Systematic Innovation

e-zine

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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.

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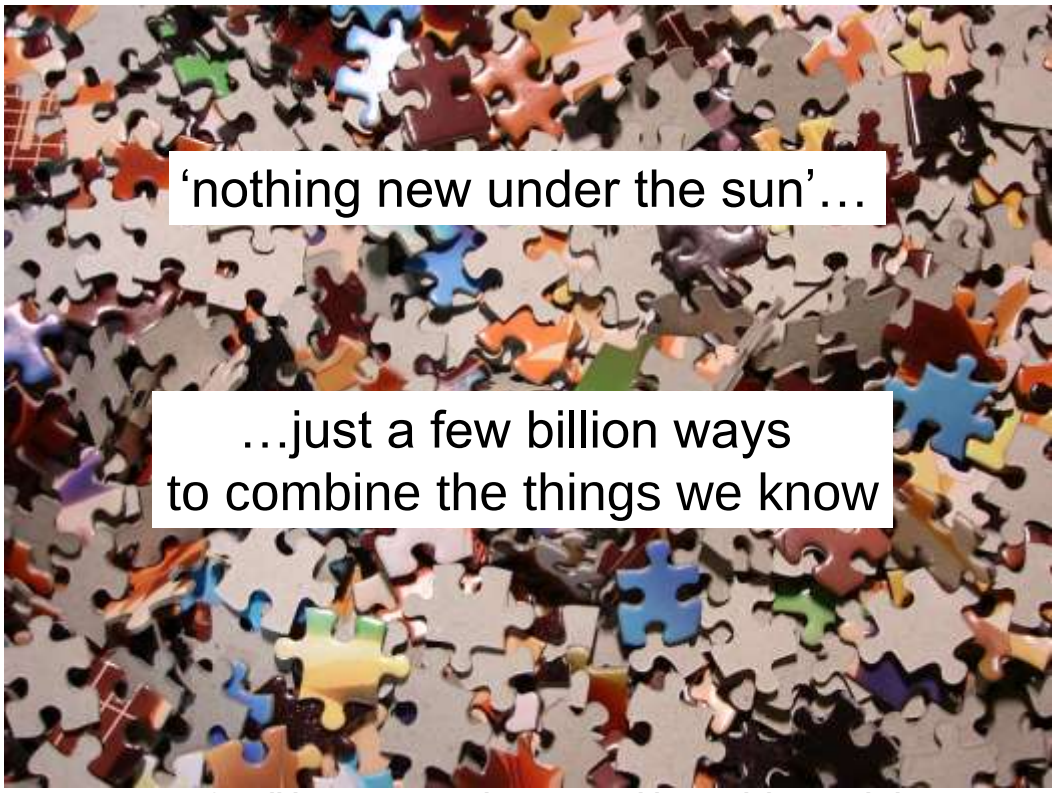
Readers' comments and inputs are always welcome.
Send them to **darrell.mann@systematic-innovation.com**

Case Studies: ‘We Already Tried That’ #47



Copy Of A Slide I Use In Nearly Every Problem-Solving Workshop

One day comes the straw that breaks the camel’s back. For me the straw arrived this year a session to help a company to improve their filter cleaning processes. The process in question had been optimized and optimized over a period of several years and now the engineers responsible had hit an impasse. No matter what they tried, they told me, it wasn’t possible to reduce the amount of time it took to clean the filters, or the amount of energy they were using, or reduce the amount of soiled water they had to clean and dispose of. The process was, it appeared stuck firmly at the top of its s-curve. Which meant it was time to either accept that there was nothing more to be done, or we solved a contradiction and made a jump to a new curve. The general (although, as it later transpires, ‘not specific’) consensus in the room was that we wanted to opt for the latter.

The group hadn’t previously been exposed to TRIZ or Systematic Innovation before and the time available in the ‘experimental’ session was limited so I decided that we’d use the Trends and Evolution Potential parts of the toolkit. We started by constructing a picture of the maturity of the current system.

In effect that meant examining a process in which the dirty filters were soaked overnight in hot water then subjected to a high pressure hot water jet to remove the deposits that had formed on the filter elements, then they were soaked overnight again and re-bombarded with the water jet. Then the filters were dried. All in all, the average filter lived in the process for around 48 hours, consumed close to 20kW of electrical energy to heat, and over a hundred litres of water per filter before it would pass the ‘clean’ test. Figure 1 shows the basic Evolution Potential analysis for the process. In essence what the picture reveals is that this ‘mature’ system had used up slightly over a third of its available potential. Thus, while the current system and design rules might be considered to be ‘mature’ the overall

job of cleaning filters still had a long way to evolve yet. We generally (although, again, not specifically) agreed that this was a good thing in terms of our chances of improving the current situation.

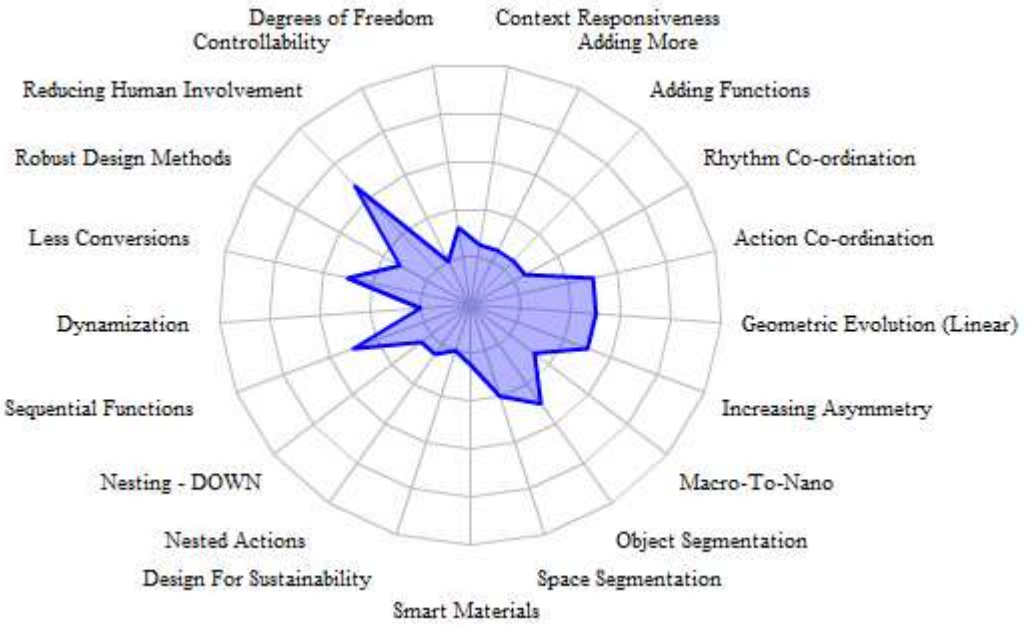


Figure 1: Evolution Potential Plot For Current Filter-Cleaning Process

At this stage, there are generally two options. One is that we simply use the Evolution Potential plot to steer a 'trendstorm' activity aimed at generating as many ideas as possible for evolving the current process. This tends to be my direction of preference in these kinds of workshop. Or at least it is when accompanied by a couple of 'rules'. Namely:

1) The trends are trying to tell us 'the answers', but they won't tell us what problem we just solved. Worry about this at the end rather than during the trendstorm idea-generating activity.
2) Write down ideas even though they don't necessarily sound relevant or correct… by themselves they may be useless, but in combination they may be just what is required to solve the problem.

The basic overall message to people here is 'the answer is in here somewhere'. Or, put more strongly, 'I guarantee that if we look forward to the day that we or a competitor filter-cleaner has made the step-change that has resolved the limitations of the current process, the solution they have used will have come from one or a combination of the jumps described by the untapped evolution potential.'

The other approach is to spend a little more time trying to get to the core of the actual problem. On this occasion, this is the direction I thought the team should travel. This choice was partly driven by an instinct that said, 'this team does not know what the core of the problem actually is'. An instinct that quickly turned out to prove correct. I got them to try and construct a function analysis model of the cleaning process and then asked them to isolate the main useful function of the main stage of the process. Perhaps because they were so intimately involved with looking after the process as a whole, the team found this exercise quite difficult. In the end, although I resisted the temptation to start talking about Smart Little People, I did ask the team to try and think about what was happening in the process at the molecular level. Perhaps in retrospect I should've been braver and forced them to use the SLP tool and from there got them to realise that the core of the problem

was that a Smart Little Deposit particle was gripping as hard as it could to the filter material and that we were trying to make him fall off by hitting him with a massive continuous avalanche of Smart Little Hot Water. Never mind. We did eventually all make it to the conclusion that the core of the problem was the fact that we were using water to deliver the main useful function.

