

Systematic Innovation



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

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

TRIZ/SI Deployment As A Function Of Innovation Capability

One of the glaring flashes of the obvious emerging from our work to develop the Innovation Capability Maturity Model (ICMM), was that TRIZ and Systematic Innovation were really systems aimed at organisations that had successfully attained Level 4 Capability. Which immediately helped explain why penetration of either has been relatively limited. There simply aren't that many Level 4 and Level 5 innovators on the planet right now.

This thought has been interpreted by some to mean that there is no point in trying to deploy TRIZ until the organisation reaches Level 4. It's a logic akin to turning up to run in the London Marathon after remembering how you successfully ran up a flight of stairs last week. Running marathons requires training. Winning them requires a lot more.

Just as smart runners design themselves a smart training regime, those with a genuine desire to build innovation capability inside their organisations, know they too will need a meaningful and realistic plan.

The next problem, having made this brave decision, is recognizing that the context of every enterprise is unique to that enterprise. Comforting – hopefully! – to know that if you're a Level 1 organisation, you have lots in common with other Level 1 companies, but does it make any kind of sense at all for a Level 1 financial services organisation in India to adopt the same plan as a Level 1 aerospace company in Mexico?

To a large extent, the answer appears to be 'yes'. In addition to all of the unifying factors found in the Capability Model Levels, there are a number of 'universals' regarding any kind of problem solving activity. An important one, for example, is the idea of successive cycles of divergent and convergent behaviour – Figure 1. Another is our oft-used von Clausewitz expression, 'bring the critical mass of resources to bear at the critical point'.



Figure 1: Minimum Chain Of Divergent-Convergent Problem-Solving Activities

So what does this mean for the first three ICMM Levels?...

ICMM Level 1 – Seeding

An important thing to keep in mind with ICMM Level 1 organisations is that there is little point deploying *any* innovation support tool or methodology in the hope that it will have a collective impact. Level 1 is really all about individuals. Great to put large numbers of people through some kind of (one-day) TRIZ/SI 'Appreciation' training, provided there is no expectation of it delivering any kind of immediate impact. But if there is such an expectation – and realistically speaking that's what's going to be needed in order for the organisation to progress to Level 2 – then the key thing to bear in mind is 'sense of progress'. There's little point in blanket deploying TRIZ if all it's going to do is frustrate lots of people when they become aware of the power of the method and then find themselves with no meaningful way to do anything with it. Sell the idea of TRIZ as 'good for your CV' (e.g. part of your Continuing Professional Development) on the other hand and this will overcome that problem. It won't unfortunately, solve the bigger problem of creating the tangible successes that will be necessary for the organisation as a whole to move forward. Tangible success at ICMM Level 1 means 'any kind of tangible success'. Which in turn means not working on the company's biggest problem. Or the one that will transform the industry. Or revolutionise the way things are done across the business. 'Critical mass at the critical point' for the individual-focused innovation capability is all about finding something that's contained within the individual's sphere of responsibility. It's not about finding the highest value problems to work on, it's about finding the ones that are the easiest to deliver.

With that in mind, the formal tools required to do the job are minimal. The attitude of the individual needs to be 'pirate' and the main attributes of pirates tends to be their resourcefulness. The best that management can do to help the individual in a Level 1 organisation, besides staying out of the way and offering forgiveness rather than permission, is to provide simple tools that allow the individuals in question to a) weave their way through the inevitable complexities of the business to find the 'right' problem to work on, and, b) some simple solution triggers aimed at pointing people in the right direction as far as solutions are concerned. In our experience, these two needs tend to mean teaching people the Perception Mapping tool and a few of the Inventive Principles:

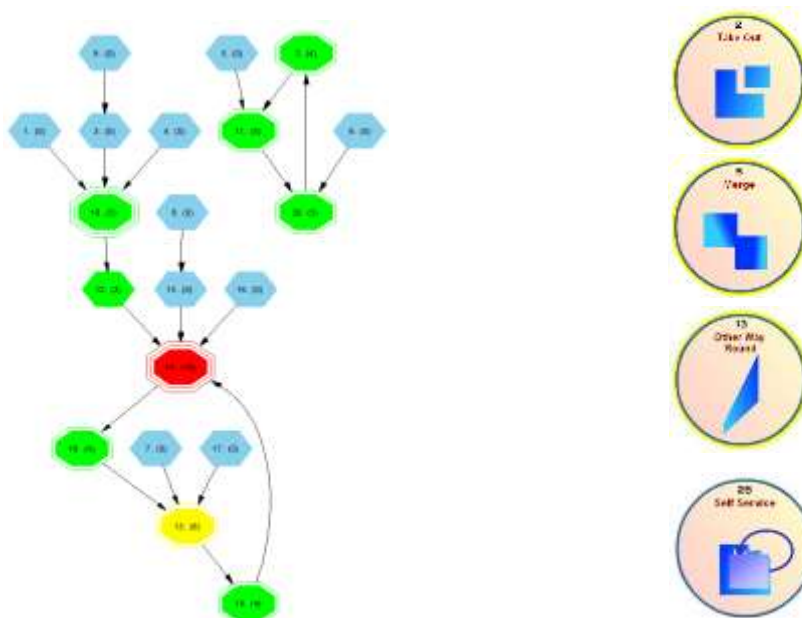


Figure 2: Typical 'Biggest-Bang-For-The-Buck' ICMM Level 1 Toolkit

As far as ‘which Inventive Principles?’ is concerned, this is where industry and domain contexts need to come in to play. Some of the Principles are more relevant than others depending on whether I’m a chemist with a chemistry problem or a bank teller with an awkward customer problem. Management’s job here is to work out what the right ‘Top 5’ is for their context, and then finding simple ways to populate them around the business. We’ve seen quite a few organisations do this with playing cards or ‘cheat-sheets’.

ICMM Level 2 – Championing

As the organisation progresses from Level 1 to Level 2, the emphasis needs to shift from the individual to the team. Critical at this stage is that collectively, this team possesses a critical mass of knowledge of the whole portfolio of TRIZ/SI tools and methods. It’s the time when the organisation might consider Certification programmes for the chosen team members. Ideally after the members have been allowed to self-select. Or rather, after the right candidates – see previous articles on PanSensic psychometric tools – have been told they would be eligible for membership were they to meet the right criteria. ‘Right criteria’ here meaning the ability to work as part of a team (the TRIZ world, for some reason seems to attract an unfortunate proportion of ego-maniacs), and to possess the collective persistence to get projects all the way through to a successful execution... delivery of tangible success continuing to be a big factor in the Capability Journey progressing to Level 3.

We’ve seen two strategies work in regard to ‘critical mass of knowledge’. The first involves Certifying everyone in the team to Practitioner Level. The second involves giving everyone a more basic Level of training and then tasking individuals to build up a more involved level of capability with some of the tools. The idea here being that, while no individual will have the critical mass of tools necessary to work on any problem, the collective does. In other words, some individuals specialize on (say) Contradictions, while others concentrate on Function Analysis.

Once this critical knowledge mass has been accrued, the main thing management can do to help, is to give team members a place and time to go and practice their skills. The ultimate combination is that they’re given a regular space and time to go work on problems that affect the business and that the team can expect to be able to deliver on (‘critical mass at the critical point’ always applies). Most helpful of all is keeping this ‘safe place’ firmly away from the world of the Efficiency Engine and ‘Operational Excellence’. Or at least until such times as the team is ready to work with the Efficiency Engine to iterate and integrate their proposed solutions... which is a good way of also noting that the team should never be allowed to become a closed clique (another sad TRIZ-world trait), but rather an entity with somewhat amorphous boundaries across which newcomers are free to come and go. Teams will know they’ve got this balance right when there is a certain ‘gravitational pull’ into the team – people (including managers) want to be part of it, rather than having to be coerced into participating. Oftentimes there is no better way to get someone to do something (learn some new tools for example) than by telling them, sorry your meeting is full and therefore they can’t attend this time... and that, their chances of being able to participate next time would be greatly enhanced if they learned tool X, because that’s something that’s lacking across the team at the moment.

Figure 3 conceptualises where something like a ‘TRIZ/SI Club’ might best reside within the organisation as a whole. All the time bearing in mind that ‘tangible success’ will only ever happen when things flow across the red-green boundary. In both directions.

