Systematic Innovation

e-zine

Issue 180, March 2017

In this month's issue:

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Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.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

Case Study: B2B Intangibles

Everyone involved in the Business-to-Consumer world is at least beginning to understand the importance of designing for the unspoken intangible outcomes customers are looking for. A lot of times those in the B2B world still don't get it. We'll hear sentences like, 'the contract manager is simply looking to get us to reduce our prices', or 'it's all about legal compliance; so long as we're compliant, that's all they want'.

We thought a project with a B2C client with a number of adjacent B2B functions might be useful to let the B2B world see what they're missing out on. The story started a couple of years ago. For what will probably soon become obvious reasons, the name of the client has been removed from the story. We have their permission to 'adapt' the story…

Which begins with their Patent Department. A significant number of the Customer-facing people within the organization understand the ABC-M model and its relationship to mapping customer outcomes. Here's what they suggested to the Patent Department people as a way of rethinking their relationship with their 'customer' – the Patent Examiner at the Patent Office:

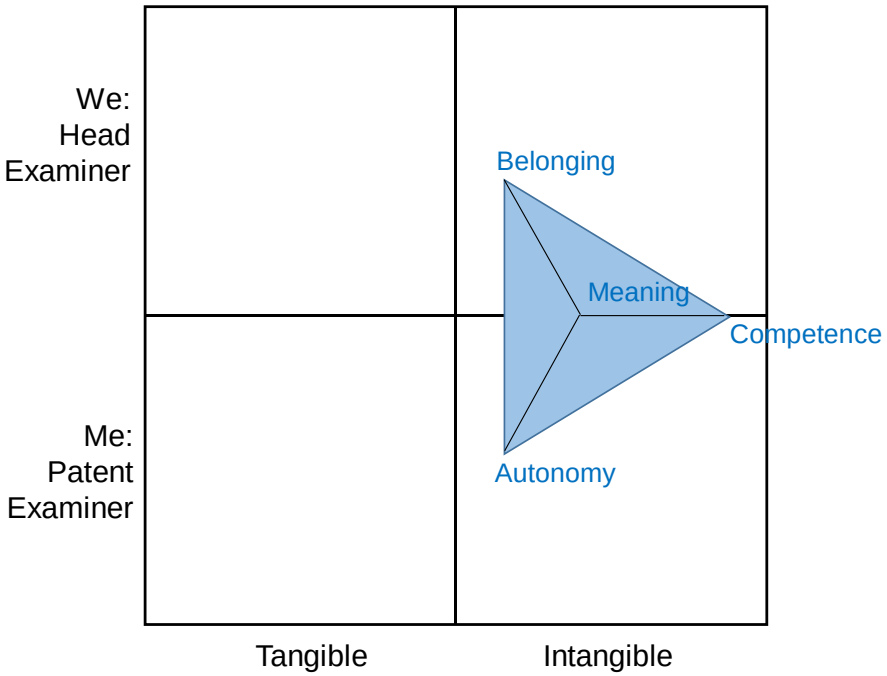


Figure 1: ABC-M Intangible Outcomes Model Inserted Into Outcome Map

It was the first time the Patent Department had seen the model. After getting used to the idea that the Patent Examiner was a 'customer', and even more strangely, a customer with human needs and wishes, they proceeded to use the ABC-M model as a way of mapping the outcomes that might drive the Examiner's behavior.

As in the consumer world, the ABC-M model starts from the premise that we don't need to directly go and talk to customers in order to understand what drives their emotional behavior. Figure 2 reproduces some of the thoughts written down by the Patent Department team when asked to think about the outcomes their Examiner 'customers' were looking for:

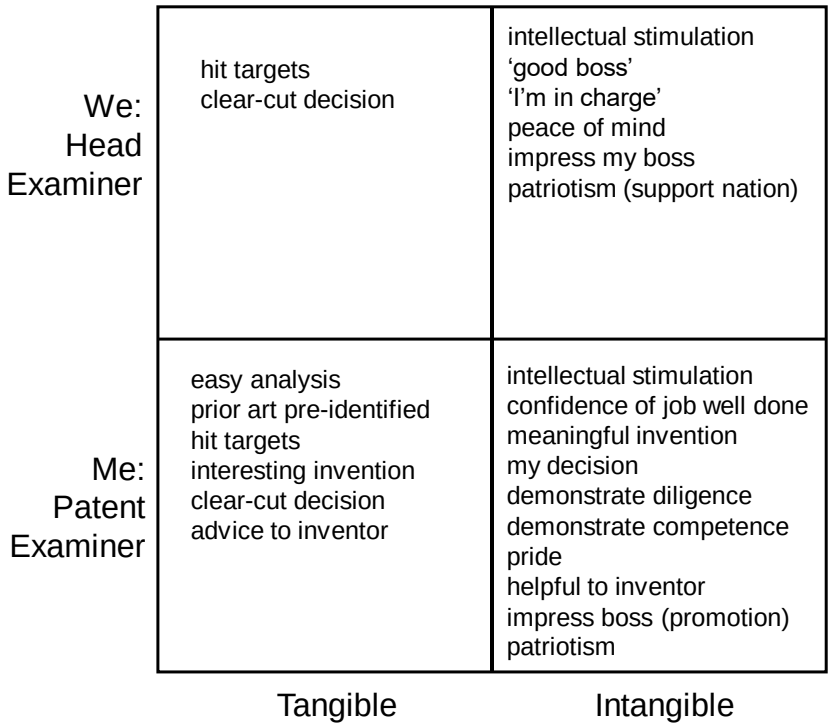


Figure 2: ABC-M Intangible Outcomes Map For Patent Application Submission

Suddenly the very transactional, anonymous relationship that the Department had previously assumed was inherent to their dealings with the Patent Office didn't look quite as cut and dried as they'd previously assumed. The Examiner has ABC-M needs. And so does their boss.

How to make the Examiner into a 'hero' in the eyes of their boss? That became a question worthy of a good answer. This was already quite a turn-around. The Examiner up to this point had been seen as some kind of adversary. The guardian of officialdom. Now, it seemed, they were a friend in need. Albeit one that was somewhat remote and inaccessible.

This seemed like an intriguing conflict. We had a quick look at the Business Contradiction Matrix.

One of the Inventive Principles to unexpectedly turn up was number 9, 'Prior Counter-Action.

And from there came the following idea: normally, we seek to write the best possible invention disclosure we can. No matter how good we make it, it always seems like the Examiner comes back with some kind of a query. How about if we write a 'less good' invention disclosure. One, for example, that contains a mistake or two. Not obvious mistakes, but ones that the Examiner will have to work to find?

This way, maybe, everyone gets to win: the Examiner gets to find a problem so they get a big tick from their boss, 'well done, I can see how diligent you were'. The Examiner's boss gets to feel that his team is working hard. The inventor, maybe, gets to avoid the problem of Examiners inventing things to challenge them on. The whole system works more smoothly. A contradiction is solved.

The Morality Of Toast

I've known it for a while, of course. The main job of conferences is to make me angry. Great for sparking some deeper thinking, not so great for my mental health. Which is why I have to limit how many and which ones I attend. I learned something this year: some conferences are more hazardous to health than others. It's not just how many conferences I attend that affects my health, it's also how toxic they're likely to be. The main toxicity driver seems to be the number of politically-correct liberals in attendance. It often takes an extreme example to make the realization hit home. Like toast. Surely not the sort of topic that people should expect to get upset about. But apparently, nothing is off limits these days. Enter the main protagonist, Professor Invertebrate. Who is telling the audience about his moral dilemma with the aforementioned carbonized bread. It's really bad for people, the good Professor began telling us, hands-wringing uncomfortably, I'm concerned that my research will be seen as endorsing the consumption of more toast.

At first I thought he was joking. I looked around the rest of the audience, thinking they were all waiting for the punch-line like I was. They weren't. Apparently, the Professor had hit an uncomfortable nerve. Nay, within the next couple of minutes, he'd sparked a liberal hand-wringing epidemic. I was in political-correctness Hell.

Here's the problem. All of this getting offended on behalf of others actually has the exact opposite of the intended effect. It assumes that a 'command and control', 'I know better than you' strategy will be helpful, when in reality it just creates a horrible downward spiral in which we all – society – find ourselves seemingly unable to say anything at all without offending someone. Command-and-control and complex systems do not make for useful companions. Try and command and control a complex system and all you do is push everyone to the edge of chaos.