Knowing this, makes it possible to begin constructing a hierarchy of importance of the trends. The closer a trend is to having a connection to water, the more important that trend is in its relevance to resolving the core problem we're facing. Top of the 'water trend' hierarchy I decided was the Object Segmentation trend – Figure 2:

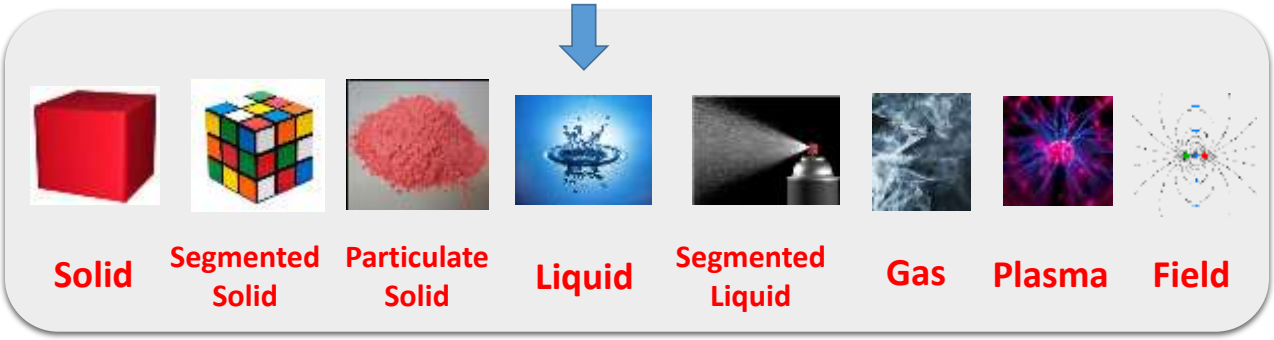


Figure 2: Object Segmentation Trend And Current Position Of The Filter-Cleaning Process

The trend prompted some immediate questions:
Have you tried segmenting the water jet? Answer: 'no'
Have you tried using gas? Answer 'yes, it is useless'
Have you tried increasing the speed of the gas? Answer 'no, it would damage the filter'
Have you tried using ultrasound? Answer 'yes, it didn't work'

And there, then, was the moment the (me) camel looked around at what was going to turn out to be its last straw. 'You tried ultrasound?' I repeated. I sounded doubtful. Mainly because in my mind ultrasound is as close to a panacea solution as you're ever likely to get, short of using a 'field' based solution.

'Yes', the team repeated, 'about five years ago. We had a guy come in for an afternoon with his ultrasound kit. It didn't work.'

The 'we already tried that' camel's back now broken, I try to remain calm. Which basically means remaining calm and not trying to make an audible comparison between a couple of hours of experiments with an ultrasound horn and the dozens of man-years of effort expended on the current water jet solution. Amazing how quickly we can allow ourselves to reject a solution. Especially when it's outside our domain of expertise.

Now granted as far as the process team are concerned they have no idea whether the guy that turned up with the ultrasound equipment was just another random guess at an answer, so they had no great cause or incentive to explore further when their little ultrasound experiment failed. I'm not an ultrasound expert either. But I do know that the Trends of Evolution make for a pretty good road-map to successful solutions. Fluid solutions get beaten by gases get beaten by fields because thousands of people before us have proved it to be true.

An ultrasound solution, in other words, should by rights have been better than the water jet. The fact that the little experiment showed otherwise didn't feel like enough evidence to reject the technology completely. Especially since we should also remember that, per my jigsaw image slide, innovation success is most likely to come from a combination of ideas

rather than crossing our fingers and hoping that one turns out to be the silver bullet we craved. I did a quick Evolution Potential plot for an ultrasonic filter cleaner in my head and then began quizzing the team about their five year-old ultrasound experiment:
Did you vary the frequency of the ultrasound? No.
Did you vary the energy input? No.
Did you cycle it? No.
Did you try and make use of any resonant frequencies? No.
Did you use multiple horns? No.
Did you move the horn? No.
Did you vary the shape of the horn? No.
Did you introduce any kind of asymmetry? No.
Did you try the ultrasound in combination with any water? No.
A pause.
Do you think you tried enough options to reject ultrasound as a possible solution?
A longer pause.
I said, 'shall we have a tea-break?'
Everyone nodded.
They went for a tea-break. I went onto the Internet.
When they came back I put this picture on the screen:

Shall we switch to another problem? I asked.
It's a fine line sometimes between making an important point and potentially embarrassing the domain experts into realizing they're the experts in the wrong domain.

The real point being, whenever someone says 'we already tried that', what it usually means is 'we tried one combination'. The TRIZ trends really are trying to tell us something important about where things 'want' to evolve in the future. While there might indeed be millions of possible combinations of jumps, the trends tell us which ones are far more likely than others. And in that sense, yet again, there really is nothing new under the sun.

Case Studies: Uber Part 2

In this follow-up to last month's 'part 1' description of the Uber phenomenon, we move the focus to capturing what customers think about when they think about taxis.

For some reason taxi services seem to evoke a lot of social media discourse, and so finding large quantities of consumer narrative turns out to be a fairly easy job. The difficult, time-consuming part is sorting out the meaningful content from the 'you done me wrong' revenge rants, the fake reviews from competitors and the 'oh, that's awful,' bandwagon jumpers. Which is where our PanSensic toolkit is intended to enter the picture. Here's the sort of thing we will be looking for to feed into the analysis engine:

I lost my misguided faith in black cabs last week, on the corner of Royal College Street in north London. It was the tiniest trip — 2.4 miles from Bloomsbury to my Camden flat at 11.30 in the evening. Hard to mess up, too: empty roads, good weather and the easiest of routes — practically a straight line to my flat. To my horror, the cabbie dodged the obvious, straight route and embarked on an extended loop through the traffic-choked hub of Camden Town tube station and Camden Market.

I pointed him in the right direction and he reluctantly did a U-turn and headed up Royal College Street. Not a word of apology — and still a £11.20 fare for a ten-minute journey. No tip, needless to say.

I can't know whether he was ripping me off or merely clueless. But either way, in the days of satnav, it's staggeringly incompetent. And in the days of highly efficient taxi and minicab apps — like Uber, Addison Lee and Kabbee — it's unforgiveable. The exclusive privileges given to black cabs must go.

Black cabs are the go-slow thugs of the road. Overpriced, selective in who they pick up, arrogant about their knowledge and the Knowledge, nasty to other drivers, homicidal to bicyclists, bullying to competitors, they crawl across our cities in a puffed-up bubble of self-importance that has needed pricking for years.

Multiply this type of content by a factor of a couple of hundred (we weren't being paid to do this research, so we erred in the direction of economy), focus on the non-Uber or pre-Uber social media customer narrative relating to taxi experiences and we end up with the emotion profile reproduced in Figure 1:

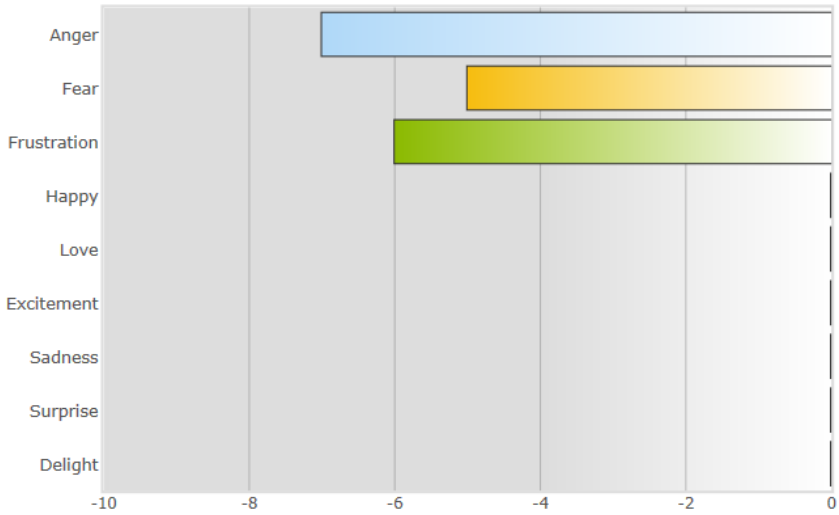


Figure 1: Emotion Profile of Non-Uber Taxi Customers

All in all, customers don't seem to have much positive to say when their taxi experiences trigger them to tell the rest of the word about it. That finding should already be ringing a few alarm bells for taxi drivers, but there's nothing here that is actionable in terms of understanding why people are expressing such negative emotions. In order to achieve that aim, we need to dig a layer deeper and use the PanSensic toolkit to analyse and categorise what people are frustrated and angry about. Figure 2 illustrates what happens when we map this information onto one of our Frustration Maps:

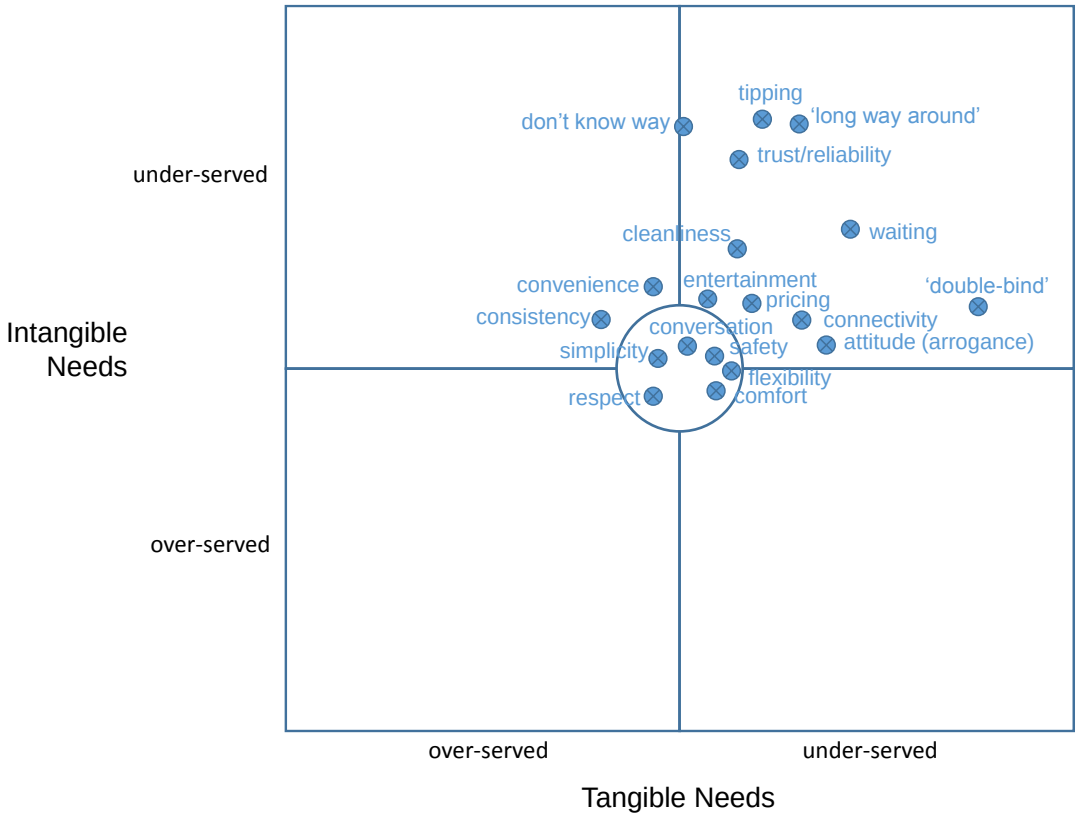


Figure 2: Conventional Taxi Service – Customer Frustration Map

The basic idea with these maps is that the further a data-point migrates away from the centre of the graph the greater the level of frustration, and therefore the greater the innovation opportunity. According to this particular picture, it would seem that the main frustrations seem to be taxi-drivers not knowing the way to the customer's intended destination (or not using or ignoring their satnav screens), taking the long way around, double-binds (i.e. the customer perceives they are in effect paying twice when the driver travels by an indirect route – they pay more because they travelled a longer distance than was necessary, and the journey takes longer so they lose their own time as well), waiting for cabs and tipping (should I tip? Should I not tip? How much should I tip?).

The next thing we can then do with this data is to begin to map it to the Autonomy-Belonging-Competence (ABC) triangle we discussed in Part 1 of the article. This time we can also introduce an equivalent PanSensic scrape of what Uber customers are experiencing against the same three metrics. Figure 3 reproduces the results of this pair of non-Uber and Uber ABS analyses.

Per the main suggestion from the Part 1 article that innovation happens when all three of the A, B and C parameters 'get better' with the new solution, Figure 3 clearly seems to suggest that Uber is achieving that outcome. To the extent that – according to the relatively small data sample size used in our study – with both Belonging (tapping in to our innate desire to be a part of some kind of 'tribe') and Competence (i.e. allowing customers

to feel like they're smart) Uber has pretty much hit the nail on the head when it comes to satisfying both the tangible and intangible needs of today's taxi passengers.

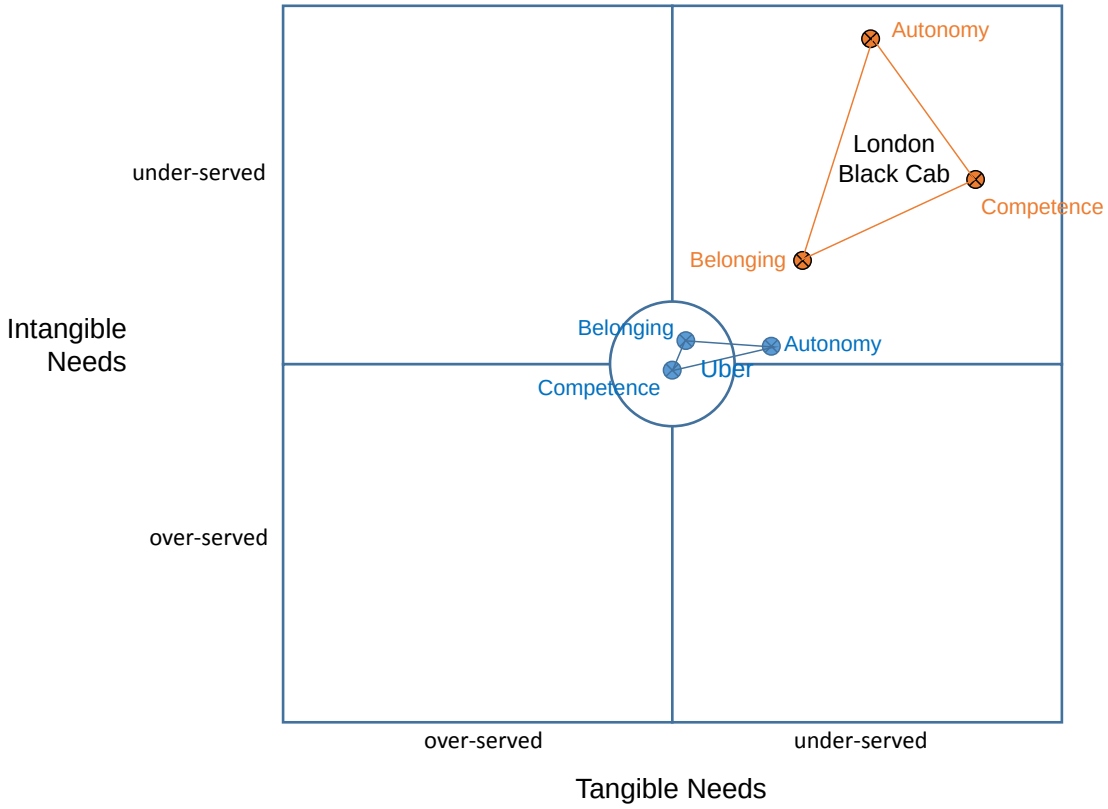


Figure 3: Mapping ABC Universals Onto The Frustration Map

Only the Autonomy attribute remains outside the no-frustration sweet-spot zone at the centre of the picture. Digging a little deeper into why this lack-of-control frustration is still present in a system that is fundamentally all about giving control to customers reveals that so called 'surge pricing' is the issue that provokes the negative emotions – customers, in other words, perceive that they lose control of a situation when they see quoted prices going up because they wish to travel at busy times of the day, or when the weather is bad, or there's a public holiday.

Maybe Uber doesn't need to worry about such issues right now. It appears to have done all it needs to do right now to satisfy the 'ABC all get better' test. And, according to Figure 3, by a quite substantial degree on all three dimensions. Maybe, turning the Uber success story around the other way for a second, Figure 3 offers some kind of a definition of what success looks like?

What we don't yet know is how transient the 'ABC get better' effect is. Or what the Frustration Map looks like from the other side of the fence: what do the taxi drivers think about the new Uber world into which they now increasingly find themselves? Maybe that's the time we might start to get a clearer picture as to why Uber finds itself being hounded out of many of the cities into which it begins operating? And, more importantly, what they – or their emerging competitors – might want to do to curtail the criticism. Or, better yet, turn it into a resource that secures their growth into the future. Perhaps that's where we ought to shift our attention in the third and final part of this case study.

Not So Funny - Irony

Irony
ˈʌɪrəni/
noun
noun: **irony**

- the expression of one's meaning by using language that normally signifies the opposite, typically for humorous or emphatic effect.
- a state of affairs or an event that seems deliberately contrary to what one expects and is often wryly amusing as a result.
- a literary technique, originally used in Greek tragedy, by which the full significance of a character's words or actions is clear to the audience or reader although unknown to the character.
- Dubious illustrations of TRIZ Inventive Principle 13

(with added Principle 17)

(Principle8?)

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(Principle 38?)