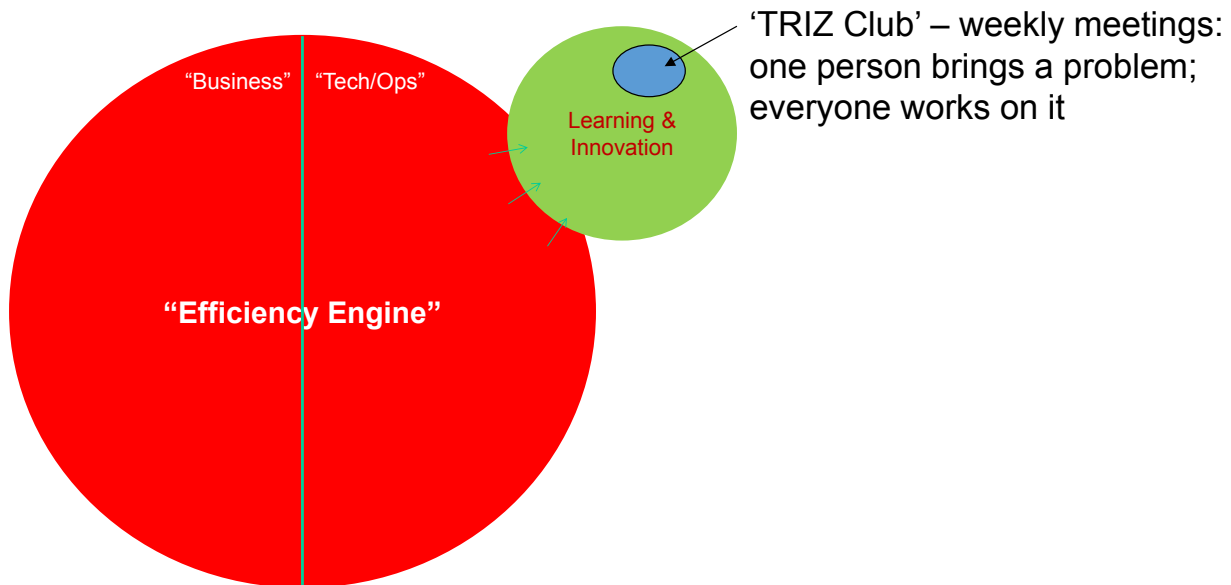


Figure 3: Providing The TRIZ/SI Team With Safe Place & Time To Do Their Work

ICMM Level 3 - Managing

If Level 1 is about individuals and Level 2 about teams, then Level 3 sees another step change shift to management. And specifically management across silo walls and boundaries. From a learning perspective, this means that its now not just the 'do-ers' that will need a critical mass of TRIZ/SI tools, but that significant proportions of the management community have at least an appreciation of the tools, method and – especially – the philosophy of innovation and how it is a different but complementary world to their usual Efficiency Engine world.

Parts of the TRIZ toolkit will still be perceived as 'dangerous' in an ICMM Level 3 organisation, and so while the 'do-ers' might have been given a full armoury of tools to work with, they also need to be taught contextual relevance, and in particular, how they interface with the Efficiency Engine and domain experts. To take a specific example, the Ideal Final Result 'tool' is conceptually very simple, but quite profound in its deployment, often sending the message to domain experts that what they're expert in is the wrong expertise for what the customer actually wants. Far better for teams to avoid this kind of discussion if they're looking for TRIZ to continue to flourish. Put the IFR battle off to a later day, when the organisation is mature enough to deal with its implications. Meanwhile, in order to start planting the right seeds, it is very definitely a good idea to impress upon a broad spectrum of the people within the enterprise the idea of a universal direction of successful solutions towards 'increasing ideality', and the associated Perceived-Benefits-Over-Cost-Plus-Harm equation. And quite possibly, too, the desirability of 'self-x' solutions.

When we look at those Level 3 organisations that have successfully deployed TRIZ/SI (and it has to be said there aren't that many of them across the globe), generally speaking the deployment carries a lot of the generic traits illustrated in Figure 4. Perhaps the key, if there can be said to be such a thing at Level 3, is making 'contradiction' a part of the everyday language of the business. Training large number of people to recognize a contradiction and, more important, to know that they're there to be challenged is the going to be the heart of any kind of 'innovation engine' inside any sustainably successful organisation.

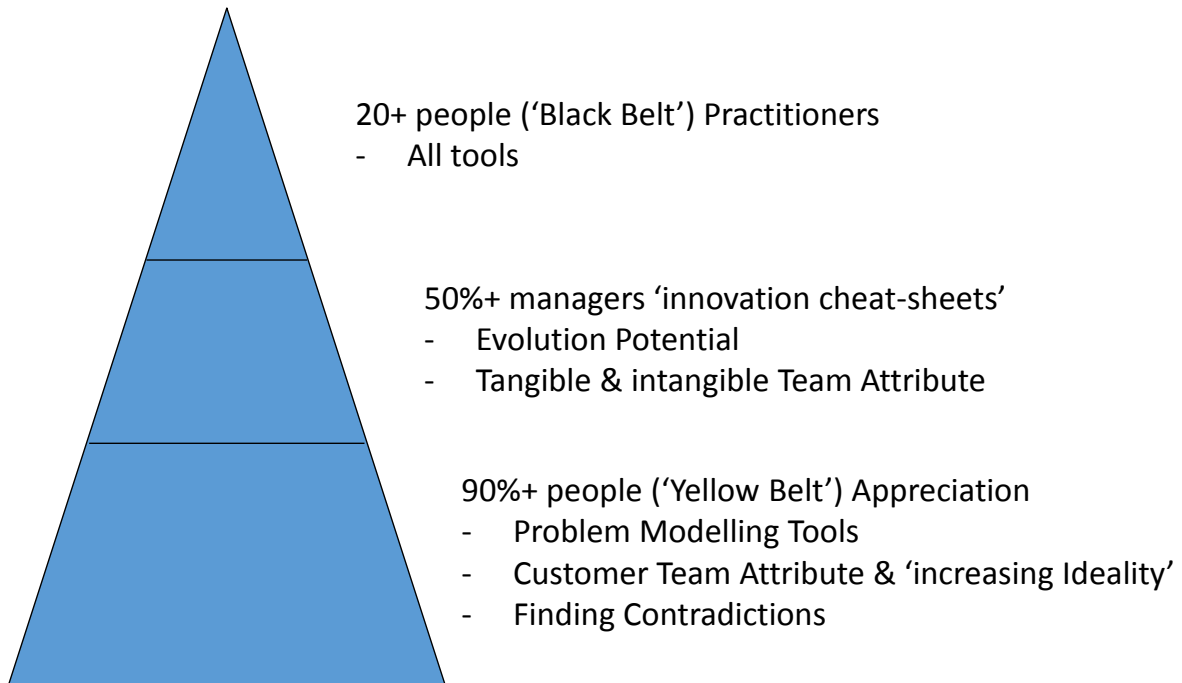


Figure 4: Typical ICMM Level 3 TRIZ/SI Intra-Organisation Deployment Model

Hopefully the sequence sounds simple. Conceptually, we think and have seen that it is. The real issue throughout is persistence, and the recognition that, in the words of the cliché, Rome wasn't built in a day. ICMM Level 3 Rome's typically take years to build rather than days. Even if there is a template.

Case Studies: Why We Don't Go To The Places We Have Ideas

Here's a fairly typical conversation I seem to find myself having with senior leaders.

Leader: what we need around here are more ideas.

Me: what makes you say that?

Leader: we can never seem to escape from the status quo. We need to get out of the box.

Me: what sort of idea generation techniques do you use?

Leader: Err. Brainstorming?

Me: In the office?

Leader (nodding): In the office.

Me: There's some very good research that says when you ask people where they were when they last had a good idea, 95% of the answers will be somewhere other than in the office. It's almost like we go to work to not have ideas.

Leader: I read that I think.

Me: So how about letting people out of the office? Give them idea generation time off-site?

Leader: (silence)

I've had the conversation enough times now, that I took the opportunity to follow up one of these uncomfortable leader silences with a perception mapping exercise. The starting question we posed was this:

Despite the fact that 95% of ideas appear outside the workplace, managers still won't let people escape from the office because....

And here are the responses we received from a mixed group of managers and designers, along with the results of the collective 'leads to' analysis:

Identifier	Perception	Leads To
A	People will generate ideas outside the office in their own time anyway	J
B	People will 'goof-off'	F
C	Ideas might cause excitement and a need to do something about them	I
D	We'll end up with too many ideas	G
E	We need to focus on everyday business	A
F	We'll get the wrong kind of ideas	C
G	Someone will have to sort through them all	E
H	Managers won't be in control anymore	B
I	It will build peoples' expectations of it being a regular thing too much	N
J	Ideas aren't the problem, execution is	K
K	We need more emphasis on finishing than starting	O
L	Benefits won't be measurable	M
M	Managers will have to justify the move to their boss	P
N	Work isn't supposed to be fun	H
O	Ideas might reveal what we're currently doing is wrong	M
P	Inconsistency with currently agreed targets	E

When we drew up the map, we saw a quite rare situation. Two big loops in which almost all the perception statements were a part of the loop. The two loops helped the team to see that there were two independent issues present. That was a start. But then, in terms of which perceptions are more or less important than others, because nearly everything is in a loop, they're all in effect equally important. Meaning that, in terms of knowing what to do next, we weren't too much further than the good start.