The toast episode was the final straw for me. Before the end of Professor Invertebrate's naïve ill-conceived diatribe was over, you'd have thought he was responsible for the creation of a napalm replacement. I'm sure I wasn't the only one in the audience who was thinking, maybe we've stepped a tad too far away from sanity here, but, as I looked around the room, it was clear no-one was going to say anything. And when nobody feels able to call out stupidity when we hear it, we're all in trouble.

Here's what I think was happening in the morality-of-toast sermon:

SYSTEM ATIC INNOVAT ION

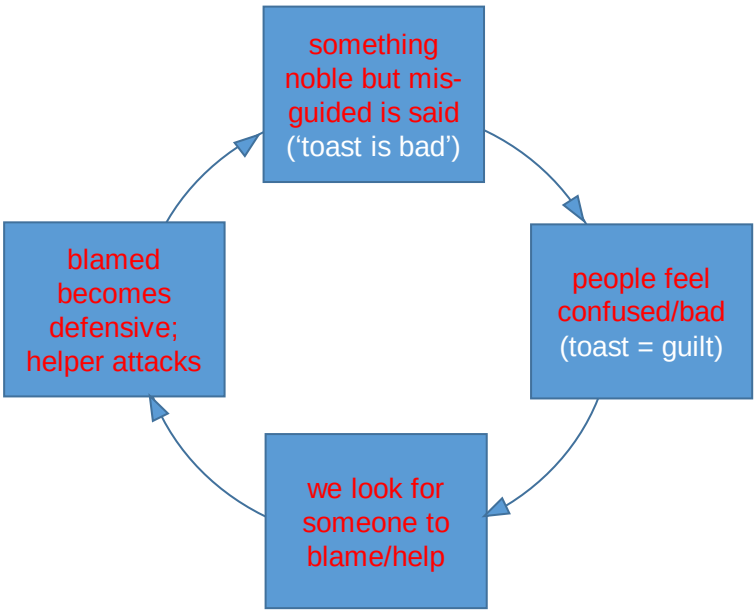


Figure 1: Generalised Version Of Political-Correctness Downward Spiral

That was almost the exact picture I drew while I was sat there gritting my teeth and trying to rationalize why the room had gone nuts. It felt like I was on to something, but the more I thought about it, the more I realized I was trying to encapsulate several different downward spirals into one central 'root-contradiction' cycle, and the complexity of the situation wasn't going to allow such a thing to happen.

What I needed, I eventually worked out (a few days later, I might add, after my initial anger at Professor Invertebrate's nonsense had subsided), was to look at the different stakeholders involved in a generalized situation in which a political-correctness-Nazi feels the need to step in to a situation where they see something 'bad' happening.

Figure 2 illustrates the basic vicious cycle people like Professor Invertebrate very easily find themselves trapped in:

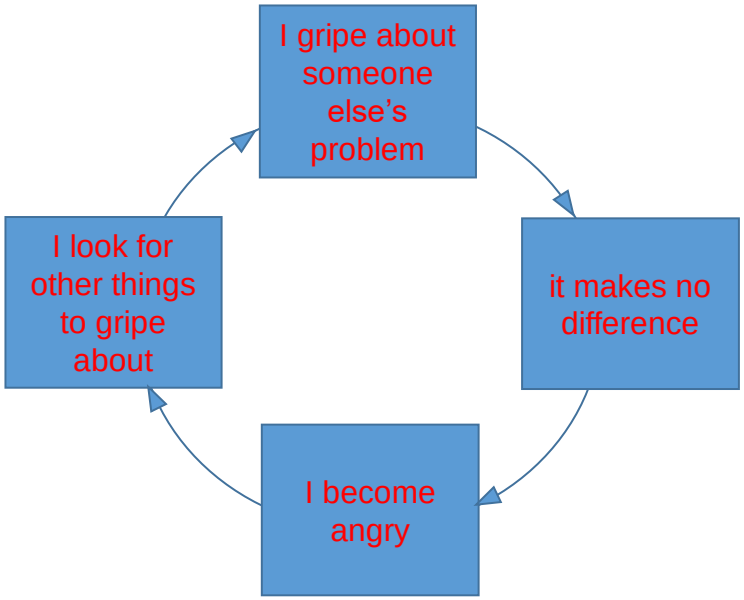


Figure 2: Proxy-Offendee Vicious Cycle

The more people like the Professor interferes in other people's problems, the less impact they have, the angrier they become, the more they look around for other things to whine about.

This is a sad state of affairs. But not nearly as toxic as the effect they have on the actual person that is suffering from the supposed bad thing. Figure 3 makes an attempt to represent the vicious cycle the Politically-Correct intervener has on the only important person in the story, the victim:

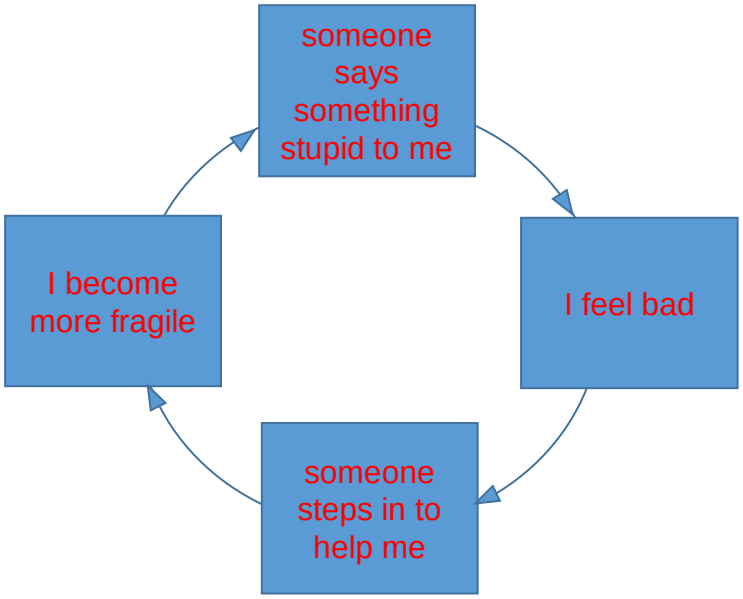


Figure 3: Victim Downward Spiral Resulting From Politically-Correct Third-Party Intervention

The politically-correct intervener, according to this cycle serves only to make the victim more and more fragile. The best of intentions, in other words, serves to deliver the worst of outcomes. This is what Command-and-Control does. It tampers with what would have otherwise been a self-organising system that would have worked out virtuously for the victim. That virtuous cycle looks something like the image shown in Figure 4:

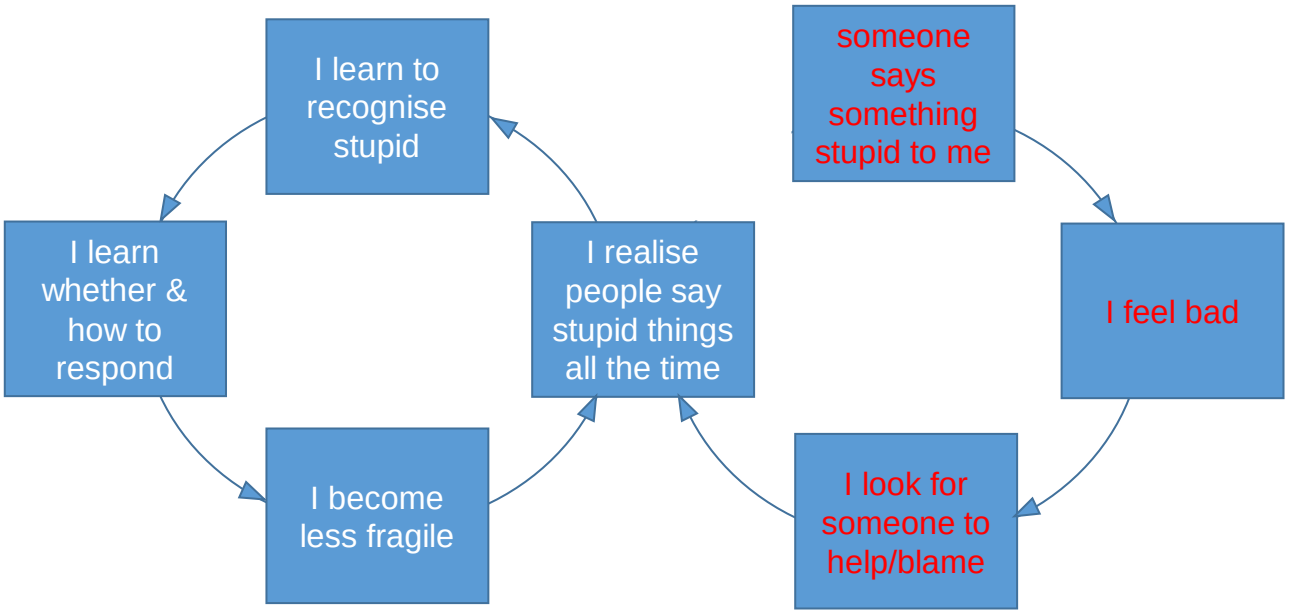


Figure 4: Naturally Occurring Victim Self-Correction Cycle When Third Party Support Is Absent