Patent of the Month – Enhanced Combustion

A rare trip to the automotive industry for the patent of the month this month. Or at least a trio of inventors at the Southwest Research Institute in San Antonio Texas working on behalf of the automotive industry. Their 'Enhanced combustion for spark ignition engine using electromagnetic energy coupling' patent was granted as US8,910,619 on December 16. A remarkably succinct background description section reveals the problem they've overcome as follows:

Dilute operation of internal combustion engines through lean fueling and/or high levels of exhaust gas recirculation (EGR) is frequently employed to increase fuel efficiency and reduce emissions. In particular, for spark-ignition engines, dilute operation is a promising approach for increasing engine efficiency, in the form of either lean burn (air dilution) or EGR (inert dilution).

In the case of spark-ignition engines, primary limitations of dilute combustion are due to poor flame speed and flame growth instability*. Various methods have been developed to reduce these limitations, such as enhanced ignition systems and charge motion improvements. Intake charge composition modifications, either through fuel reforming for lean dilution applications or exhaust reforming for EGR applications, has also been shown to improve dilute combustion by improving thermal efficiency.*

When inventors write things in this way it makes it very easy for the SI research team to map the problem onto the Contradiction Matrix: we want to improve combustion dilution and we can't because of speed and instability issues. Here's how we might best map that pair of conflicts onto the Matrix:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Loss of Energy (27)

WORSENING PARAMETERS YOU HAVE SELECTED:

Speed (14) and Stability (21)

SUGGESTED INVENTIVE PRINCIPLES:

14, 10, 28, 3, 35, 6, 12, 2, 13, 19

And here's how the team solved the problem:

A method of improving the combustion of a spark ignition engine, the engine having at least one cylinder, each cylinder having a combustion chamber and a piston that reciprocates within the combustion chamber, comprising: locating an antenna within the combustion chamber; providing an air-fuel mixture into the combustion chamber; igniting the air-fuel mixture with an igniter, such that a combustion event occurs; delivering an electromagnetic signal to the antenna; wherein the antenna applies electromagnetic energy into the combustion chamber near the time of the combustion event; adjusting, during the combustion event, the frequency of the electromagnetic energy in response to changing dimensions of the combustion chamber as the piston moves with the combustion chamber.

Which all sounds a lot like adding a field to me. Hello Inventive Principle 28. Plus a bit of Principles 3 and 10 thrown in for good measure.

The main thing, though, is that something as simple as 'adding a field' can still be seen as novel in the automotive industry in 2014. The internal combustion engine isn't destined to be with us for ever, but this simple addition might just do something to lengthen its reign.

Plus, finally, field solutions are really simple to draw. At least in comparison with the mechanical systems they're being integrated into:

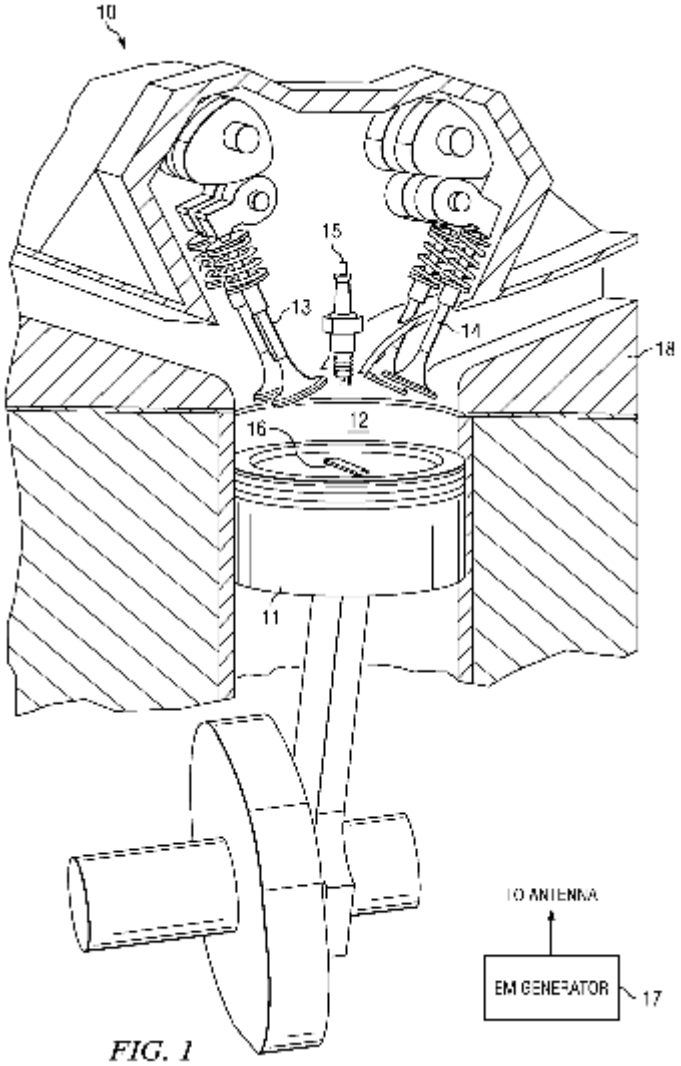


FIG. 1

Best of the Month – Complex Adaptive Leadership

A long time ago one of my favourite TV shows was Question Time on the BBC. For those readers outside the UK that have never heard of it, the basic idea of the show was to invite a quartet of politicians from different points on the political spectrum to answer questions from an audience made up of 'everyday citizens'. That was in my pre-TRIZ days. Now TRIZ and the concept of 'eliminating contradictions' has become part of my DNA I find myself unable to watch Question Time any more. Nowadays all I see is one politician telling me that the answer is black, three others telling me it's white, and (a recent innovation on the programme) a random fourth non-politician – often a comedian! – to make a suitably glib comment about both black and white. And me shouting to all of them, 'it's both: solve the contradiction you idiots'. That was fun for a year or two, but then it gets a bit wearing. The problem is the world of politics – in the UK at least – is based on Socratic principles: meaning that the entire job of the 'Opposition' parties is to argue against what the governing party is espousing. Irrespective of any of the inherent benefits and good sense it might contain. The Socratic approach might have worked a couple of thousand years ago, but I'm not sure it helps any more.

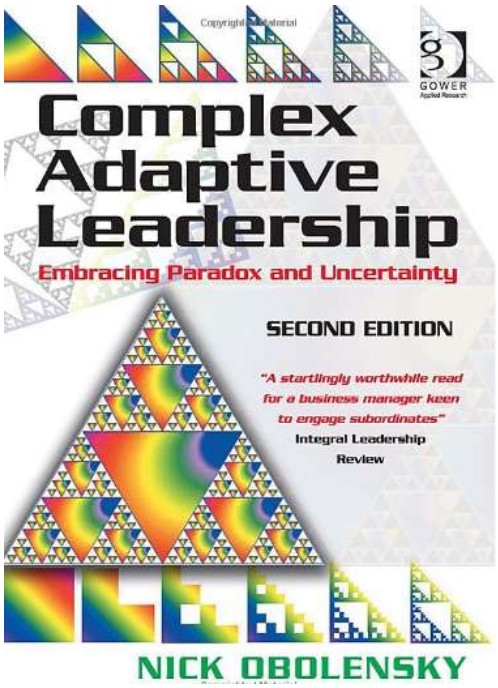
I mention my Question Time allergy because I increasingly find myself experiencing the same reaction when I do my duty on the SI business book reading research panel. With over 5000 business books published this year in theory it ought to be difficult for us to keep up with the flow of new information. In practice however, 95%+ of the books we pick up evoke the, 'it's both: solve the contradiction' scream. Socratic (trade-off) thinking is endemic. Congratulation Ancient Greece! Worse, there is little sign of a change coming any time soon. If anything, the world of publishing seems to be retreating into a swaddling blanket of bland, 'un-controversy'. Don't offend anyone, take on board everyone's perspective, make naïve, lame suggestions about solutions the author will never have to face any consequences over.

It's the 'take on board everyone's perspective' part that offends the most. Not because that's a bad thing to do necessarily, but because the idea is not to listen to all the views in order to find a happy 'middle ground' answer, it's to identify the contradictions in a manner that allows them to be challenged. Socrates, you have a lot to answer for.