Here's what the first of the two loops looked like:

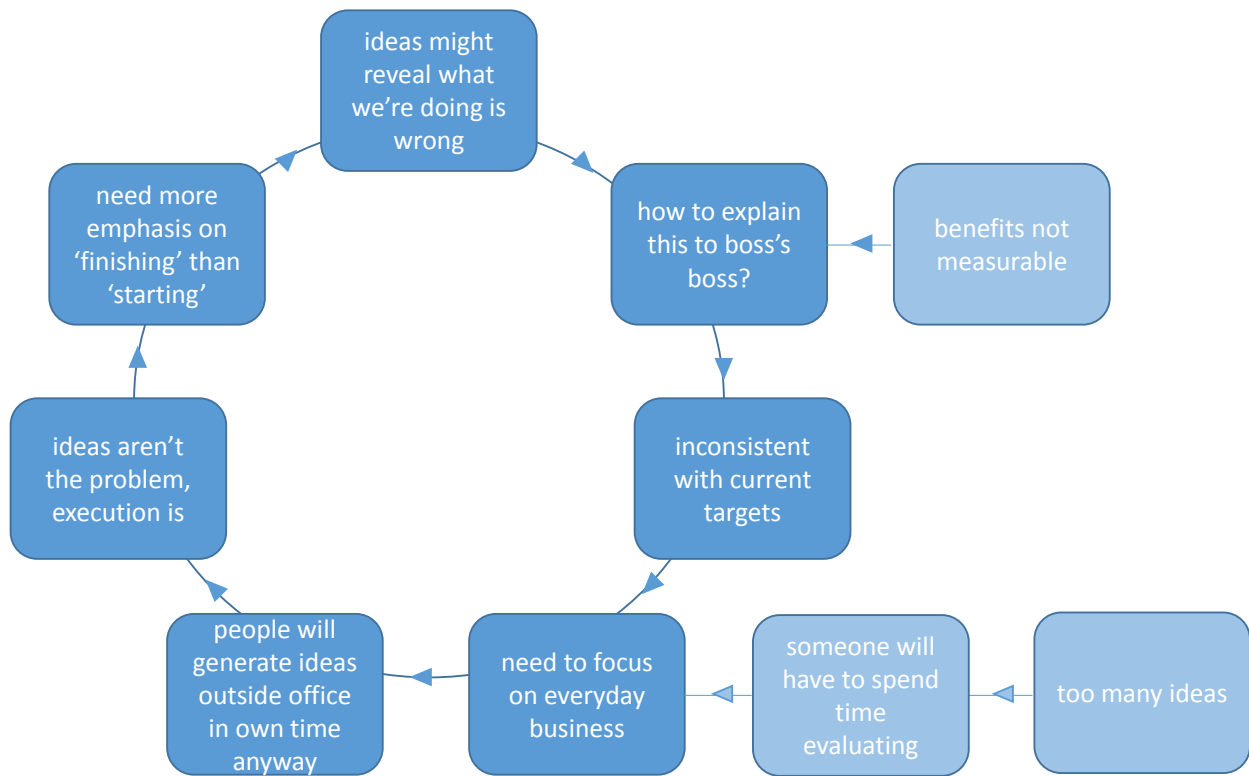


Figure 1: First Loop: 'If People Keep Generating Ideas, Managers Lose Control'

Interesting to note, when the team sat back and looked at this loop was to manner in which the managers began visibly squirming. Their own answers had revealed the picture in front of them. But then, the more we reflected on the picture, the more we could see the second side of the coin: while we might get lots of ideas when people are 'unleashed' from the office, there's no promise that what they come back with will be of any use to the organisation. Taken together, the contradiction to be solved seemed to have something to do with not just unleashing people and letting them run free, there need to be boundaries. A bit like what's required at a child's birthday party. The best parties are the ones where the kids are given some clear boundaries ('go upstairs into my office and you'll be grounded for a year'), some appropriate stimulus (a multi-layer wrapped parcel to pass) and then left to get on with the job of having fun. It's not about a compromise half-way house between management control and anarchy, but a recognition of *where* and *when* the control is needed and when it is not.

So far so good. What about the second loop?

Figure 2 shows the other loop emerging from the Perception Map:



**Figure 2: Second Loop:
‘Ideas Are Easy, It’s Better To Finish The Wrong Thing Than Keep Starting New Things’**

This loop too seemed to imply criticism of management – not wishing to challenge existing targets they had agreed with their bosses. But again, too, there is an important second side to the coin: there’s no need to unleash people to go and generate lots and lots of additional new ideas. Ideas aren’t and probably never have been the problem. The problem is sticking with the existing ideas long enough to deliver some tangible success. Or rather, combining the two sides of the coin, it’s solving the contradiction between delivering success and at the same time knowing that ‘success’ also demands that we’re working on the right problem. Figure 3 summarises this contradiction:

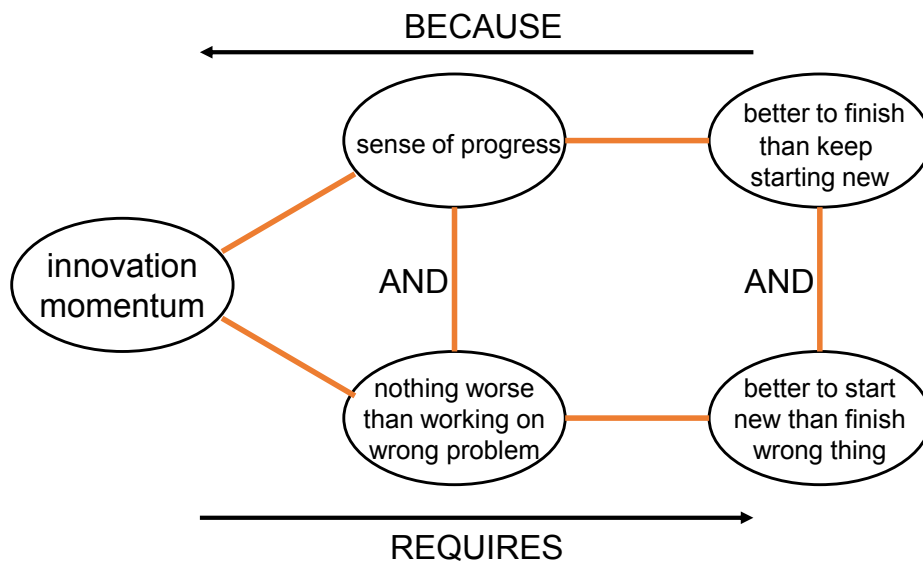


Figure 3: Sense-Of-Progress Versus Wrong-Problem Contradiction

It's a problem that takes us right to the heart of innovation in a complex environment. Complexity means that there's never such a thing as the 'right problem', merely the 'best problem to be working on right now'.

The key phrase here being 'right now'. Which is why, when we map this contradiction into the Matrix+ Wizard, the most frequently used Inventive Principles used to solve similar problems are Principle 19, Periodic Action, Principle 23, Feedback and Principle 21, Hurrying:

Which means, for managers:

- Make sure you understand the step-change pulse rate of the domain you're working in. Once you know this, that helps determine the appropriate problem-solution-execution cycle time required
- 'Fail Fast, Fail Forward: recognize that there is no such thing as the 'right problem' and that what's needed is rapid learning cycles that progressively help reveal what needs to be done.
- Provide metrics that allow people to know that progress is being made... part of which is establishing how the number of unknowns or 'wrong problems' is reducing.

And for the idea generators:

- The best time to get out of the office is during the fuzziest part of the fuzzy front end of a new project, making sure when you're incubating ideas, your head is filled with as much relevant stimulus as possible.
- There are times and periods when finishing is much more important than starting... so maybe the critical thing to mull over on the way to the office would be ideas pertaining to how the organisation might get better at finishing stuff.

Not So Funny – Evolving Pet Accessories

How's this for a contradiction. We love our pets, but at the same time we do some pretty horrible things to them. In theory the contradiction is resolved because the pet doesn't know they're horrible things. In practice, I have a hunch that when our pets see crowds of people gathered around pointing at them and laughing hysterically, it can't be good for their mental health.

On the other hand, some of the solutions on offer make for pretty good illustrations of 'advances' along the predictable lines of evolution. So that justifies all of the potential canine psychiatrist bills.

First up, muzzles. Which need to become more flexible. And then more curved:



More curvature examples:



Mono-Bi-Poly and/or Space Segmentation:



Increasing Dynamization:



I'm not totally sure what the Korean 'Pet Pavilion' is actually doing, but I have my fingers crossed it has nothing to do with microwaves. I'm also not so sure about driving along the motorway at 70mph towing the pooch-caravan. Although videoing the experience might be fun.