When people are nasty to us, it never feels good. It's not supposed to. The discomfort we feel is the mechanism that forces to get out of our comfort zone and learn something. What we are likely to learn in the situation when people say dumb things to us is that it was indeed dumb, and that dumb stuff happens all the time, not just to me, but to everyone else as well. We're all victims at some time or other of dumb stuff. The more I realise that dumb stuff is merely that, the less fragile I learn to become. That's why, when we look at the background of some of the most famous and successful people on the planet, we see they got where they did thanks to their ability to overcome adversity and this kind of virtuous harm-into-good cycle.

So much for the victim, now let's have a look at the world from the perspective of the person saying the dumb thing. First up, what happens when Professor Invertebrate gets involved and makes their adverse comment:

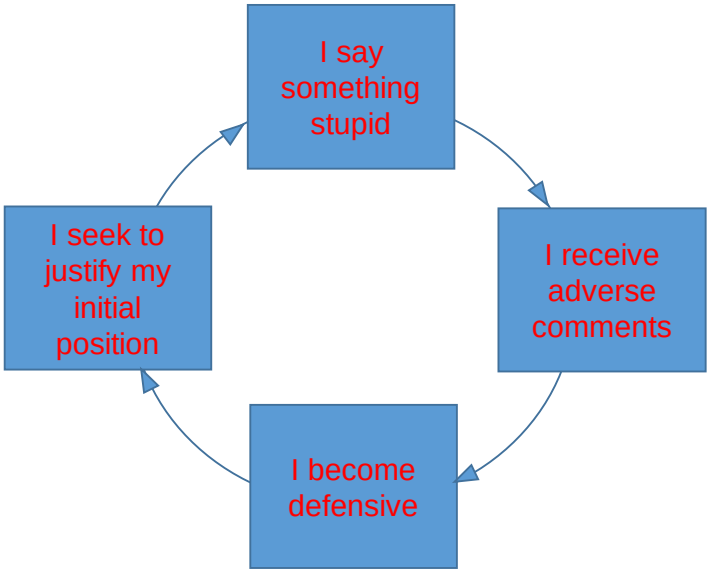


Figure 5: When People Saying Dumb Things Get Called-Out By The Politically Correct

Calling dumb comments out, makes the person saying the dumb stuff defensive and this in turn starts a downward spiral of more and more dumb stuff. Contrast this with what happens when the Politically Correct liberal learns to shut up:

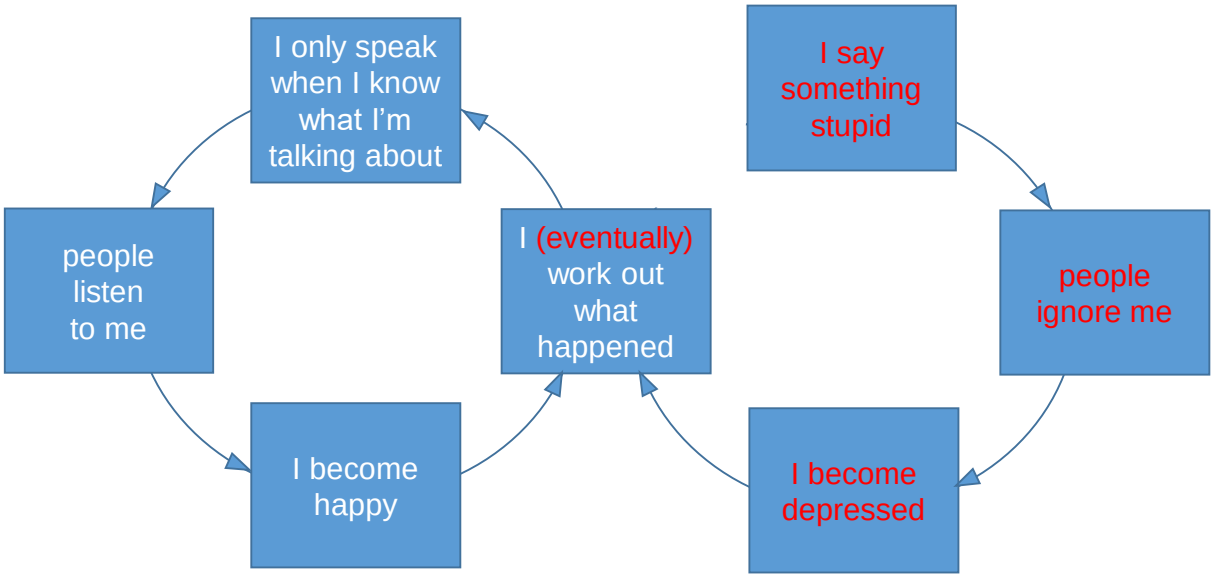
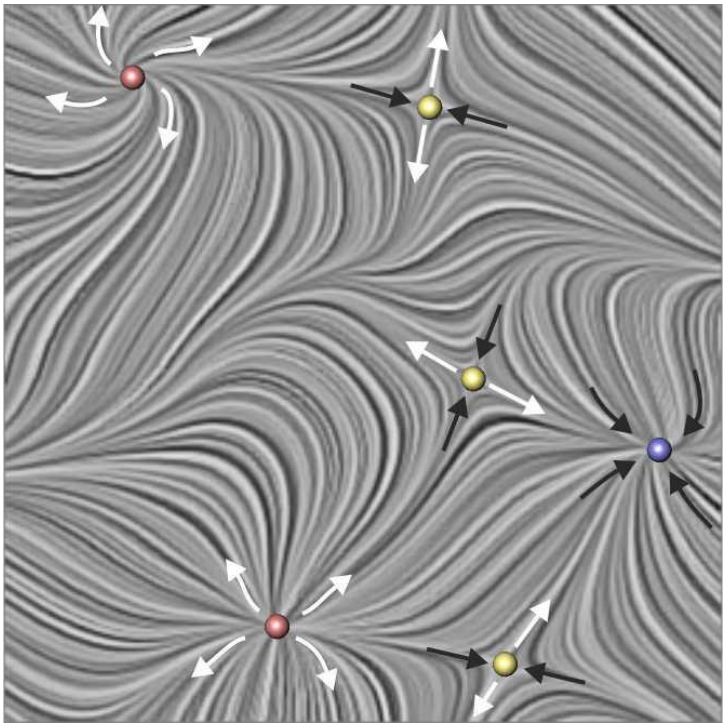


Figure 6: When People Saying Dumb Things Are Ignored

Without Professor Invertebrate in the picture, people that say dumb things learn to say them less. It's counter-intuitive – to the politically correct liberals at least – but that's the way the world used to work: an ocean of virtuous and vicious cycles we all (naturally) learn to navigate, provided we keep command-and-control out of the picture.



Tamper with complexity and we only make things worse. Time for the politically correct to be shown the impact of their naivety: best intentions delivering worst outcomes.

So is toast bad for us or not? Let the self-organising system tell you the answer not some politically-correct scientist with no skin in the game: Eat too much toast and you'll become obese and your pants don't fit anymore. That's a signal to eat less of it, dummy. Don't eat enough toast and you'll feel like you're missing something in your life. That's a signal to go and eat more of it. Two balancing feedback loops mean we'll eventually realise how much toast we should allow ourselves to consume. It's not rocket science.