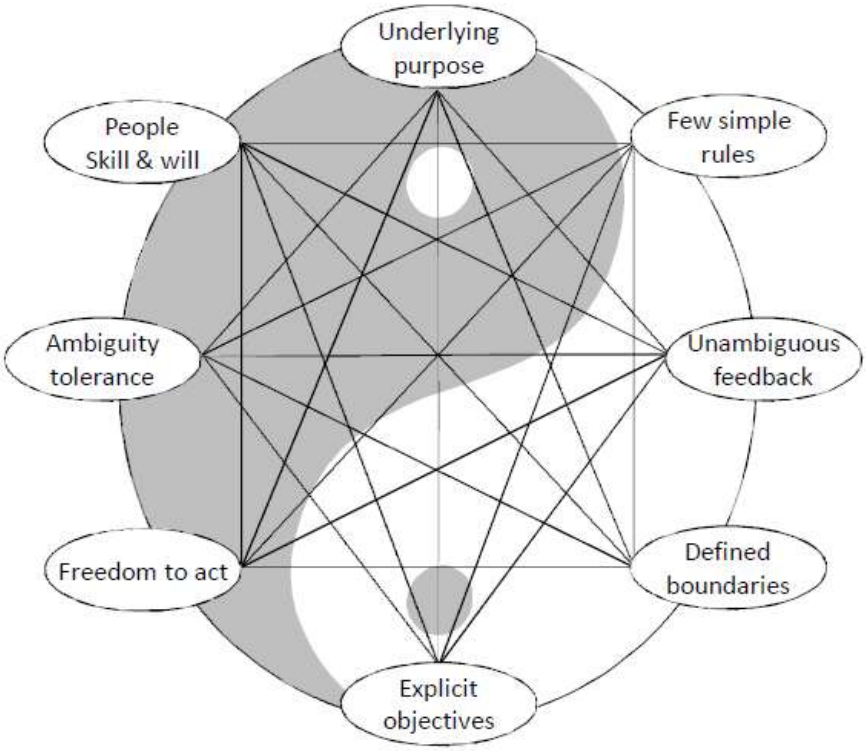
All this, of course, is a rant that comes in the wake of yet another month of struggle to find anything even remotely interesting to recommend to e-zine readers. To the extent that, for a while I was seriously contemplating recommending 'Clothes Clothes Clothes Music Musuc Music Boys Boys Boys' by Viv Albertine, which would have been about as far away from 'business literature' is it is possible to get. Viv Albertine being the ex-guitarist of punk band The Slits in the late 1970s. The lovely Ms Albertine might not have much to say about running businesses better, but she could teach business leaders an awful lot about prevailing in the midst of adversity.

In the end though, in the spirit of some kind of 'calm down, dear' tolerance, I've ended up recommending 'Complex Adaptive Leadership' by author Nick Obolensky. First up because he's one of the few business authors to make any kind of sense when he tries to convey the meaning of complex adaptive systems to a business audience. Second up because he writes nicely, and thus makes you want to keep reading. And thirdly because the book contains one or two intriguing nuggets that offer up a modicum of insight about how to lead teams better.

That's the good news. In theory – looking at the sub-title of the book, 'embracing paradox and uncertainty' – it could have been oh so much more. 'Embracing paradox,' terrific I thought, finally someone who's gone beyond the Socratic way of thinking. Alas, the truth behind the words is somewhat different. Mr Obolensky might understand complex systems, but he's very definitely still raised in the Socratic way of thinking. Which ultimately means that the book identifies a few paradoxes (good!) but is only then able to suggest to prospective leaders that they need to be 'managed' (i.e. traded off). Not so good.



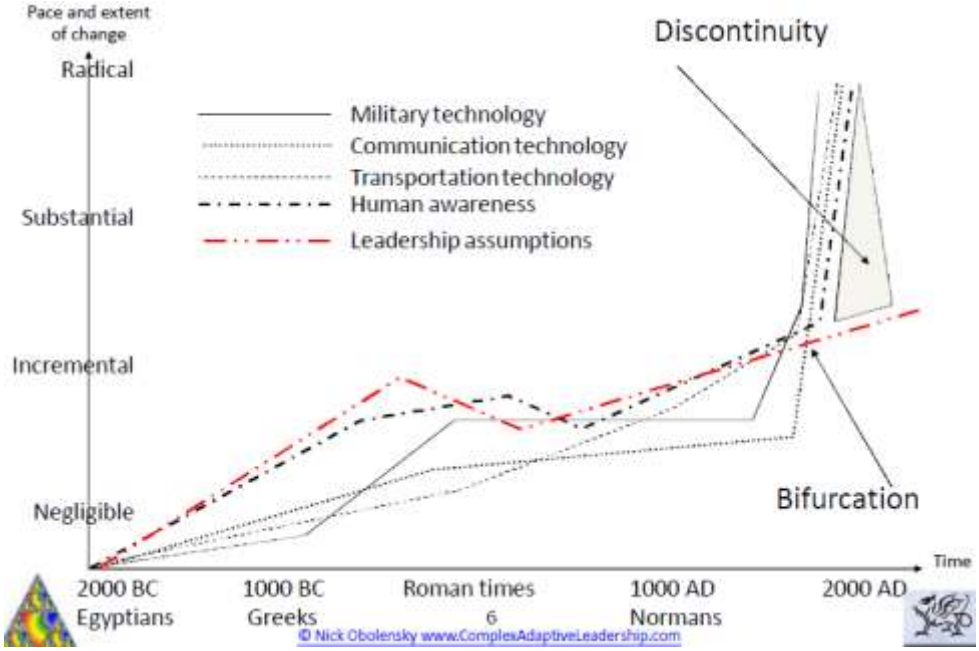
Not surprisingly, the advice to anyone that decides to follow our ezine 'best of' recommendations is to admire Obolensky's prose and his identification of a few good paradoxes..



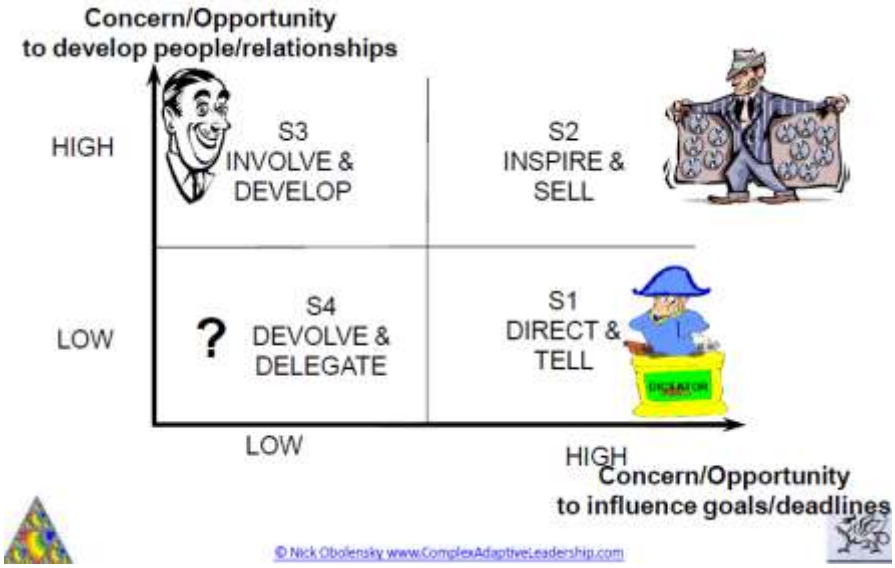
..and then to begin applying some post-Socratic TRIZ thinking to each of them. That's the point where interesting things might start to happen.

If you're not going to follow the recommendation (I haven't sold it that well have I?), and want to cut to Obolensky's chase, it pretty much boils down to this:

- There is a growing divergence and discontinuity between the complexity of the (business) world and the strategies and rules managers deploy to cope with that complexity:



- Underneath complexity SIMPLE RULES are operating – the trick is to discover and understand them
- Where you start is not as important as where you want to get to and the rules you employ
- Just because something looks random and chaotic does not mean it is – results emerge
- Excellent Leadership is the best choice and blend of four strategies:



(NB: ‘blend’ is yet another covert trade-off word. In contradiction-solving terms, what Oboloensky is actually telling us is that each of the four strategies represents an opportunity to solve a Physical Contradiction using a ‘by condition’ strategy.)

Hmm. Maybe we might have to rethink this section of the ezine in future? Or get braver and start telling C-Suote executives they need to start bringing Viv Albertine in to come and tell them how the world really works.

Wow In Music - Money

The English progressive rock band Pink Floyd is known for its sonic experimentations and elaborate live shows, which together have made them one of the most successful and influential groups in the history of popular music.

In 1973, for the album The Dark Side of the Moon, composer Roger Waters wrote Money, featuring, within a traditional (overall) twelve-bar blues form, from the perspective of a popular song, an unusual combination of musical characteristics, the most apparent being the use of the 7/4 time signature. That is the ‘tip of the iceberg’, of course, as what makes Money stand out from the crowd is not solely embedding this uncommon music element but blending it with a series of other resources gradually unraveled during its almost 7 minutes adventure.

Money starts with a well-crafted collage of sound effects (clinking coins, cash register, etc.) in a loop that defines the overall atmosphere of a 7/4 time signature. Without today’s widespread use of computers, in the seventies that had to be done manually, by slicing and gluing pieces of magnetic tape together. Next, the main rhythmic element is introduced by the bass which is then persisted throughout the rest of the song. Around a simple rhythmic ostinato, the listener is hypnotised, little by little, until the instrumental solos take place: initially, by the saxophone, still in 7/4 and, then (by 3:03 min) by the guitar, just after a drum fill in 4/4 (Inventive Principle 19B).