Speaking of Dynamization, it seems it also applies to goldfish:



('walkies')

And in case you were thinking about the 'liquid' stage of the trend, here's how it applies back to the dog:



That'll teach you to stink up the place.
Time to head back to more Space Segmentation. This one might just qualify as the ultimate doggy humiliation. Wrong on sooo many levels:

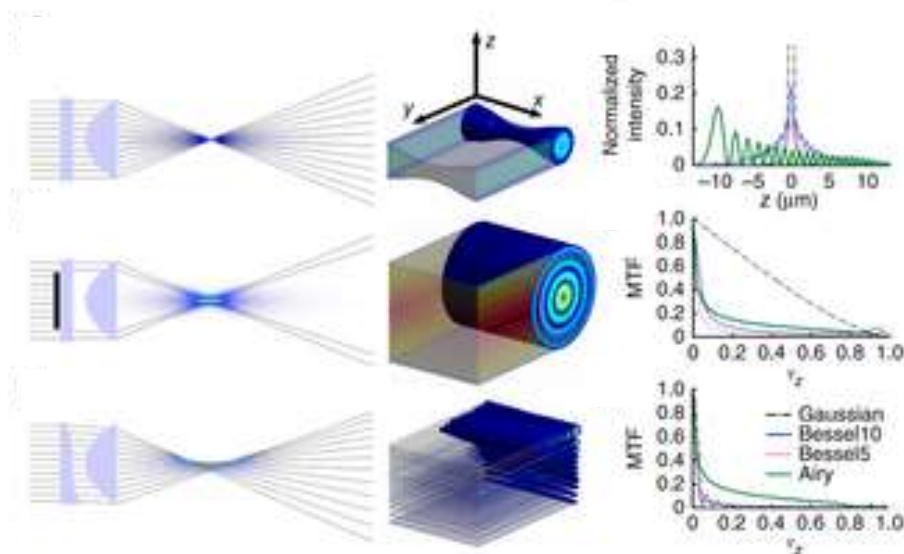


Oh, wait a minute, no, it's this one...



...only I'm not quite sure what trend it is. Nesting Up? Decreasing Energy Conversions?
Or maybe Customer Purchase Focus?

Patent of the Month – Optical Manipulation Of Micro-Particles



Patent of the month this month takes us to Scotland and a trio of inventors at St Andrews University. US9,176,313 was granted to the team on November 3. The title probably does a good job of describing both the purpose of the invention and its main inventive step. Here's what the invention disclosure background section tells us about the deeper rationale for the work:

Optical micromanipulation has expanded into a substantial field that continues to have major impact upon the biological and colloidal sciences. A particular theme that has emerged is the use of novel light fields and extended arrays of traps: these may be grouped under the particular title of "optical potential energy landscapes". The ability to influence the movement of colloidal and biological objects in such landscapes is of importance in observing phase transitions and to initiate optical sorting. Such microparticles respond to the gradient and scattering forces exerted and follow trajectories not commensurate with the flow direction of the liquid in which the particles are provided.

*According to the present invention, there is provided a method for **causing particles to accelerate** along one or more curved trajectories using one or more beams, for example an Airy beam, that has a curved, for example, parabolic profile.*

*Moving a particle up and along a curved trajectory using an Airy beam is possible because of the fundamental nature of the beam. Movement can be imparted to the particle by the beam **without the need for microfluidic flow or beam movement**. This is a significant advantage.*

An Airy wavepacket has been shown theoretically to be "diffraction-free" solution to the Schrodinger equation for a free particle. In the absence of any external potential the wavepacket may freely accelerate transverse to its propagation direction. The mathematical analogy between the Schrodinger equation and the paraxial wave equations may be used to realise finite energy Airy beams in the optical domain. The beam has the form of a central maximum and a number of side lobes that exhibit transverse motion. These beams remain, however, a curiosity and have not yet been employed in any useful application.

An Airy beam has a transverse acceleration associated with its light field. Particle trajectories may be induced to follow parabolic trajectories, commensurate with that transverse acceleration...

The present invention can be used to invoke precise transfer or "clearing" of particles from a given quadrant in a sample chamber with no motion of the light beam. When an Airy beam is used, it acts as a form of micron-sized "snowblower" attracting particles at the bottom to blow them upwards and sideways.

The basic contradiction being solved can be observed by looking at the text highlighted in red – the inventors are trying to accelerate/move the micro-particles without moving any kind of fluid or light beam. Here's how me might best map this conflict pair onto the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Speed (14)

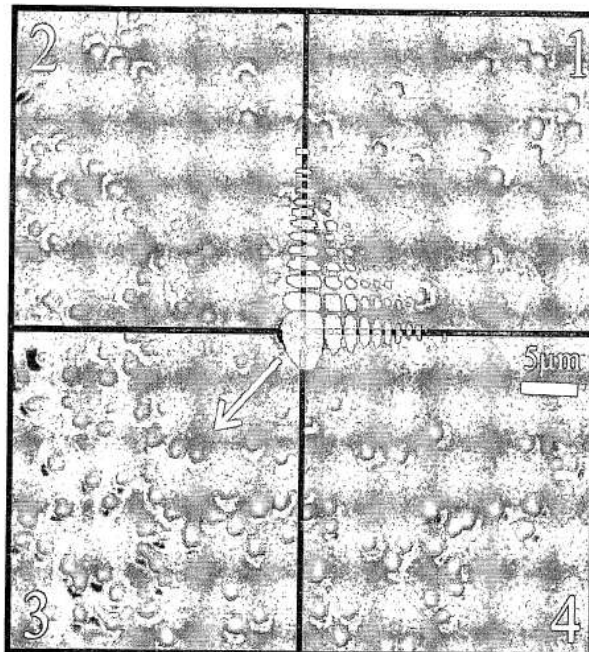
WORSENING PARAMETERS YOU HAVE SELECTED:

Force/Torque (15) and Energy used by Moving Object (16)

SUGGESTED INVENTIVE PRINCIPLES:

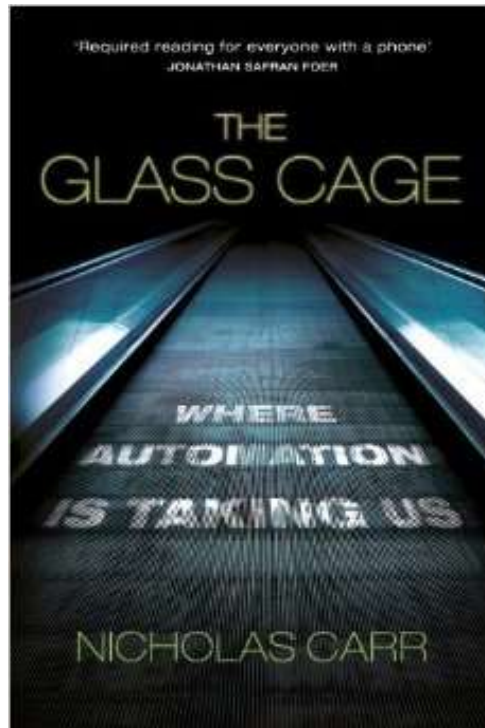
19, 28, 15, 35, 13, 12, 3, 29, 38, 18, 5, 17

There's no great surprise in the solution deployed by the inventors to achieve the desired outcome – it's a (Principle 28) use of a 'field'. In this case optical. Or, more specifically, the 'Airy beam'. Interesting to note, as we see with a significant proportion of inventions coming from academia, the solution has come before the application. Airy beams, in other words, were previously seen as a 'curiosity'. Now, thanks to the St Andrews team, they have a potentially very important role to play in the worlds of micro-biology, colloids, microfluidics and aerosols (e.g. air cleaning). Plus, the whole concept of moving physical objects, albeit small ones, using just light seems like a pretty counter-intuitive thing to be able to do. Even though the TRIZ trends would have told us it would eventually happen. It just did.



Read more and see some of the amazing things being done by the St Andrews team at: <http://www.st-andrews.ac.uk/~photon/manipulation/>

Best of the Month – The Glass Cage



I've never actually refused to take out a hire car featuring a 'change gear now' indicator on the dashboard, but probably because I only discover my car has one when I'm a couple of miles away from the parking lot. I don't care if the car knows when to change gear better than I do, I'm driving and I get to decide. Not the transmission designers at Ford. Or Renault. Or whoever.

Here's a book for the dystopian control-freak ranters like me.

Staying with the annoying-car theme, Google recently announced proudly that its fleet of self-driving cars has clocked up more than half a million miles on the road. Admittedly, there has been one nasty accident along the way – a five-car pile-up – but this, as Google was quick to point out, occurred "while a person was manually driving the car".

Yet what exactly has automation done for us? Has it freed people from drudgery and made them happier? Or has it, as Nicholas Carr wonders in this elegantly persuasive book, had the opposite effect, transforming us into passive zombies, helplessly reliant on machines to tell us what to do?

One of the strange things about automation is that it hasn't been around that long. The word only entered the English language in 1946 when engineers at the Ford Motor Company wanted a term that would describe their new assembly lines. At first these new computerised machines were little more than lumpy beasts of burden; they did what they were told and never got uppity.

But slowly that relationship has changed. As computers have become ever more sophisticated, so we have ceded ever larger amounts of control to them. And in doing so, it's just possible that we have lost more than we've gained.