It's time to call out the politically correct: they think they're helping. Now we know they're not, and, more importantly, that we have the answer to whatever bullshit they come out with to try and shut us up: they're best intentions turn virtuous cycles into vicious ones.

We (the West) have forty-plus years' worth of political correctness to unwind, so its not going to be an overnight job. Political correctness, for the moment at least, isn't a crime, but if anyone's interested, I'm happy to start a petition if it will help speed things up.

Not So Funny – 2016 Darwin Awards

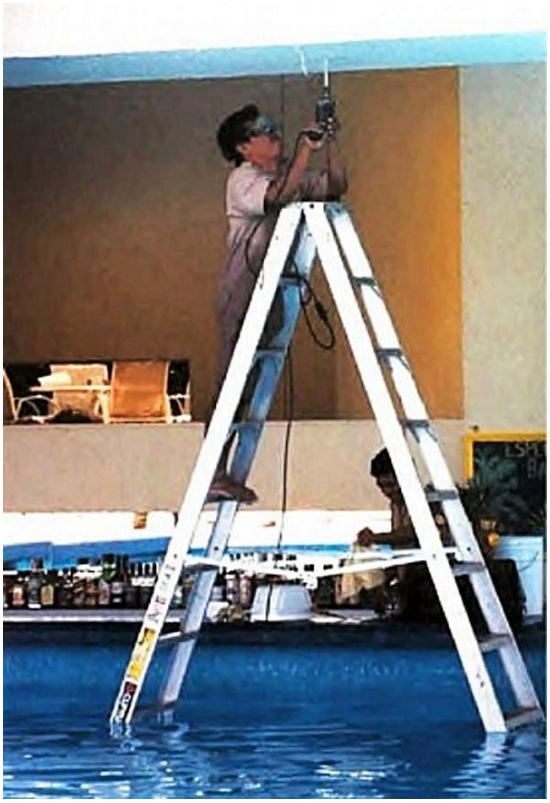
As we all know by now, there are two kinds of invention. The good kind and the not good kind. The Darwin Awards are all about rewarding the latter type. They need encouragement too. And, if we do the job right, they give us a whole new set of insights into TRIZ and the Inventive Principles.

Here's what that means in practice. First up, Inventive Principle 14. Or maybe 12?

The rather less frequently used, Principle 30, Flexible Shells & Thin Films…

SYSTEM ATIC INNOVAT ION

Not sure where to start with this next one. I suppose, strictly speaking this is a Principle 17 solution to an ‘I want a hole, but I don’t want to drain the pool’ conflict. When what was really needed was probably a tad more Principle 11. Electric drills and swimming pools? A winning combination.



I still haven’t quite worked out whether the bottles on the side of the pool are part of the problem or the solution. Maybe this is as much about Principle 38 as anything else?

Less doubt with this one. Step up Principle 24, your time has come…

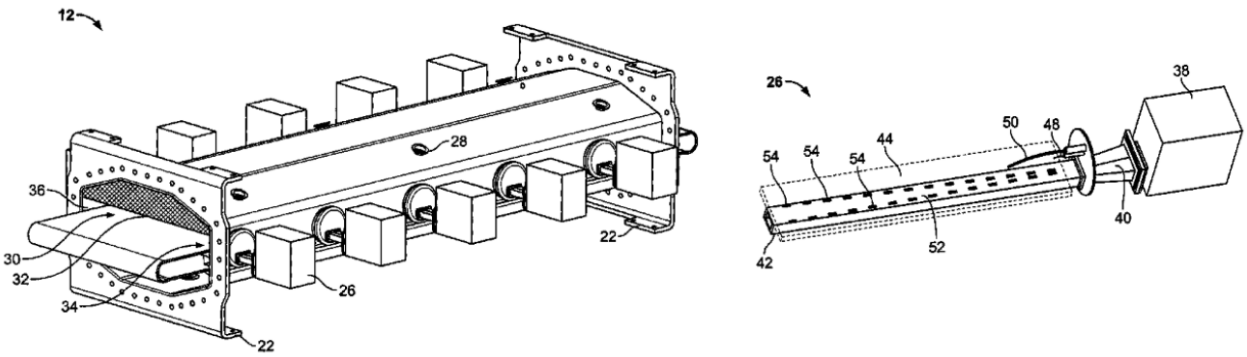
SYSTEM ATIC INNOVAT ION

All pretty good, but I think here's my candidate for the winner. As discussed many times before, there is a strong correlation between the number of Principles on display and the quality of the solution. See how many you can spot here…

Start, damnit, start.

SYSTEM ·ATIC INNOVAT· ION

Patent of the Month – Microwave Dehydration



Patent of the month this month goes to a company we've been tracking for some time now. Real innovation in the food industry is somewhat sporadic and very few seem willing to go for the bigger jumps. Nuwave Research of British Columbia, Canada is one of those 'bigger jump' companies. Their focus is food dehydration, and the opportunity they've been focusing on is making the technology simpler, more portable, and, above all, lower energy, where, with the results of this just-granted patent, they're now able to claim an 85% reduction over the previous state of the art. The patent in question is US9,585,419, which was granted to the company on 7 March.

Here's what they have to say about the problem to be solved:

The dehydration of various materials by exposure to microwave radiation at reduced atmospheric pressures is well studied. In general, a reduction in atmospheric pressure reduces both the boiling point of water and the oxygen content of the atmosphere. Vacuum microwave dehydration, VMD, processes may accordingly permit dehydration to occur in the absence or reduction of oxygen, and without exposing the material that is being dehydrated to significantly elevated temperatures, thereby yielding dried products that may have better physical, organoleptic and/or chemical qualities as compared with dried products obtained using other known dehydration processes such as hot air convection or freeze drying. VMD processes may also be relatively quick and energy-efficient as compared with many other dehydration processes. Temperature and/or oxygen sensitive materials of the sort that are known to be amenable to drying by VMD include, but are not limited to, food products such as fruits, vegetables, berries, herbs, meats, fish, seafood, dairy products, prepared foods, seeds, grains, roots and tubers, as well as a wide variety of agricultural feed products, pharmaceutical and nutraceutical products, dietary supplements, synthetic organic compounds, and the like.

As is well known, VMD may be carried out as a batch or continuous process, and a typical VMD apparatus will comprise at least a vacuum chamber (in which an input material is dehydrated into an end product), a source of microwave radiation, and associated sensing equipment (e.g. infra-red detectors) and control equipment (e.g. a programmable logic controller, "PLC") to monitor the status of the product during the dehydration procedure and to make desired or necessary adjustments. For example, such monitoring may include monitoring the surface temperature of the material (such as by using infrared detection) or surface texture (e.g. wrinkling). In continuous VMD processes, the apparatus will also typically comprise input and output means such as air locks that permit the input material and end product to enter and exit the vacuum chamber, respectively, without disrupting the vacuum level, and a conveying means (e.g. a conventional conveyor belt) to convey the material through the vacuum chamber between the input and output ends.

It has generally been established in relation to known VMD processes that a higher microwave

field strength will have a greater effect (as measured over the complete drying cycle) on increasing the rate of dehydration than does a deeper vacuum. A primary focus of current state of the art VMD apparatus and process engineering has accordingly been to maximize the intensity of microwave radiation that can be applied to the material being dried.

In keeping with the general objectives of maximizing microwave field intensity while controlling the temperature gain of the material being dried, the microwave emitters (e.g. magnetrons) of current VMD apparatuses are typically located outside of the vacuum, or irradiation chamber where they may be operated under atmospheric conditions (and protected from the conditions within the chamber). The microwave radiation generated by the emitters enters the vacuum chamber through one or more microwave-transparent windows typically after being conveyed through one or more waveguides. Various microwave waveguides are known in the art. Non-gas dielectric waveguides include microstripline, coaxial, and stripline types. However, such dielectric waveguides convert some of their energy into heat (i.e. are "lossy"), and typically cause microwave fields to be established on the outside surfaces of the waveguide. For most microwave applications, this results in microwave radiation interacting with anything that happens to be near the dielectric waveguide. For these reasons, the waveguides used to convey microwaves from the emitter to the irradiation chamber are generally also maintained outside of the chamber. Such placement serves to reduce the occurrence of high voltage standing waves caused by reflection of microwaves, which may lead to arcing within the waveguide. Thus, in typical known microwave dehydration apparatuses and methods, the material to be dehydrated is generally subjected to microwave radiation in the far-field region.