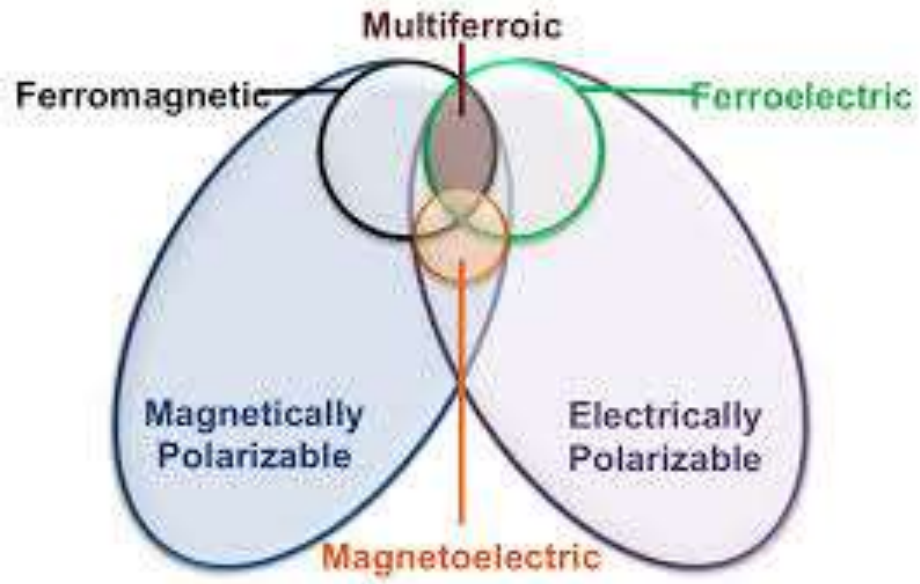
Changing the time signature from 7/4 to the more common 4/4 time signature, an oft cited example of a musical ‘wow’ from the very start of our research evokes the reaction by producing a sensation of unbalance, as if someone had tripped on the floor. In addition to that (around 3:51 min), ‘out of the blue’, as the sound of the guitar dries out, the listener is transported to another (perhaps smaller) ambience.

More subtle, but actually also a key part of the wow, the first of three choruses which comprise the solo was recorded using real-time double tracking. Gilmour played the chorus nearly identically in two passes recorded to two different tracks of a multi-track tape machine. The second chorus is a single guitar. The doubled effect for the third chorus was created using automatic (or "artificial") double-tracking. One of Gilmour's ideas for the solo section was that, for the second chorus of the solo, all reverb and echo effects would be completely off (referred to as "dry"), creating the sense of just four musicians playing in a small room. For this "dry" chorus, all musicians played softly and subtly, with Gilmour's solo, now one single guitar, playing very sparsely. Then, for the third chorus, the dynamics would suddenly rise, with heavy use of reverb and echo (a "wet" sound), additional

rhythm-guitar parts in the background, and the drums becoming heavy and almost chaotic. The solo, in other words, provides us with an intriguing illustration of Inventive Principle 3, Local Quality. Perhaps with a touch of Principle 12 thrown in for good measure.

The succession of musical events introduced by Money and, especially by the rising tense atmosphere around the rhythmic ostinato makes me think that Waters may have followed a formula very similar to the one Ravel used in his famous Bolero. Both compositions use very simple harmony, and repetitive rhythmic elements. Both take the listener by the hand through an unknown, almost deceptive journey. On the other hand, there are a considerable number of differences between these two pieces especially from the perspective of instrumentation and their typical audiences. It is striking, however, to realize how the mechanisms of wow can be at the same time so widely spread and closely related… to the 40 Principles maybe?

Investments – Multi-ferroic Materials



To encode data, today's computer memory technology uses electric currents -- a major limiting factor for reliability and shrinkability, and the source of significant power consumption. If data could instead be encoded without current -- for example, by an electric field applied across an insulator -- it would require much less energy, and make things like low-power, instant-on computing a ubiquitous reality.

A team at Cornell University led by postdoctoral associate John Heron, who works jointly with Darrell Schlom, professor of Industrial Chemistry in the Department of Materials Science and Engineering, and Dan Ralph, professor of Physics in the College of Arts and Sciences, has made a breakthrough in that direction with a room-temperature magneto-electric memory device. Equivalent to one computer bit, it exhibits the holy grail of next-generation non-volatile memory: magnetic switchability, in two steps, with nothing but an electric field. Their results were published online Dec. 17 in Nature, along with an associated "News and Views" article.

"The advantage here is low energy consumption," Heron said. "It requires a low voltage, without current, to switch it. Devices that use currents consume more energy and dissipate a significant amount of that energy in the form of heat. That is what's heating up your computer and draining your batteries."

The researchers made their device out of a compound called bismuth ferrite, a favourite among materials mavens for a spectacularly rare trait: It's both magnetic -- like a fridge magnet, it has its own, permanent local magnetic field -- and also ferroelectric, meaning it's always electrically polarized, and that polarization can be switched by applying an electric field. Such so-called ferroic materials are typically one or the other, rarely both, as the mechanisms that drive the two phenomena usually fight each other.

This combination makes it a "multi-ferroic" material, a class of compounds that has enjoyed a buzz over the last decade or so. Paper co-author Ramamoorthy Ramesh, Heron's Ph.D. adviser at University of California, Berkeley, first showed in 2003 that

bismuth ferrite can be grown as extremely thin films and can exhibit enhanced properties compared to bulk counterparts, igniting its relevance for next-generation electronics.

Because it's multi-ferroic, bismuth ferrite can be used for non-volatile memory devices with relatively simple geometries. The best part is it works at room temperature; other scientists, including Schlom's group, have demonstrated similar results with competing materials, but at unimaginably cold temperatures, like 4 Kelvin (-452 Fahrenheit) -- not exactly primed for industry. "The physics has been exciting, but the practicality has been absent," Schlom said.

A key breakthrough by this team was theorizing, and experimentally realizing, the kinetics of the switching in the bismuth ferrite device. They found that the switching happens in two distinct steps. One-step switching wouldn't have worked, and for that reason theorists had previously thought what they have achieved was impossible, Schlom said. But since the switching occurs in two steps, bismuth ferrite is technologically relevant.

The multi-ferroic device also seems to require an order of magnitude lower energy than its chief competitor, a phenomenon called spin transfer torque, which Ralph also studies, and that harnesses different physics for magnetic switching. Spin transfer torque is already used commercially but in only limited applications. They have some work to do; for one thing they made just a single device, and computer memory involves billions of arrays of such devices. They need to ramp up its durability, too. But for now, proving the concept is a major leap in the right direction.

"Ever since multi-ferroics came back to life around 2000, achieving electrical control of magnetism at room temperature has been the goal," Schlom said.

Read more at:

J. T. Heron, J. L. Bosse, Q. He, Y. Gao, M. Trassin, L. Ye, J. D. Clarkson, C. Wang, Jian Liu, S. Salahuddin, D. C. Ralph, D. G. Schlom, J. Íñiguez, B. D. Huey, R. Ramesh. **Deterministic switching of ferromagnetism at room temperature using an electric field**. *Nature*, 2014; 516 (7531): 370 DOI: 10.1038/nature14004

Generational Cycles – I Wish It Could Be A Fairytale Of New York Every Year

As we head through the holiday season in the UK, it's a virtual certainty that if you turn on the radio for more than 10 minutes, you're going to find yourself listening to a Christmas song. The weird thing is that the song you find yourself listening to is probably thirty or more years old. For some reason, the music industry doesn't seem to be able to generate Christmas 'classic's like they used to. Take one of the all-time iconic Christmas songs, 'I Wish It Could Be Christmas Everyday' by Wizzard in 1973:

When the snowman brings the snow
Well he just might like to know
He's put a great big smile on somebody's face
If you jump into your bed
Quickly cover up your head
Don't you lock the doors
You know that sweet Santa Claus in on the way

[Chorus]
Well I wish it could be Christmas every day
When the kids start singing and the band begins to play
Oh I wish it could be Christmas every day
So let the bells ring out for Christmas

When we're skating in the park
If the snow cloud makes it dark
Then your rosy cheek's gonna light my merry way
Now the frosty paws appear
And they've frozen up my ear
So we'll lie by the fire
'Til the sleet simply knocks 'em all away

[Chorus]

When the snowman brings the snow (snowman brings the snow)
Well he just might like to know (just might like to know)
He's put a great big smile on somebody's face
So if Santa brings that sleigh (Santa brings that sleigh)
All along the Milky Way (along the Milky Way)
I'll sign my name on the rooftop in the snow
Then he may decide to stay

[Chorus]

Why don't you give your love for Christmas?

Alongside Slade's 'Merry Xmas Everybody', this is the song that still epitomizes a modern-day British Christmas. Noddy Holder, co-writer of the Slade smash still purportedly receiving over £800K per holiday season in royalties from the song. If you were a pre-teen or early teen Baby Boomer in 1973 one might say you were left indelibly scarred by saccharine-sweet artificial festive joy. And Sir Noddy screaming 'it's Chriiissstttmaaas' at you.

