimo Vergassola, a professor of physics at the University.

To tackle the problem, he and his colleagues, combined numerical simulations of atmospheric flow with "reinforcement learning algorithms" -- equations originally developed to model the behavior and improved performance of animals learning a new task. Those algorithms were developed in a manner that trained a glider to navigate complex turbulent environments based on feedback on the glider's soaring performance.

According to Sejnowski, the (Principle 25) "reinforcement learning architecture" was the same as that used by Google's DeepMind AlphaGo program, which made headlines in 2016 after beating the human professional Go player Lee Sedol.

When applying it to soaring performance, the researchers took into account the bank angle and the angle of attack of the glider's wings as well as how the temperature variations within the thermal impacted vertical velocity.

"By sensing two environmental cues -- vertical wind acceleration and torque -- the glider is able to climb and stay within the thermal core, where the lift is typically the largest, resulting in improved soaring performance, even in the presence of strong turbulent fluctuations," said Vergassola. "As turbulent levels rise, the glider can avoid losing height by adopting increasingly conservative, risk-averse flight strategies, such as continuing along the same path rather than turning."



In the two, three dimensional color graphs (shown above), the scientists illustrate how an untrained glider (at left) takes random decisions and descends, while the trained glider (at right) learns to employ the characteristic spiraling patterns in regions of strong ascending currents, as observed in the thermal soaring of birds and gliders. (The colors indicate the

vertical wind velocity experienced by the glider. The green and red dots indicate the start and the end points of the trajectory, respectively.)

The researchers write in their paper that, based on their study, "torque and vertical accelerations" appear to be the sensorimotor cues that most effectively guide the most efficient soaring path of birds through thermals, rather than differences in temperature.

"Temperature was specifically shown to yield only very minor gains," they write adding that "a sensor of temperature could then be safely spared in the instrumentation for autonomous flying vehicles."

What we think is interesting from this finding is the solution of another 'next' conflict in the chain: the soaring bird needs to be able to manage the complexity of controlling flight, but needs to do it, a) with the minimum amount of (expensive) sensory input, and, b) in an environment which is more difficult to control the more turbulent the atmosphere is. Here's what that problem looks like when mapped onto the Matrix:

IMPROVING PARAMETERS YOU HAVE
SELECTED:

Control Complexity (46)

WORSENING PARAMETERS YOU HAVE
SELECTED:

Stability (21) and Ability to
Detect/Measure (49)

SUGGESTED INVENTIVE PRINCIPLES:

13, 25, 28, 9, 37, 2, 10, 7, 24, 3, 5, 1, 32

Possible interpretations and connections to what soaring birds actually do here include:

Principle 2 – Taking Out (i.e. not using temperature as a measure – slightly ironic in a situation that is fundamentally about 'thermallings')

Principle 37 – Relative Change – i.e. not measuring torque or velocity directly, but measuring their *rate of change*.

"Our findings shed light on the decision-making processes that birds might use to successfully navigate thermals in turbulent environments," said Vergassola. "This information could guide the design of simple mechanical instrumentation that would allow autonomous gliders to travel long distances with minimal energy consumption."

"The high levels of soaring performance demonstrated in simulated turbulence could lead to the development of energy efficient autonomous gliders," said Sejnowski.

Journal Reference:

Gautam Reddy, Antonio Celani, Terrence J. Sejnowski, and Massimo Vergassola.
Learning to soar in turbulent environments. *Proceedings of the National Academy of Sciences*, 2016; DOI: [10.1073/pnas.1606075113](https://doi.org/10.1073/pnas.1606075113)

Short Thort

"You should never, never doubt something that no one is sure of."
Roald Dahl, Charlie and the Chocolate Factory



"One of the vital things for an [innovator] who's [working on a project], which is a lengthy project and is going to take about a year, is how to keep the momentum going. When you are working on it for a year, you go away and you have to come back. I never come back to a blank page; I always finish about halfway through. To be confronted with a blank page is not very nice. But Hemingway, a great American writer, taught me the finest trick when you are doing a long book, which is, he simply said in his own words, "When you are going good, stop writing." And that means that if everything's going well and you know exactly where the end of the chapter's going to go and you know just what the people are going to do, you don't go on writing and writing until you come to the end of it, because when you do, then you say, well, where am I going to go next? And you get up and you walk away and you don't want to come back because you don't know where you want to go. But if you stop when you are going good, as Hemingway said...then you know what you are going to say next. You make yourself stop, put your pencil down and everything, and you walk away. And you can't wait to get back because you know what you want to say next and that's lovely and you have to try and do that. Every time, every day all the way through the year. If you stop when you are stuck, then you are in trouble!"

Roald Dahl again.

News

ELEC

September sees the UK's biggest 'Lean' conference, at the University of Buckingham. Darrell is keynoting on day 1, and then giving a half-day TRIZ Introduction workshop on Day 3 (15 September). In an ideal world, people attend the whole conference. That said, if you're looking to attend a public TRIZ workshop in the UK, it's okay to just book to attend the workshop. Check out the ELEC2016 website for more details.

EvPot+ Software

The new web-based Evolution Potential software is looking for Beta testers Three month's free subscription to the first 50 people that try the software out and give us feedback. Contact trevor.smith@systematic-innovation.com for registration details.

Business Matrix 3.0

The new fold-out sheet is now available for purchase from the SI shop. Printer-permitting, the Business Matrix 3.0 book will be available in September....

Web-Based Matrix+

...we have a race on to see whether the book or the new software will be available first. Again, beta testers welcome.

StarMaker

PanSensic partners, Happen, have recently launched their 'StarMaker' new product launch innovation supertool. Watch the video here... <http://www.happen.com/successful-innovation/innovation-supertools/>

New Projects

This month's new projects from around the Network:

- FMCG – PanSensic personality profiling study
- Healthcare – Patent Bulletproofing Project
- Education – Innovation Strategy Study
- Agriculture – TrenDNA Future Customer Study
- White Goods – Technology Roadmapping Project
- Automotive – Design/Make Project
- Retail – PanSensic Study
- Consumer Electronics – PanSensic StarTracker Project
- FMCG – PanSensic StarTracker Project