In general, as is known in the art, the power density in the electromagnetic far-field region is reduced as the square of the distance from the source.

That last sentence does a pretty good job of defining the contradiction: the microwave problem is a power-versus-distance problem. Which looks something like this when we map it onto the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Power (18)

WORSENING PARAMETERS YOU HAVE SELECTED:

Length/Angle of Stationary Object (4)

SUGGESTED INVENTIVE PRINCIPLES:

17, 14, 1, 35, 4, 28, 10, 29, 30

The solution to the problem represents a classic if subtle example of Principle 35. Not one of our favourite Principles, because ‘Parameter Change’ often sounds like an optimization strategy. The key to using the Principle is changing a parameter in such a manner that a non-linear shift occurs. The ‘non-linear’ shift in this case being that by physically moving (clue from Principle 17?) the magnetron from the far-field to the near-field a very substantial shift in behavior of the microwaves takes place:

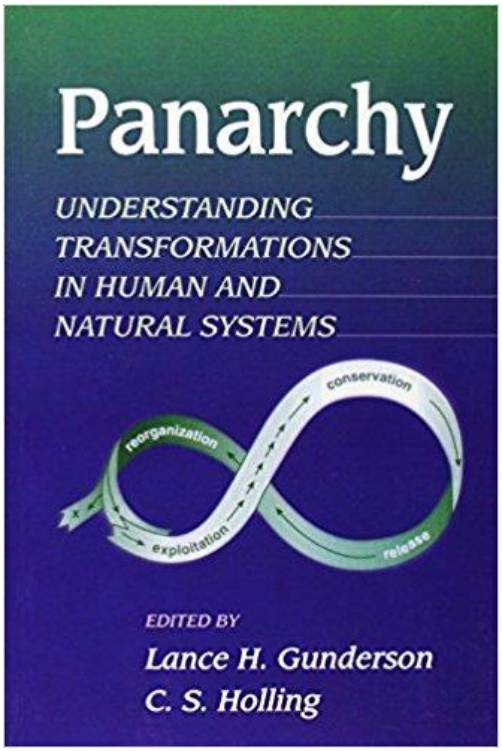
…within the near-field region (i.e. a distance that is within about one wavelength of the electromagnetic radiation, but possibly extending so far as to include a transition zone ending within about two wavelengths), very high electromagnetic fields that do not decrease as the square of the distance may occur. This enables relatively high field strengths to be developed within the near-field region… Without being restricted to any particular theory, it is believed that exposure to microwave radiation at such proximity results in ***evanescent coupling*** *of the electromagnetic*

radiation emitted by the waveguide (acting as a source) and the material (acting as a receiver).

The key here is the ‘evanescent coupling’. I’m not a physicist, but an evanescent field, or evanescent wave, is an oscillating electric and/or magnetic field which does not propagate as an electromagnetic wave but whose energy is spatially concentrated in the vicinity of its source. All the input energy, in no doubt grossly over-simplified terms, stays in a ‘trapped’ zone and isn’t able to dissipate and be lost. Couple that with a bit of resonance – microwaves operate at the resonant frequency of water molecules – and a partial vacuum and that’s where the 85% energy reduction comes in to play. Lovely stuff.

The Nuwave Research website is pretty sparse on detail, but worth a look anyway to see how the IP is being commercialised: www.nuwaveresearch.com

Best of the Month – Panarchy

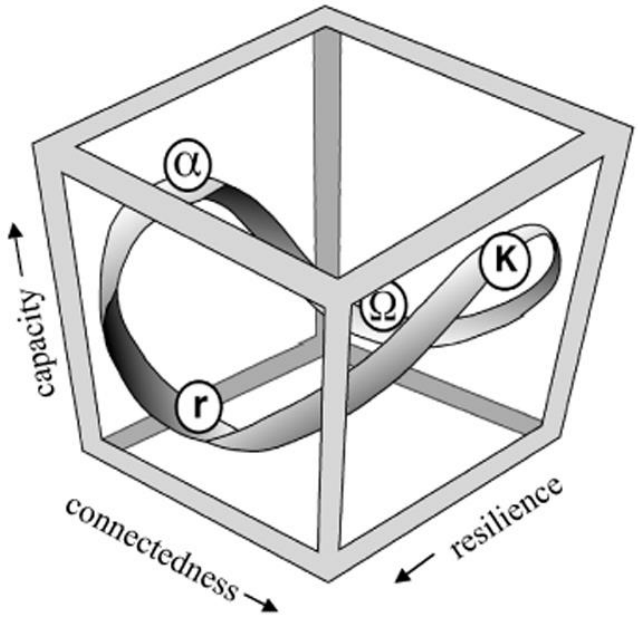


A tough one this month. Not an easy read, but I can safely say that this is a (2002) book that has knocked me out of my comfort zone into productive new places more than any other in the last three or four years. Perhaps mostly because it crosses so many boundaries. The book is somewhat unique in this attempt to bridge different disciplines. It examines the connections between ecology, sociology and economics related to the concepts of resilience and sustainability. It is primarily about the explication of a particular theory - the theory of panarchy, which basically posits ideas about how connections across different scales (both in time and space) affect resilience. While there are moments where the reading is tough if you do not have a background in all three disciplines, the book is still more than worth persevering with. For me, it was one of those rare books which noticeably changed the way I think about how the world works. It deepened my understanding of what makes ecosystems resilient and exposed for me a number of misconceptions I (and TRIZ!) had held up to this point.

It is difficult to work in such a transdisciplinary way and occasionally the connections between the three disciplines could be tighter. This does not detract at all from the overall development of idea, however. It is also difficult to establish coherence in a book where chapters are contributed by a variety of authors. This is achieved unexpectedly well in this volume, however. It is obvious that the authors of each chapter are familiar with the content of the other chapters, and for the most part the book reads as if it were written by a single author, with the development of ideas across the various chapters being relatively seamless.

No system can be understood or managed by focusing on it at a single scale. All systems (and Socio-Economic systems especially) exist and function at multiple scales of space, time and social organization, and the interactions across scales are fundamentally important in determining the dynamics of the system at any given focal scale. This

interacting set of hierarchically structured scales has been termed a "panarchy" (Gunderson and Holling 2003).

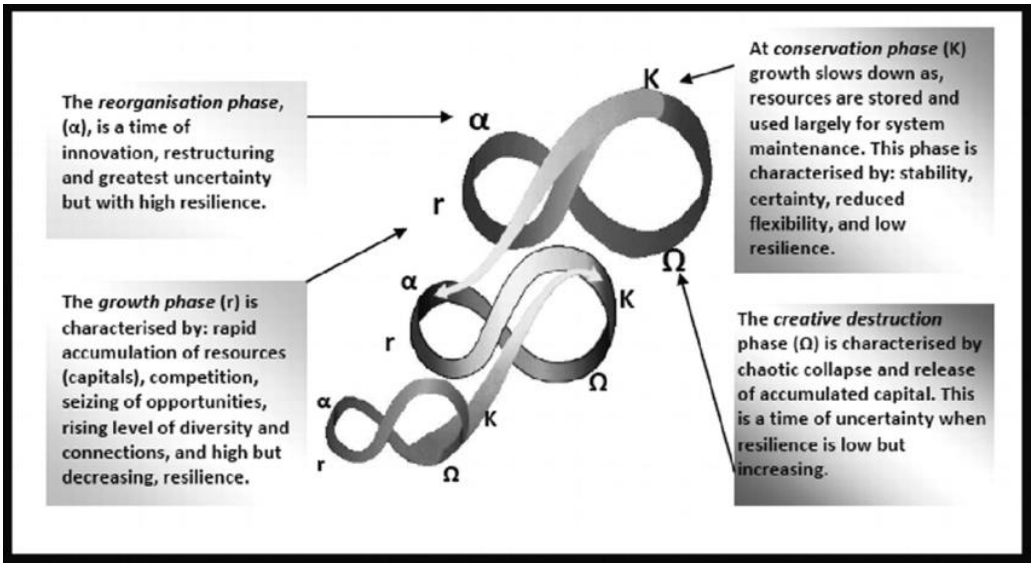


Panarchy is a framework of nature's rules, hinted at by the idea of both ‘pan’ as in the latin for ‘all’, and then also the name of the Greek god of nature- Pan - whose persona also evokes an image of unpredictable change. Since the essential focus of Panarchy is to rationalize the interplay between change and persistence, between the predictable and unpredictable, the authors draw on the notion of hierarchies of influences between embedded scales to represent structures that allow adaptive evolution.