Spool forward to 1987 and we find ourselves listening to what is considered to be another of the all-time Christmas classics. As it turns out it's also the last one on the iconic list. A Fairytale Of New York by Irish band, The Pogues. Nothing emerging since has come anywhere close. It's often cited as the 'best' Christmas song of all time. Here's what writer Shane McGowan penned:

It was Christmas Eve babe
In the drunk tank
An old man said to me, won't see another one
And then he sang a song
The Rare Old Mountain Dew
I turned my face away
And dreamed about you

Got on a lucky one
Came in eighteen to one
I've got a feeling
This year's for me and you
So happy Christmas
I love you baby
I can see a better time
When all our dreams come true

They've got cars big as bars
They've got rivers of gold
But the wind goes right through you
It's no place for the old
When you first took my hand
On a cold Christmas Eve
You promised me
Broadway was waiting for me

You were handsome
You were pretty
Queen of New York City
When the band finished playing
They howled out for more
Sinatra was swinging,
All the drunks they were singing
We kissed on a corner
Then danced through the night

[Chorus]
The boys of the NYPD choir
Were singing "Galway Bay"
And the bells were ringing out
For Christmas day

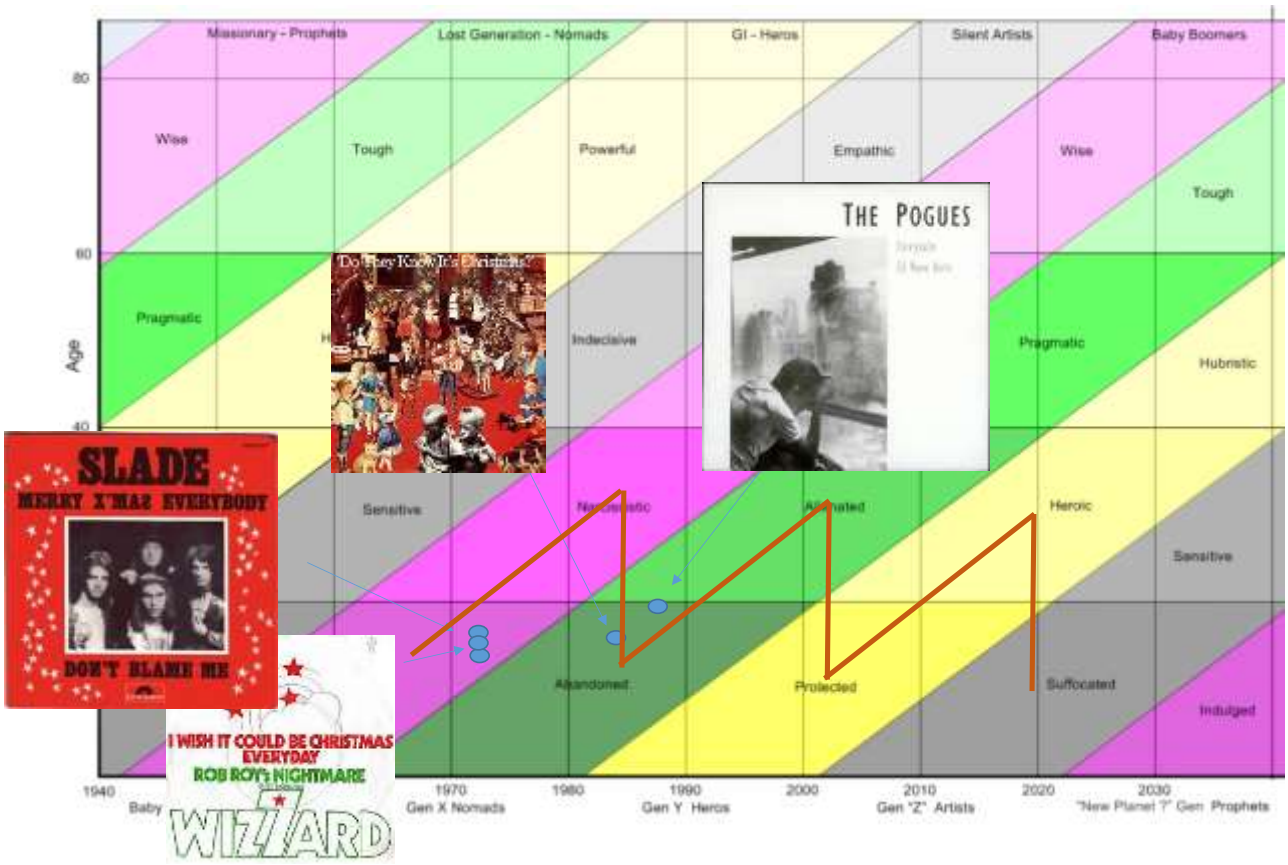
You're a bum
You're a punk
You're an old slut on junk
Lying there almost dead on a drip in that bed
You scumbag, you maggot
You cheap lousy faggot
Happy Christmas your arse
I pray God it's our last

[Chorus]

I could have been someone
Well so could anyone
You took my dreams from me
When I first found you
I kept them with me babe
I put them with my own
Can't make it all alone
I've built my dreams around you

[Chorus]

You probably won't be too surprised to find how these songs fit onto the Generational Cycles map. Just in case you are, here's what we see:



Wizzard and Slade created what turned out to be perfect songs for the Indulged (Prophet) Baby Boomers. Whereas The Pogues created the ultimate Christmas anthem for the Abandoned or Alienated (Nomad) Generation X'er.

Funny how Sean's 'scumbags, maggots and cheap lousy faggots' somehow managed to kill the festive mood ever since. As shown by the saw-tooth brown line on the Map, with Christmas being a time mainly for kids, the songs that get written are almost inevitably written by the older generation. So the Boomers grow up with I Wish It Could Be Christmas Everyday, turn into Narcissists that then write things like the Band Aid single 'Do They Know It's Christmas', a best-selling piece of Boomer pompousness if ever there was one. The Boomer written songs then poison the well for the poor old Nomads (insert image of Tiny Tim from Dicken's book A Christmas Carol here). They then grew up and were too Alienated to create anything that proved to be appropriate for their Protected Heroes.

Now those Generation Y Heroes are grown up and having kids of their own, they've thus far had to resort to regurgitating what their grandparents listened to in order to get their precious Suffocated offspring into the mood. Which seems to suggest there is some kind of Christmas song vacuum at this point in time. Nature, of course, abhors vacuums, and so I think the model is suggesting that the time is absolutely ripe for the Hero generation to re-think the Christmas classic song. Their difficulty is they really don't have a proper Christmas-song meme of their own, so they're struggling a bit to come up with anything that catches the mood. Perhaps the Generation Model can help them out a bit. Maybe by going back four generations to what the last Suffocated generation grew up listening to. Enter Irving Berlin and what is another of the best-selling and enduring Christmas songs of

all time, Bing Crosby's version of White Christmas. We leave you with this thought, courtesy of 1941.

I'm dreaming of a white Christmas
Just like the ones I used to know
Where the treetops glisten
and children listen
To hear sleigh bells in the snow

I'm dreaming of a white Christmas
With every Christmas card I write
May your days be merry and bright
And may all your Christmas' be white

I'm dreaming of a white Christmas
Just like the ones I used to know
Where the treetops glisten
and children listen
To hear sleigh bells in the snow

I'm dreaming of a white Christmas
With every Christmas card I write
May your days be merry and bright
And may all your Christmases be white

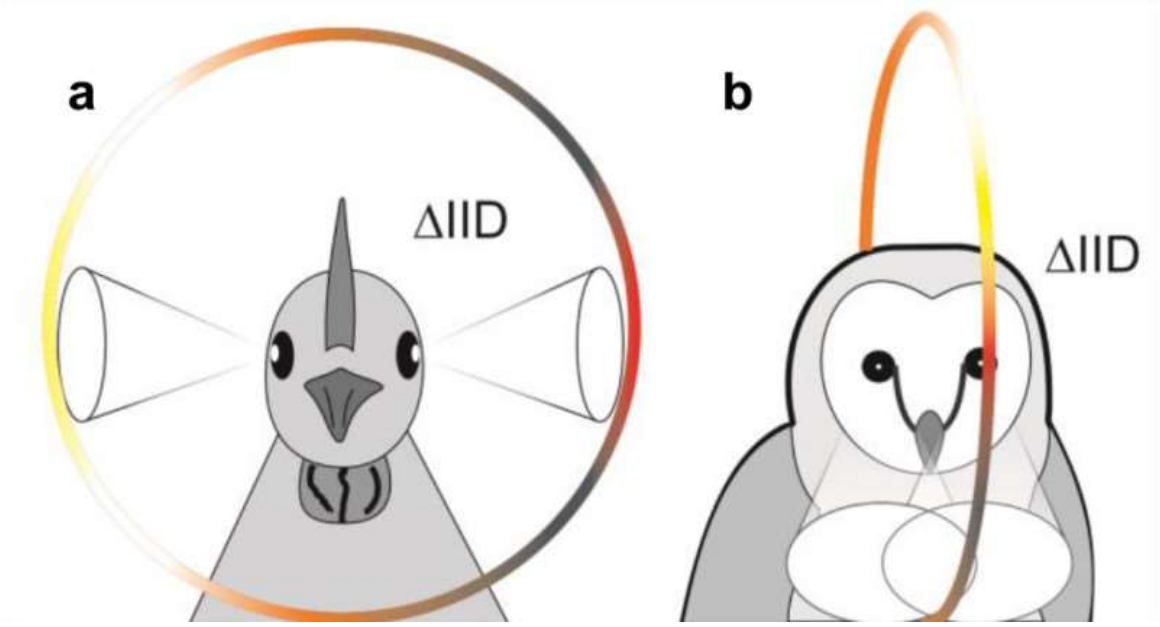
Biology – Directional Hearing In Birds

Unlike mammals, birds have no external ears. The outer ears of mammals play an important function in that they help the animal identify sounds coming from different directions and elevations. But birds are also able to perceive whether the source of a sound is above them, below them, or at the same level. Now a research team from Technische Universität München (TUM) has discovered how birds are able to localize these sounds, namely by utilizing their entire head. Their findings were published recently in the *PLOS ONE* journal.