For centuries the Inuits on the small island of Igloolik in northern Canada were renowned for their navigational skills. Stick an Igloolik resident in the middle of a barren expanse of tundra and he or she could unhesitatingly get to wherever they wanted to go. Not any more, though. Now the Iglooliks can barely move without consulting their satnavs.

But does this matter? After all, the Iglooliks can still get from A to B without mishap. Well, actually they can't, as it turns out. However sophisticated they may be, machines make mistakes and several Iglooliks have been so glued to their little screens that they've plunged down yawning crevasses never to be seen again.

By the same token, airline pilots place so much reliance on their instruments that, as one senior pilot put it: "We are forgetting how to fly." With their expertise eroded, reflexes blunted and attention spans diminished, pilots are now more likely to make mistakes whenever they have to take manual control of a plane.

There are also other, less drastic, but equally insidious effects of automation. In America, as over here, all medical records are computerised, leading – so the theory goes – to greater efficiency, a larger pool of shared knowledge and better care for patients.

But in practice something quite different is happening. Whereas doctors used to write out a patient's case notes by hand, now they just cut and paste chunks of undigested text from medical textbooks into their reports. The result is an increased stereotyping of patients and what Carr calls "a shearing away of nuance". In other words, one asthma sufferer's case notes are likely to be much like another's.

As Carr is at pains to point out, he's no Luddite who thinks that we would all be better off living in holes in the ground and making our own woad. Instead, in his thoughtful, non-strident way, he's simply pointing out that the cost of automation may be far higher than we have realised.

Although we may think that the less we have to do, the happier we are, all the evidence suggests this is rubbish. In fact, we tend to be most fulfilled when we're working. Why? Because in order to feel good about ourselves, we have to expend energy and make an effort.

This turns out to be as true of knowledge as it is of everything else. In one sense it's wonderful to be able to summon any fact with a click of a button, but in order to truly know something you have to implant it in your brain, to weave it into your neural circuitry – and no amount of button-clicking is going to do that.

For all Carr's persuasiveness, he's clearly aware that nothing he says is likely to make a blind bit of difference. It's far too late for that. Transformed from active participants into dull-eyed observers, we are being borne forward towards an increasingly mechanised and anaesthetised future. Have a nice day.

Wow In Music – Superstition



Frequently cited as one of the most important songs of the 20th Century, Stevie Wonder's 'Superstition' represents a remarkable achievement on many different levels. Not many songs, for example, merit analysis in a PhD thesis. Not many, also, offer up so many inventive leaps in so short a piece of music. Here are a few of the things you might like to listen out next time you hear the song on the radio. Along with the Inventive Principles we can hear in action:

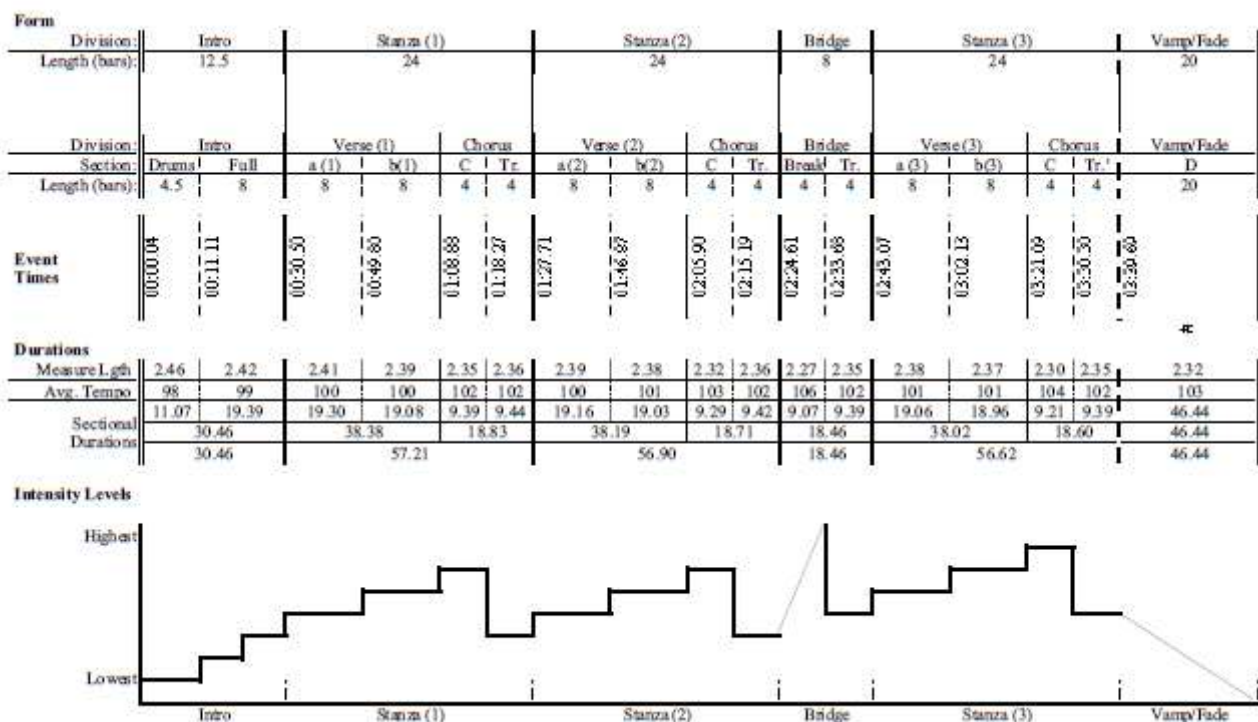
One of the things that strikes the listener early on is the sound quality of the clavinet used alongside the bass and drums during the introduction to the song. The clavinet first appeared in 1964, eight years before the recording of Superstition, but Wonder was one of the first to make use of the instrument's distinctive bright staccato sound in a funk context (Principle 17). In particular, on Superstition, the clavinet was recorded have considerably more midrange punch and lower-range resonance than clavinet recordings by other artists (Principle 35), yet still retaining the sharp, upper-range attack that gives the clavinet its guitar-like character. Wonder was enamoured of this sound quality and Superstition was designed to take advantage of it. He wanted to use the clavinet on the song to full effect in order to "show off." "It's a funky, dirty, stinky, *nasty* instrument," he said at the time.

In this case, two clavinet parts (Principle 1) with similar timbres but different rhythms (Principle 3) were placed in different locations in the stereo mix. Because of the clavinet's sharp attack, it attracts attention from the middle of a full texture and is easy to follow with the ear. By combining two parts, the result is a noticeable interlocking effect (Principle 37) that seems to have a single sound source but which greatly increases the kineticism of the part by bouncing rapidly throughout the stereo mix.

Superstition begins at a tempo of about 98 beats per minute, but accelerates to roughly 100 BPM as soon as the clavinet and bass enter (Principle 4). During the choruses the tempo increases to 102-106 BPM. It has a relatively light 4/4 drumbeat, consisting of a quarter-note pulse alternating between the bass and snare drums and steady eighth notes and swung, sixteenth-note decorations played on the high-hat (Principle 19).

The instrumentation consists of drums, two clavinet parts, synthesized bass, alto saxophone (played by Trevor Laurence), trumpet (Steve Madaio), and solo vocals. The lack of guitar or other baritone range instruments allows the clavinet and Wonder's vocals to be clearly heard without being overpowering. The instruments are predictably dispersed across the stereo mix with vocals and bass in the centre and none of the remaining instruments panned all the way left or right. There is little echo or reverb and the equalization is relatively balanced across bass, midrange, and treble. The resulting sense of space is intimate, as if the listener were hearing the song in a smaller room or studio instead of a large concert hall.

The song opens with a four-and-a-half bar introduction only on the drums (Principle 2), followed by eight more introductory bars on drums, clavinet, and bass. During this passage the clavinet ostinato that dominates the entire song is clearly stated. Once the vocal begins, Wonder sings two complete stanzas, followed by an eight-bar breakdown that serves as a bridge. After a third stanza, there is a concluding vamp that fades out after about twenty bars. Both the bridge and the vamp are based on the chorus:



In general, the form is conventional (Intro—a–a–B–a–Vamp) and relatively balanced, with three stanzas of three eight-bar sections. The bridge is quite short, only eight bars, and the concluding vamp is roughly as long as one of the stanzas. The intro begins quietly and builds in progressive four-bar sections up to the opening stanza. The intensity of the dynamics, articulation, and texture increases in each stanza from the first eight bars of each verse (clavinet, bass, drums, and vocals), through the next eight bars of the verse (added horns, a more active bass line, and intensified vocals (Principle 5)), and the first four bars of the chorus (more active drums and more prominent horns) (Principle 37), before dropping back down to begin the next stanza (Principle 13). The point of highest intensity is at the midpoint of the bridge, with a secondary climax at the midpoint of the last chorus.