The panarchy framework connects adaptive cycles in a nested hierarchy. There are potentially multiple connections between phases of the adaptive cycle at one level and phases at another level. Two significant connections are labeled 'revolt' and 'remember'. The smaller, faster, nested levels invent, experiment and test, while the larger, slower levels stabilize and conserve accumulated memory of system dynamics. In this way, the slower and larger levels set the ‘pulse rate’ within which faster and slower ones function. Thus, a forest stand moderates the climate within the stand to narrow the range of temperature variation that the species experience. But missing in this representation, is the dynamic of each level which is organized in the four-phase cycle of birth, growth and maturation, death and renewal (here, I wish we’d had more of a connection to s-curves in the book). That cycle is the engine that periodically generates the variability and novelty upon which experimentation depends. As a consequence of the periodic, but transient phases of destruction (omega stage) and reorganization (alpha stage), a system's structure and processes can be reorganized. This reshuffling allows for the establishment of new system configurations and opportunities for the incorporation of exotic and entirely novel entrants into the system. The adaptive cycle explicitly introduces mutations and rearrangements as a periodic process within each hierarchical level in a way that partially isolates the resulting experiments, reducing the risk to the integrity of the whole structure.

In addition to this creative role, Pan has a destabilizing role that is captured in the word panic, directly derived from one facet of his paradoxical personality. His attributes are described in ways that resonate with the attributes of the four-phase adaptive cycle; as the creative and motive power of universal nature, the controller and arranger of the four

elements- earth, water, air and fire (or perhaps, of K, alpha, r and omega). He therefore represents the inherent features of the synthesis that has emerged in this comparison of ecological and social systems.



Not sure whether that little lot puts you off or makes you inclined to get hold of a copy of the book. If I were in your position, I think I'd brace myself and get ready for an exhilarating ride. It's a wonder to me that this book has somehow find itself lost in the noise in the 15 years since its first publication. Time to right the wrong.

Wow In Music – Spirit Of Eden

This month, the focus is on a rare thing in the world of music. An album-length ‘wow’.

The Prelude

First up, Guy Garvey of Elbow, talking to *Mojo* last year: ‘Mark Hollis started from punk and by his own admission he had no musical ability. To go from only having the urge, to writing some of the most timeless, intricate and original music ever is as impressive as the moon landings for me.’ Talk Talk, it may be said with some degree of confidence, did not start as they meant to go on.

Their debut album, 1982’s *The Party’s Over* forecast an optimistically commercial career as frontman and singer Mark Hollis, drummer Lee Harris, bassist Paul Webb and keyboard player Simon Brenner scored a hit with their eponymously titled single. After the departure of Brenner and with the addition of producer and co-writer Tim Friese-Greene, they climbed even greater commercial heights, as the title track of their second album *It’s My Life* became an international hit.

Labelled a synth-pop act, Talk Talk was often lazily compared to Duran Duran. However, Hollis’ distinct vocal style and his often moralistic and keen observational lyrics couldn’t be compared to Duran Duran’s more frivolous subject matter. In fact, Hollis later revealed that the only reason the band used synths is because they couldn’t afford to use full instrumental orchestration.

For their next album *The Colour of Spring* they branched out and used a richer palette of organic instrumentation such as the harp and dobro, further separating them from their new wave contemporaries. This record became the band’s biggest-seller and included their hit ‘Life’s What You Make It’. Now they were in more secure financial position to record the album Hollis had always wanted to record: one that was first considered a commercial failure but has since been recognised as their opus.

The Recording

This time around Hollis and company with a specific overarching setting in mind: a 3am recording session in 1967, using only amps and microphones that were around prior to

1967. They also decided to record in a different manner, entering the studio with only sketches of songs allowing for more experimentation. They were inspired by the new digital recording hardware as it allowed them to cut and paste pieces of music multiple times without the degeneration that occurs with analogue tape. This enabled the band and their roster of guest talent to improvise much like a jazz band. A musician would play an idea and Hollis and Friese-Greene would manipulate and arrange into a structure afterward which fostered a fluidity, as Hollis told *The Sunday Times*, “A musical idea will never be as good as the first time it’s expressed.” (Big contradiction: ‘we want to be in the moment *and* structured’.)

They settled in at London’s Wessex Studios along with engineer Phil Brown who in an interview with *The Guardian* recalled an “endlessly blacked-out studio, an oil projector in the control room, strobe lighting and (Principle 5) five 24-track tape-machines synced together. Twelve hours a day in the dark listening to the same six songs for eight months became pretty intense. There was very little communication with musicians who came in to play. They were led to a studio in darkness and a track would be played down the headphones.”

Guest musicians included bassist Danny Thompson (Pentangle, Nick Drake), The London Symphony Orchestra’s clarinettist Andrew Marrine, Nigel Kennedy on fiddle, master-harmonic player, Mark Feltham, Pretender’s guitarist Robbie McIntosh and the Choir of Chelmsford Cathedral amongst others. They were asked to improvise not to a finished piece but only to a fragment of a single instrument (Principle 2). By the end of recording, Hollis and Friese-Greene had nearly 800 fragments. Unsurprisingly, it took them nearly a year to complete the album.

The Music

Because of the laborious recording and arranging process, one would think the end result would sound disjointed, but instead the album as a whole piece sounds seamless. *Spirit of Eden* is comprised of six haunting, evocative, moody and mysterious compositions, none of which could be considered a hit single in the traditional sense.

The record is an intense listen marked by beauty and abrasion (Principle 37), and a sparseness that is both intimate and expansive. Hollis has often mentioned Miles Davis as a huge inspiration, and on this album you can hear that he took heed of legendary trumpeter’s most famous (Principle 1/13/31) quote, “Music is the space between the notes. It’s not the notes you play; it’s the notes you don’t play.”

And it was a marked departure from their previous efforts. Hollis told *The Wire*, “It was just not wanting to repeat what you’ve done. All the time, you’re getting older and everything and nothing is static It feels far more bizarre to me that there should be no change. That feels really very weird to me.”

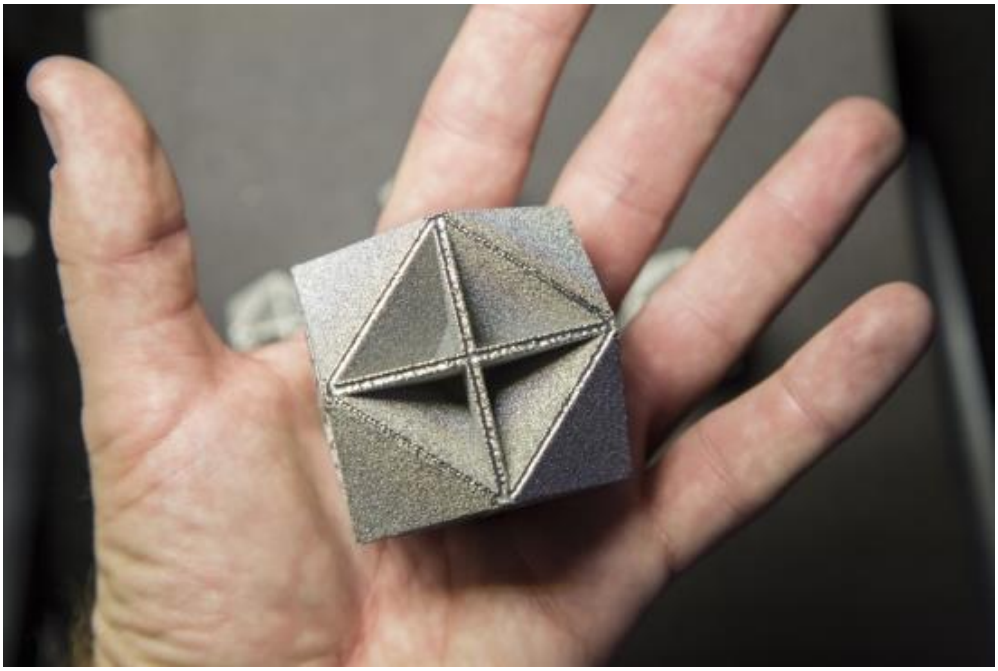
The Reception

Talk Talk’s record label EMI were horrified when they first heard the album and tried to encourage Hollis to work on a couple of the songs to make them more commercially-friendly. He refused. A brave decision at the time, but one that went on to pay great dividends.