It is springtime, and two blackbirds are having a sing-off. They are both competing for the attentions of a female. But to pick a successful suitor, the female must first be able to find him.

"Because birds have no external ears, it has long been believed that they are unable to differentiate between sounds coming from different elevations," explains Hans A. Schnyder from the TUM Chair of Zoology. "But a female blackbird should be able to locate her chosen mate even if the source of the serenade is above her."

Mammals identify sound sources in the vertical plane using their external ears, which absorb, reflect or diffract the sound waves because of their special structure. Their sense of hearing uses this information to determine the elevation of the sound source. But how do birds perceive these differences?



Schematic interpretation that directionality of vision and hearing align. Lateral eyed birds like Gallus gallus have access to elevation dependent IIDs on both sides (a) (Figures S4 to S6). Frontal eyed birds like Tyto alba however have access to their elevation dependent IIDs in front (b) [6]. Color indicates changing IID values.

The head does the work of external ears

By studying three avian species -- crow, duck and chicken -- Schnyder discovered that birds are also able to identify sounds from different elevation angles. It seems that their slightly oval-shaped head transforms sound waves in a similar way to external ears.

"We measured the volume of sounds coming from different angles of elevation at the birds' eardrums," relates Schnyder. All sounds originating from the same side as the ear were similarly loud, regardless of their elevation. The ear on the opposite side of the head registered different elevations much more accurately - in the form of different volume levels.

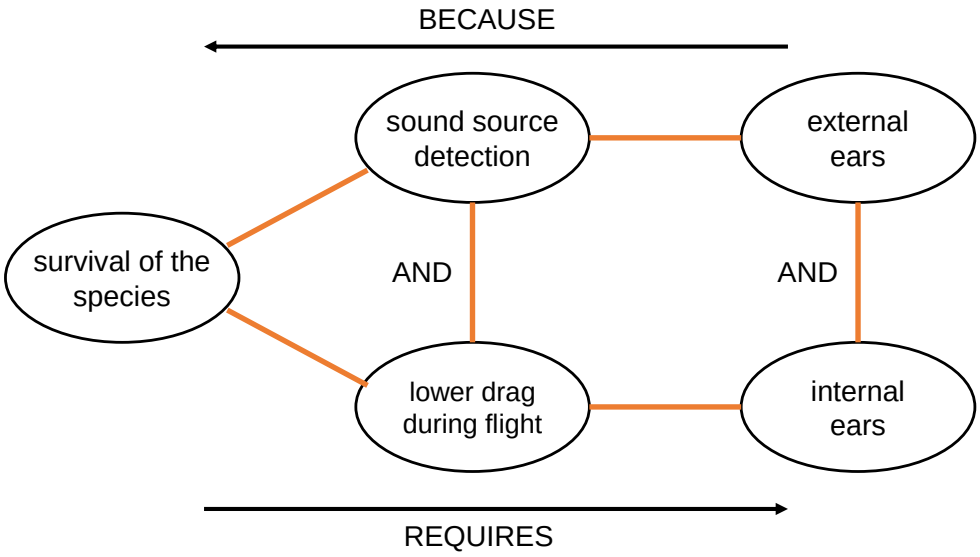
Different volume levels reveal sound sources
It all comes down to the shape of the avian head. Depending on where the sound waves hit the head, they are reflected, absorbed or diffracted. What the scientists discovered was that the head completely screens the sound coming from certain directions. Other sound waves pass through the head and trigger a response in the opposite ear.

The avian brain determines whether a sound is coming from above or below from the different sound volumes in both ears. "This is how birds identify where exactly a lateral sound is coming from -- for example at eye height," continues Schnyder. "The system is highly accurate: at the highest level, birds can identify lateral sounds at an angle of elevation from -30° to +30°."

Interaction between hearing and sight improves orientation
Why have birds developed sound localization on the vertical plane? Most birds have eyes on the sides of their heads, giving them an almost 360° field of vision. Since they have also developed the special ability to process lateral sounds coming from different elevations, they combine information from their senses of hearing and vision to useful effect when it comes to evading predators.
A few birds of prey like the barn owl have developed a totally different strategy. This species hunts at night, and like humans its eyes are front-facing. The feather ruff on their face modifies sounds in a similar way to external ears. The owl hears sounds coming from in front of it better than the other bird species studied by Schnyder.

So there is a perfect interaction between the information they hear and the information they see - as earlier studies were able to demonstrate. "Our latest findings are pointing in the same direction: it seems that the combination of sight and hearing is an important principle in the evolution of animals," concludes Schnyder.

From a contradiction resolution perspective, the problem being solved here is that the bird needs to be able to detect sound sources at different positions, and isn't able to do so because it doesn't want to have external ears…



Which, when mapped on to the Matrix+ wizard gives the following Inventive Principles solution sequence:

Which offers a pretty good correlation with the strategies that have evolved in the avian world:

- Use the shape of the head (Principle 17)…
- …to allow differences to be detected (Principle 37)
- Use the distal ear to do the directional assessment (Principle 13)
- Combine auditory and visual stimulus (Principe 5)

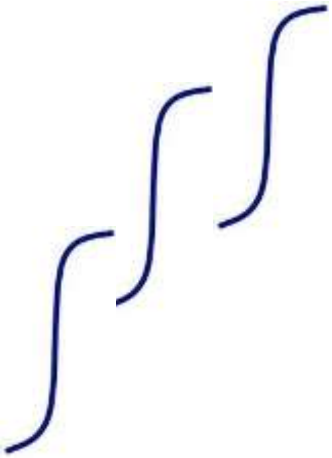
Simple when you know how.

Check out the full paper to see the full story:
Hans A. Schnyder, Dieter Vanderelst, Sophia Bartenstein, Uwe Firzlaff, Harald Luksch. **The Avian Head Induces Cues for Sound Localization in Elevation**. *PLoS ONE*, 2014; 9 (11): e112178 DOI: 10.1371/journal.pone.0112178

Short Thort

“In preparing for battle I have always found that plans are useless,
but planning is indispensable.”
Dwight D. Eisenhower

There is an expectation that we will create 1, 2, 5 year, sometimes 10 year plans.
None of which is likely to be the right question
The problem with time-based plans is
‘a year’ in one context is completely different to ‘a year’ in another.
Perhaps, far more relevant would be to write a 1, 2, 5 or sometimes 10 *generation* plan?



News

eBooks
with a following wind, the first of the SI books should become available as ebooks starting from January. TRIZ Companion is looking like the first that will come off the production line. Closely followed by the technical edition of HOSI

Managing For Growth
The really rather excellent industry-oriented 100-day programme designed by DTU in Copenhagen looks like it will be running twice during 2015. The first cohort (and Darrell’s

2-day SI session) begins in February, the second in early September. Contact Ellen Als at DTU for more details.

PanGenic Music Project
The first 'product' to come out of the project with Plymouth University – the 'RealME' iphone app – is currently looking for beta testers. The basic idea in the first instance is to enable users to build playlists based around emotional trajectories. If you think you might be interested in being one of the first 1000, please get in touch with Cara in the first instance.

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

FMCG – PanSensic consumer insight study
Healthcare – PanSensic dashboard
Manufacturing – Sweat project
Pharma – bespoke SI software
Automotive – Senior leadership team workshop/strategy definition session
Automotive – SI Certification workshops
Construction – PanSensic market opportunity-finding study
Transport – ICMM journey design study
FMCG – Evolution Potential assessment study
FMCG – NPD strategy definition workshop
FMCG – SI software

2015
Given that the e-zine usually appears at the end of the month, please allow us to take this opportunity to offer all of our readers thanks for their support and inspiring questions and feedback during 2014 and wish everyone a happy, prosperous and peaceful 2015.