“Superstition” is much like the James Brown songs that Robert Palmer refers to as

having “no chord changes” (Principle 20). Harmonic change does occur, but infrequently: the only chord changes in this song occur during the chorus and the chorus-derived bridge and vamp. As Brackett points out in his discussion of “Superbad,” the infrequency of harmonic motion makes the changes that do occur much *more* significant, simply because of their infrequency, even as it also indicates that harmonic progression is not the primary source of forward motion in Superstition. The three-part, **a-a-B** form, with cadential figures only in the B sections, also means that “Superstition” is essentially a double-scale blues form (Principle 5), although the only primary blues reference is the subject of the lyrics (perhaps an answer to the long tradition of blues songs with mystical subjects).

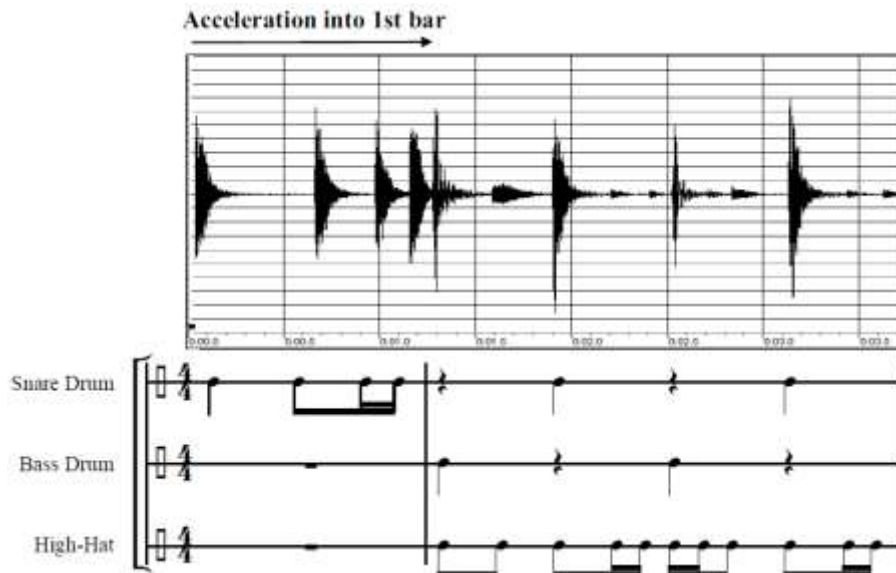
The bulk of the song—the introduction and verses—is built on Eflat harmony of ambiguous quality. The only fully voiced tonic chord is an Eflat dom9, which includes both major and minor thirds (enharmonically) (Principle 5). This chord is used to support melodies derived primarily from the Eflat minor pentatonic scale (Eflat, Gflat, Aflat, Bflat, and Dflat). The use of the minor pentatonic over the dominant ninth (which includes G#) creates a three-note chromatic passage within the minor pentatonic scale (Gflat, G#, Aflat). This produces the so called “minor blues scale,” which is quite conventional in funk and many other styles derived from African-American musical traditions. It is also conventional in funk to sustain long passages over a single dominant ninth chord. This chord allows great melodic flexibility by providing harmonic support for several Eflat scales: major, mixolydian, minor pentatonic (and/or blues scale), and dorian. Chromatic passing tones and intertonal inflections in the vocals, bass, and horns offer further flexibility, which Wonder uses to full advantage.

The first four bars of the chorus feature a quickly shifting group of chords—in essence a blues turnaround—culminating in a two-bar, **IVflat7 – V+** cadence, emphasized by a brief, half-bar stop-time effect (Principle 19). The primary groove returns in Eflat after this cadence, supplemented by a descending melody in the horns that announces an end to the stanza while simultaneously preparing its successor. The harmonic changes, while infrequent, thus are clear indicators to the listener of the main sectional divisions (Principle 23).

The Primary Groove of “Superstition”

The introduction of “Superstition” begins with a half-measure pickup consisting of four notes on the snare. It builds progressively from there until it is fully voiced at the beginning of the first verse. In many ways, the infectious qualities of the song are established in its beginning. It is worth examining the first four-and-a-half bars in some detail. They provide a good opportunity to hear the drum part that supports the groove—which in turn supports the entire song—in full isolation from other, masking sounds.

After the sharply struck first note, there is a pause of 0.6 seconds (Principle 2) before another note is heard. This pause grabs the listeners’ ears in much the same way as the very similar, opening snare-shot of Bob Dylan’s “Like A Rolling Stone.” This first note is a quarter note, followed by an eighth, and then two sixteenths (Principle 19). The second of these two sixteenth notes is only two-thirds the length of the first, so the effect of all four notes is an acceleration into the downbeat of the first full measure (Principle 4). This acceleration is visible in a graph of the audio levels superimposed above the music of the pickup and first bar of the introduction:



After the pickup, Wonder begins four measures of a 4/4 shuffle-style part on the high-hat, bass drum, and snare. This simple but variable pattern is the basic beat that underlies the entire song. The bass drum plays on beats 1 and 3, while the snare plays on 2 and 4. The use of a heavy snare backbeat as a structural foundation for a complex groove, while fairly conventional, was particularly characteristic of Benny Benjamin's style at Motown (Principle 26).

The high-hat plays a steady stream of relatively even eighth notes, interspersed by sixteenth notes in an organized but improvisational fashion. It is possible to hear the high-hat part as alternating between a pair of two-beat motives, one of which is fixed and the other variable (Principles 15, 37). The first motive of each bar has three eighth notes followed by a pair of sixteenth notes (Principles 3, 4). It is used throughout the introduction with little variation. The second motive (B) consists of an unbroken stream of notes, but for each half-beat there is an option of either a single eighth note or a pair of sixteenth notes.

It is unusual to characterize this pattern as a stream of eighth notes with interspersed sixteenth note decorations or variations, but Wonder's timing makes it clear that the eighth notes play a different role than their subdivisions. All divisions of an eighth note or longer are divided quite evenly; but the sixteenth notes are played with a deliberately inconsistent swing feel:

Measure	Beat	Durations (sec.)			Percentage of Duration		Ratio (or nearest rational approximate)
		1st note	2nd note	Pair	1st note	2nd note	
Pickup	4	0.18	0.12	0.30	60.00 %	40.00 %	3 to 2
1	2	0.20	0.12	0.32	62.50	37.50	5 to 3
1	3	0.18	0.13	0.31	58.06	41.94	(11 to 8)
1	4	0.19	0.12	0.31	61.29	38.71	(11 to 7)
2	2	0.20	0.11	0.31	64.52	35.48	(9 to 5)
2	3	0.20	0.10	0.30	66.67	33.33	2 to 1
2	4	0.20	0.12	0.32	62.50	37.50	5 to 3
3	2	0.21	0.11	0.32	65.63	34.38	(13 to 7)
3	3	0.19	0.11	0.30	63.33	36.67	19 to 11
3	4	0.19	0.12	0.31	61.29	38.71	(11 to 7)
3	4	0.21	0.09	0.30	70.00	30.00	7 to 3
4	2	0.17	0.12	0.29	58.62	41.38	(10 to 7)
4	3	0.20	0.11	0.31	64.52	35.48	(9 to 5)
4	4	0.22	0.09	0.31	70.97	29.03	(12 to 5)
4	4	0.21	0.08	0.29	72.41	27.59	(13 to 5)

Notice the evenness of the eighth-note durations, which range from 0.29 to 0.32 seconds (a 10.3% variation) and the contrasting (Principle 16) unevenness of the sixteenth notes. The longer first notes of each pair range from 0.17 to 0.22 seconds (29.4%) and the shorter, second notes range from 0.08 to 0.13 (62.5%). Overall, from the shortest sixteenth note in the passage (0.08 seconds) to the longest (0.22), the variation is a whopping 275.0%. The Table shows the proportional timing for all the sixteenth-note pairs in this passage.

The effect of this irregular pattern of inconsistently swung sixteenth-notes, nested within even eighth notes, is consistent with funk style: The beat is smooth and predictable overall, but convoluted and highly unpredictable in detail (Principle 7). In other words it is *loosely organized*, by design. This feeling of loose organization, of “standing on shaky ground” (to paraphrase a Temptations song with a similar groove) is clearly established in the opening drum part. It provides a foundation for the entire song, which is built throughout to produce this same feeling.

All in all, one could call it the greatest example of ‘feel’ ever. Or maybe, to quote another feel maestro, Duke Ellington, ‘it don’t mean a thing if it ain’t got that swing’.

Check out the full PhD analysis at: [http://www.steviewonder.org.uk/bio/life-stories/groove&flow/T.Hughes%20-%20Groove%20And%20Flow%20\(S.Wonder\).pdf](http://www.steviewonder.org.uk/bio/life-stories/groove&flow/T.Hughes%20-%20Groove%20And%20Flow%20(S.Wonder).pdf)
Best PhD ever.