The album did not sell nearly as many as Talk Talk’s previous efforts yet with time, it has become a cult classic and one of the most influential albums of all time. It is often regarded as one of the first post-rock albums, a genre later championed with great success by Radiohead, Bon Iver and Sigur Ros. It seems Talk Talk were several years

ahead of their time, to the point that *Spirit of Eden* still sounds contemporary and relevant today. It's also a great contradiction-solving listen from beginning to end.

Investments – Isomax



In 2015 UC Santa Barbara mechanical engineer and materials scientist Jonathan Berger developed an idea that could change the way people think about high-performance structural materials. Two years later, his concept is paying research dividends.

In a letter published in the journal Nature, Berger, with UCSB materials and mechanical engineering professor Robert McMeeking and materials scientist Haydn N. G. Wadley from the University of Virginia, prove that the three-dimensional pyramid-and-cross cell geometry Berger conceived is the first of its kind to achieve the performance predicted by theoretical bounds. Its lightness, strength and versatility, according to Berger, lends itself well to a variety of applications, from buildings to vehicles to packaging and transport.

Called Isomax™, the beauty of this solid foam — in this case loosely defined as a combination of a stiff substance and air pockets — lay in the geometry within. Instead of the typical assemblage of bubbles or a honeycomb arrangement, the ordered cells were set apart by walls forming the shapes of pyramids with three sides and a base, and octahedra, reinforced inside with a “cross” of intersecting diagonal walls.

The combination of the pyramid and cross-shaped cells, said Berger, resulted in a structure that had low density — mostly air, in fact — yet was uncommonly strong for its mass.

“The Isomax geometry is maximally stiff in all directions,” explained Berger. Other geometries — a honeycomb, for instance — may be able to resist forces from one direction, but approach it from a different direction and the cell will collapse easily.

Isomax's cell structure makes it possible for the material to resist crushing and shearing forces without the need to make it heavier or denser.

However, for all the early interest that his proposed metamaterial generated and the computer modeling that supported his claims, Berger knew he couldn't rest until science backed him up.

"There was obviously a lot of positive feedback, but for me as a scientist, it's a bit too much hand waving until you have something in a peer-reviewed journal," Berger said.

And now the work has borne fruit.

"I carried out some simplified calculations of the stiffnesses of some of the foams and was able to see that the pencil-and-paper results agreed with the computer calculations," explained McMeeking, whose research focuses on computational science and engineering as well as the mechanics of materials, including their fracture and durability. "This gave us confidence that the computer calculations were both correct and being formulated accurately."

McMeeking's calculations also proved that, in the case of the lightest weight foams, they were identifying the optimal geometries of the foams that enabled them to achieve the maximum possible stiffness. "That finding also meant that we could be sure that the computer calculations were also successfully obtaining the optimal geometries for the heavier weight foams, where pencil-and-paper calculations are almost impossible to carry out because they are much more complicated," he said.

The closed-form solutions and equations developed to create the mechanical model of the metamaterial's behavior "matched up beautifully" with the earlier computer models, said Berger.

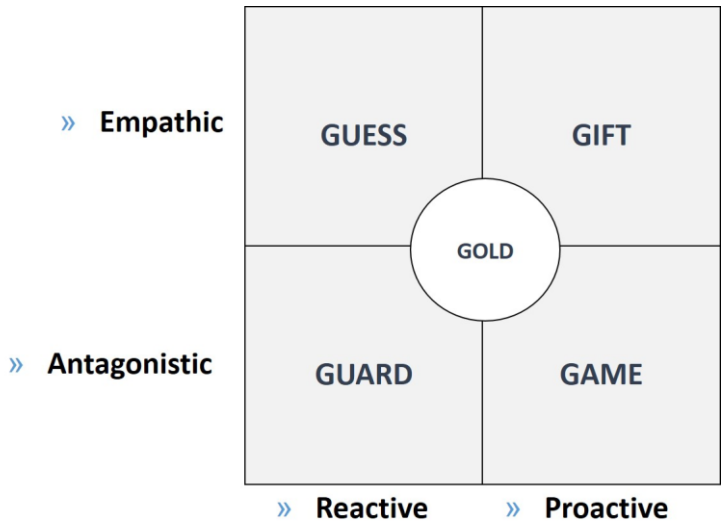
Given its properties, Isomax "is going to be a very interesting metamaterial," said Wadley, whose research spans the synthesis, structure and performance of novel materials. "It will also be an excellent thermal insulating and sound absorbing material. Potential applications for this ultralight material are likely to emerge in aerospace structures, for lightweighting automobiles and in many robotic machines, especially mobile types that carry their own power and must maneuver."

The development could not have better timing. As resources become more limited and concern for energy efficiency grows, a material with this mass relative to its strength would require fewer resources to produce and less fuel to transport. The simple geometry makes it versatile enough to fabricate for a variety of situations, and, functionally graded, it can be used to create objects with varying levels of stiffness from one end to another, such as prosthetics and replacement joints, and the design is compatible with manufacturing methods from origami-like folding to bonding and 3D printing.

The study is one of a series of steps investigating the potential of this metamaterial. Berger and team are currently following up with experimental analysis and are looking into manufacturing methods that may allow for efficient fabrication.

More information about Isomax may be found at Nama Development, a company Berger formed with the help of John Greathouse and UCSB's Technology Management Program.

Generational Cycles – 4Gs & Generations

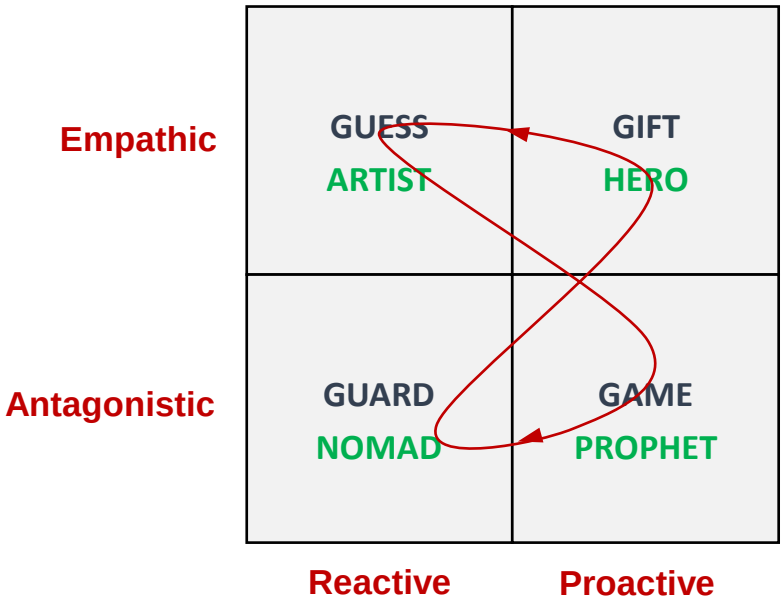


Here's something we've noticed recently when we've been deploying our PanSensic tools to establish how meaningful a piece of narrative data is. We've used our '4G' model for some time as a means of categorizing the typical responses people have when they communicate with others:

Gift – if we feel positively about the people we are communicating with, and are also pro-active in wishing to display that positivity, we are likely to gift them the answers that we think they wish to hear ("yes, you look lovely in that outfit, it makes you look five years younger").
Game – if we feel negatively and are pro-active in our desire to communicate that negativity, we are likely to game the system, deliberately deflecting the listener from anything that might be useful to them ("it was the worst film I've ever seen, we walked out half way through and asked for our money back. Then the cinema manager was very rude to us. We will never be coming back").
Guess – if we're empathic, but feeling reactive, our tendency is to guess the answers we think the listener wants to hear. We don't know what they want and so say random things until something produces a positive reaction, then we say more of that ("I thought Defoe played well, did you? No, you're right, he wasn't so good in the second half. Sterling should have been man-of-the-match. Or Lallana. Maybe Alli.").
Guard – if we're feeling antagonistic to the listener and simultaneously reactive, we will tend to simply guard what we say, or say nothing. We don't know how to put the listener on the wrong track, so best to say as little as possible ("Mmm. Possibly. Uhu.")