Conference – ETRIA, TRIZ Future, Berlin



My first ETRIA conference for almost a decade. To say I was feeling trepidatious was something of an understatement. Especially in light of the depressing SSI conference in Hong Kong earlier this year. The initial signs were all good: Berlin. Quirky 'rock-and-roll' hotel. 150 participants. 25 different nationalities. Lots of friends to catch up with. Close to 70 papers. The biggest and best TRIZ conference on the planet this year. What could possibly go wrong?

Quite a lot as it happens.

With parallel streams running for most of the conference, it was impossible to go and hear everyone, but based on what I did see plus reading all of the abstracts before deciding who to go and see, there were seven basic kinds of paper on offer:

- 1) I work for a large impressive organisation and by writing the word 'TRIZ' on one of my slides, I hope to convince you that it is being used across the whole of this large, impressive organisation. Plus I really understand it personally. This was basically all of the keynote presentations.
- 2) I also work for a large organisation, but at the working level, so I know that we really don't use TRIZ at all, and I will set about proving this to you by presenting either, a) a really old case study where we didn't use TRIZ to solve a problem, or, b) a recent case study where not only didn't we use TRIZ to solve the problem, we didn't use TRIZ to find the right problem either.
- 3) I have a theory with a vague connection to TRIZ and I'm going to tell you about it, and how, one day in the future, I might do some actual work to prove whether my theory is right or wrong, although, like me, you've probably realized, I am never going to do any real work in my whole career if I can help it.
- 4) I am going to study a really big subject like Oceanography, and I'm going to do it by by peeing into a tea-cup and then analysing the contents through a faulty sieve. This was nearly all the papers by the 'academics'. Usually starting with the 'corpus' of previously published TRIZ papers. Corpus is a good collective noun. But not when 90% of the previously published TRIZ papers are the sort of meaningless crap found in category 1), 2) or 3) above.
- 5) My supervisor told me to study Oceanography. He then handed me a teacup filled with his pee and an even faultier viewing sieve, and telling me to go find something interesting to talk about. These were the papers by the students working for the 'academics'. In every case, what they concluded is that there is almost nothing interesting to say about teacups filled with pee.
- 6) I realized that you can't just study Oceanography using indirect sources like urine, so this time I obtained two teacups, one filled with pee and the other filled with

actual ocean water. I then added miscellaneous sea-life to the two cups and will now prove to you that the sea-life in the pee survives longer than the sea-life in the seawater.

- 7) I pee'd in a teacup ten years ago and would like to update you on predictions I made then that have absolutely no correlation to what actually happened.

It wasn't pretty.

The best thing about conferences is the opportunity to network with like-minded people. I consider many of the attendees of the conference my friends. But I also put them in to two categories. Category One is the friend you can share a beer and a few client war-stories with. Category Two is the friend that you can have a meaningful discussion about advancing the subject with.

Here's an example of a Category Two situation at this year's conference: During one of my papers, I said something that Professor Nakagawa disagreed with. He asked a question at the end of the paper, and I tried to answer it, but clearly didn't do it very well. I realized this after the session, when, at the lunch break, Professor Nakagawa approached me. We both smiled at each other. He sat down and we started to discuss our different opinions. We both knew we needed to find the contradiction. After a few minutes we found it: he held his belief because of one perception, I held mine because I held a different perception. Having understood the root of our difference, we then set about designing a way forward such that we would be able to test each of our respective hypotheses and subsequently be able to, hopefully, solve the contradiction and hence both learn something new. This was not just a lovely conversation, it might actually produce some tangible progress.

On the other side of the coin, here is an example of one of my (multiple) Category One conversations at the conference. Again started by something I presented in one of my papers. Basically that the failure rate of innovation attempts that had involved TRIZ was no different from innovation attempts that had not used TRIZ. A Russian person challenged my statement in a question at the end of my presentation. I responded by saying that I was very happy to share the data we used to draw the conclusion we drew so that he could make up his own mind. His response to this offer was, 'thanks, but I don't need to see your data, I know you are wrong'. When I tried to continue the discussion out of the public eye, it quickly became clear that he held the opinion that he did merely on the basis that he didn't want to hear a different opinion. I left the conversation thinking he was a willfully blind clot, and no doubt he left the conversation thinking that I was an unruly troublemaker. Neither of us made any useful progress. And the beer wasn't that good either.

I like beer, but I like making progress and advancing TRIZ even more. And right now I see no signs of any kind of progress being made in the European TRIZ community. Almost as if the 'don't touch TRIZ' plea of Victor Fey back in 2002 is still haunting everything that is done or said. Whatever you do, don't criticize the history. The up to date reality is that it has become much more insular, more stuck and, rather worryingly, has taken on an attitude of defensive sniping at a world that still hasn't taken up the method.

In last month's ezine I wrote an article questioning whether the TRIZ Community ever used TRIZ. If they do, I'd have to say there was very little evidence of it in Berlin between 26 and 29 October. If I were a little braver, I'd say there was none. As in zero.

I can (and should) say all these things for two reasons. The first reason is that I've been a part of the 'TRIZ Community' for almost 20 years now and I care about it deeply. I really

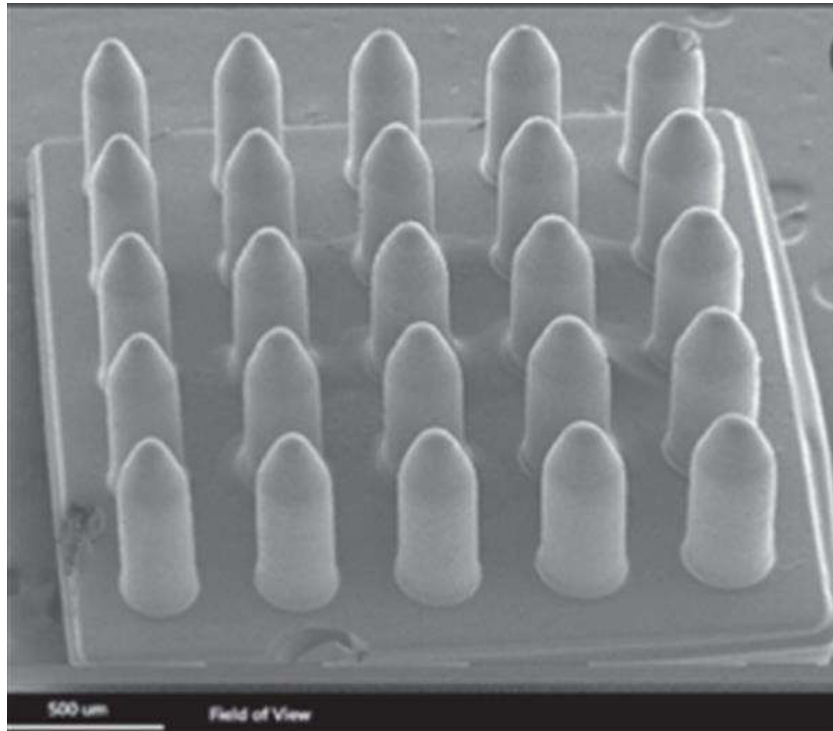
and truly want it to succeed: when TRIZ succeeds, we all succeed. The second reason is - thank goodness - I don't have to rely on the TRIZ world for any of the income I need to earn in order for Systematic Innovation Ltd to survive. This second reason gives me permission – in my mind at least – to say things that the rest of the Community is also thinking, but doesn't have the freedom to express because their income is unfortunately coupled to still being part of the Community. I love TRIZ. To the extent that I have now devoted over half of my life to it and what comes after. Getting 150 people to attend a conference is a good thing. Insulting their collective intelligence by showering them with bad research, worse case studies and the very worst elements of cult'ism is not a great way to encourage people to want to recommend that all their friends should come to Poland for next year's event. And that's the test that needs to be passed. Sadly, I don't think the current round of organisers understand that fact. Really, TRIZophiles, it's time to wake up.



The conference venue – nHow. It was 'innovative'...
...if you include pink walls, dysfunctional architecture and bad soundtrack music in your definition of innovative. Maybe they used TRIZ?

(see also 'Who Moved My TRIZ?' blog post at www.darrellmann.com – a story 'inspired' by ETRIA'15)

Investments – 3D-Printed Drug Delivery Needles



Mechanical engineers in the US have 3D ‘micro-printed’ an array of biodegradable needles capable of drug delivery. The technique offers a pain-free drug delivery device that will allow drugs to diffuse within the body as the biomaterial device degrades.

Treatments could cover a wide range of diseases, including melanoma cancers. The researchers, based at the University of Akron in Ohio and the University of Texas, produced a drug-loaded array for transdermal delivery of a chemotherapy drug. The array consisted of 25 micro-needles, each having a tip and base diameter of 20 μ m and 200 μ m, respectively, and a height of 1mm.

The micro-needles were 3D printed using a photo-curable biomaterial to encapsulate the drugs and a digital micro-mirror device (DMD). This device is a micro-electrical mechanical system which controls light using an array of 780,000 aluminium micro-mirrors.