Everyone is, of course, different. It's impossible to position an individual in any one of these quadrants and expect that that's where they will always be. We're all of us quite dynamic in our emotions and how we interact with others. Nevertheless, it seems that there is a clear generational bias when we look at which quadrants of the picture each of the four generation archetypes seem to at least start a conversation with another person. The bias, we think, based on a small number of trials where we've been able to explore generational-effects, looks something like this:

SYSTEM ·ATIC INNOVAT· ION

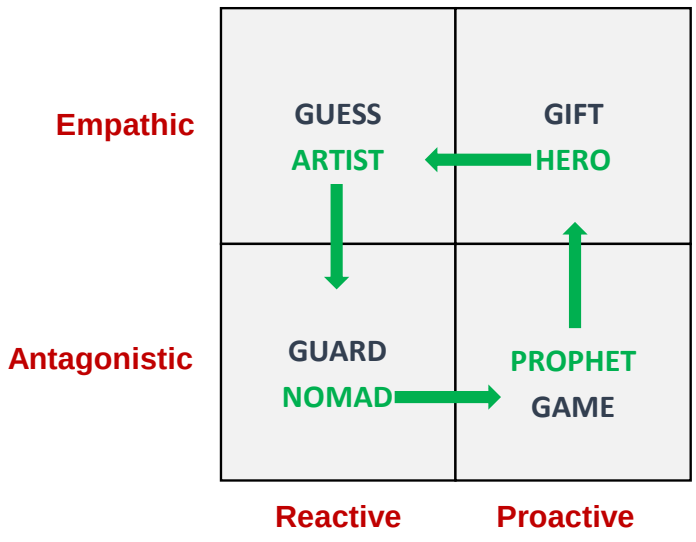


Without wishing to over-generalise:

Baby-Boomer (Prophets) tend to be pro-active and more interested in themselves than others, hence they are likely to game conversations to their advantage. Their offspring, Generation X (Nomads) inherit the antagonistic 'me' orientation, but also tend to be more reactive than pro-active when encountering someone new. Trust no-one, guard what you say. Their offspring, the Generation Y (Hero's) tend to exhibit a significant pendulum swing to the opposite corner of the picture – Hero's are upbeat and empathic because that's the way they were raised. The 'we' empathy continues with their Generation Z (Artist) kids, only, because the world enters its next Crisis Turning, the Suffocated Artists have been taught to be backward at coming forwards.

We think the pattern is at least an interesting start point for any Marketer looking to interview a person from any of the generation cohorts: If you're interviewing GenX'ers, prepare for them to not say a lot.

We also think it's interesting to see what happens when you increase the level of pressure on each of the generational cohorts:



Stress the Nomad surveyee, for example, and they'll tend to become much more pro-actively antagonistic to you. Somewhat like cornered rats. Hero's, on the other hand tend to remain empathic, but switch from gifting to guessing when under pressure. Artists clam up, and Prophets will tend to reduce the stress by getting on your good side.

Funny world sometimes.

Biology – Honeyguide

As adults, the pink-billed Honeyguides live up to their name, leading local hunters to wild beehives stashed in the cavities of baobabs and other tall trees. The men then scale the trunks, smash the hives, and make off with the sticky riches, leaving the wax and the calorie-rich larvae within for their partners in crime. (The Greater Honeyguide is one of few avians that can eat and digest wax.) It's what scientists call a mutualistic interaction, and for the Yao community in Mozambique, where evolutionary biologist, Claire Spottiswoode, carried out her newest research, honey plays a vital role in their daily lives.

This unlikely business arrangement between wild birds and people has been chronicled in multiple regions around Africa as early as the 1500s, but it wasn't until Spottiswoode's time with the Yao that the most remarkable part of the relationship was uncovered: The birds and people communicate with one another. As Spottiswoode recently discovered, the Yao use a resounding *brrr-hm*—rolling their tongues like a Spaniard before punctuating it with a brassy "humph"—to let the honeyguides know when they're ready to hunt.

In Spottiswoode's experiments, the call was effective in luring in honeyguides 66 percent of the time. And with a bird leading the way, the chances of finding a hive rocketed: Spottiswoode noted that 75 percent of the searches with guides were successful. This level of complex communication is unheard of in nature. In fact, it's the only known example of targeted two-way signals between people and a free-living species. The next closest scenario might be an unproven partnership involving dolphins and fishing villages in Laguna, Brazil.

While most animals are wired to flee from human presence, the Greater Honeyguide embraces it. But how do the birds learn to work with people? Spottiswoode's theory is that the behavior is innate. Because the chicks are reared by alternative species (hoopoes, kingfishers, scimitarbills, you name it), they can't learn this highly unusual behavior from their parents. So, instead, the birds must inherit the knowledge, refining it to match their

locale as they mature. In Tanzania, for example, the cue is a whistle; in Zambia, the sound of chopping wood draws them near, she says.

The role of the little bush bird is shrinking, however. As more villagers turn to farming and taming their own hives, they're leaving the honeyguide to fend for itself. But for the Yao of Mozambique, the alliance remains strong. "'Why would we do anything else?' That's what they told me," Spottiswoode says. The *brrr-hm* is part of their language, part of their very identity. They learned it from their fathers, and they'll teach it to their sons. After centuries of living alongside nature, the Yao know: In the savanna, you need every friend you can get.

So, here's what the human-Honeyguide symbiosis looks like from a TRIZ contradiction perspective: humans want to eat honey, but don't know how to find the beehive; Honeyguides want to eat the other contents of the hive, but aren't big enough to be able to break in:

…each, then, solves the problem by becoming the (Principle 24) Intermediary for the other.

Short Thort

“Every great magic trick [innovation] *consists of three parts or acts. The first part is called "The Pledge". The magician* [innovator] *shows you something ordinary: a deck of cards, a bird or a man. He shows you this object. Perhaps he asks you to inspect it to see if it is indeed real, unaltered, normal. But of course... it probably isn't. The second act is called "The Turn". The magician takes the ordinary something and makes it do something extraordinary* [contradiction]*. Now you're looking for the secret... but you won't find it, because of course you're not really looking. You don't really want to know. You want to be fooled. But you wouldn't clap yet. Because making something disappear isn't enough; you have to bring it back. That's why every magic trick has a third act, the hardest part, the part we call "The Prestige".”*

“Magicians protect their secrets not because the secrets are large and important, but because they are so small and trivial. The wonderful effects created on stage are often the result of a secret so absurd that the magician would be embarrassed to admit that that was how it was done.”
Christopher Priest

News

Buckingham SI Accreditation Short Course
As mentioned last month, in preparation for the formal launch of the new Innovation MSc at the University of Buckingham, we will be running an SI Level 1 and 2 Certification module. The five-day workshop will happen during the week 26-30 June and will cost £1200 for delegates who just wish to attend, and £1500 for those that also wish to

complete the assignment. The latter options means the delegate will not only gain 15 Credits towards the MSc programme, but they will also be eligible to receive the SI 'Practitioner' Certificate. More details from the University's Lean Enterprise 'BLEU' website…. Where you'll also see that the first Module of the officially-launched MSc will take place the week 11-15 September.

ICSI Conference, Beijing
Darrell has been asked to present a keynote address and tutorial at this year's biggest TRIZ/Systematic Innovation conference. The event will take place over the period 11-14 July. More details at http://i-sim.org/icsi2017/index.html.

IMechE Webinar
Darrell will be conducting a '21st Century TRIZ' Introduction webinar with the Institution of Mechanical Engineers on 29 September. A long way off, but that's the way these things work out sometimes. Details arriving shortly on the IMechE website.

New Projects
This month's new projects from around the Network:

ICT – 'Innovation Champions' Coaching Workshop
Retail – Strategic Problem-Solving Workshops
Automotive – SI Workshops
FMCG – PanSensic Study
Transport – 'Eyes On The World' Study
Transport – Innovation Strategy Workshop
Tourism – TrenDNA study
Education – Technology Validation Project
Utility – Turnkey Product Development Project
FMCG – Patent 'Invent Beyond' Study