Jae-Won Choi, assistant professor of mechanical engineering at the University of Akron, said that the technique improves upon current skin-patch drug delivery methods. He said: “The light emitted from a mercury lamp is reflected on the DMD which creates the same light profile as the DMD pattern. The focused light pattern delivered through several optics is projected and crosslinks a photopolymer.” Dacarbazine, commonly used to treat skin cancer, was blended into the solution before crosslinking.

Testing confirmed that the needles are able to withstand the stresses and strains they would be submitted to when inserted into the body. The team hopes to improve the process by optimising printing parameters, such as light intensity and exposure energy.

No patent applications as yet, but you can find out more here:

<http://iopscience.iop.org/article/10.1088/1758-5090/7/4/045001/meta;jsessionid=9F4AE0DFC0B18418049DC46DDB8A2DB8.c1>

Generational Cycles – It's Not Dead, It's Resting

C: ...I wish to make a complaint!

O: We're closin' for lunch.

C: Never mind that, my lad. I wish to complain about this parrot what I purchased not half an hour ago from this very boutique.

O: Oh yes, the, uh, the Norwegian Blue...What's,uh...What's wrong with it?

C: I'll tell you what's wrong with it, my lad. 'E's dead, that's what's wrong with it!



Question: How do you spot which side of the Boomer/GenX fence people born in the 1961-1964 period fell?

Answer: watch them in action at a party. If they partake of any level of alcohol (aka truth serum), and then at some point during the remainder of the evening they proceed to recite old Monty Python sketches to one another, they are Boomers.

If anyone in the group swiftly then leaves the group, probably cursing something about 'sad losers' under their breath, they fell onto the Generation X side of the fence. Either that, or they stayed home. Probably because the Boomers didn't invite them.

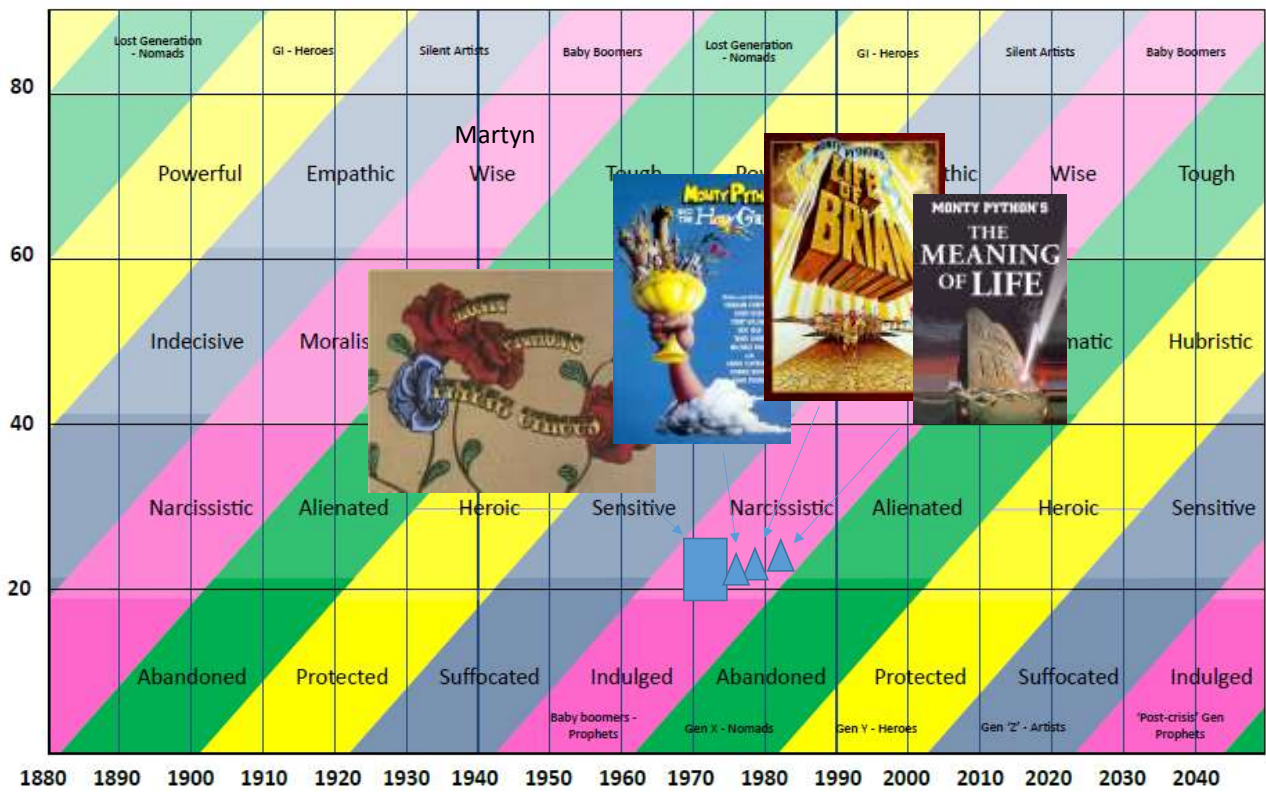
Boomers love Monty Python. When the first TV series arrived on British screens in 1969, it immediately achieved massive success with the audience of young Indulged and Narcissistic Boomers. There was simply no finer way to annoy mystified Silent generation parents than a 30 minute dose of surrealist humour.

Boomers still love Monty Python. That's why they paid a fortune to get a ticket to the series of 're-union' concerts at the London O2 arena last year.

The Generation X Nomads, stayed away in droves. Why would anyone want to sit through two hours of inauthentic re-runs of the 40+ year old scripts? Unless, of course, they were semi-senile Boomers looking to demonstrate to their friends that they were still able to repeat all the scripts verbatim. Just like the other 12,000 people in the room.

(Check out a typical review here: <http://www.dailymail.co.uk/news/article-2678665/Look-bright-George-Osborne-thinks-theyre-funny-But-200-ticket-watch-tired-old-Pythons-fluff-tired-old-lines-QUENTIN-LETTIS-isnt-sure.html>)

Monty Python was/is the archetypal Boomer comedy act:



The five TV series (1969-74) plus three classic films (Holy Grail – '75, Life Of Brian – '79, and Meaning of Life – '83) caught the Narcissistic Boomer zeitgeist perfectly.

(‘Zeitgeist’ – another important Boomer word.)

But that was then and this is now. ‘And now for something completely different...’ indeed. Or not.

Biology – Cricket



Many insects mate by transferring their sperm in a capsule, or ampulla. In decorated crickets, *Gryllodes sigillatus*, an additional edible present, known as a nuptial gift, is offered to the female during mating in the form of a large gelatinous ball of protein attached to the ampulla which the female eats while the sperm are being transferred.

As described in a *PLOS ONE* paper by authors from the University of Exeter and Max Planck Institute for Chemical Ecology, scientists have recently learned that some of the proteins contained in the nuptial gift prevent digestive enzymes in the female's gut from breaking down other active proteins in the gift. These protected proteins may then alter her reproductive physiology and make her less likely to mate with further males.

Professor Richard French-Constant from the University of Exeter said: "It has long been thought that the purpose of the edible love gift was so that male crickets could be sure their sperm wouldn't be eaten by the female. However our study suggests that the story may actually be more complex and that the gift not only functions to feed the female but it may also affect her behaviour."

"It's a bit like the old cliché of offering a box of chocolates on the understanding that your sperm will be met by a receptive reproductive system."

The researchers analysed the proteins contained in the nuptial gift to determine their molecular structure and function. They found that not only are some of the proteins protected from being broken down by enzymes, but they bear a striking resemblance to growth factor proteins known to exist in other insects. This similarity suggests that the proteins could promote cell growth and development in target tissue within the female's body and as a result influence female reproductive behaviour.

Nuptial gifts occur in several insect species in various forms including nicely wrapped dead bugs collected by males, various body secretions, body parts or even the male's entire body.

In the decorated cricket, the female detaches the gelatinous nuptial gift, which is made by the male, from the sperm capsule and feasts during sperm transfer. When she has

finished eating the gift she then consumes the sperm capsule itself and in doing so terminates sperm transfer.

There is a direct correlation between the time needed for a female to consume the nuptial gift and the time required for complete transfer of sperm from the ampulla to the female's sperm storage organ. The larger the gift, the longer the ampulla attachment time and so the greater the male's chance of paternity.

From a contradiction-solving perspective the male cricket's strong desire to have the next generation of crickets sired by himself rather than other males, tends to be hindered by the likelihood that a chosen female might go off and mate with another cricket after you. She has every interest to be promiscuous, in other words. Here's how we might map that contradiction onto the Matrix:

IMPROVING PARAMETERS YOU HAVE
SELECTED:

Productivity (44)

WORSENING PARAMETERS YOU HAVE
SELECTED:

Trainability/Operability/Controllability (34)

SUGGESTED INVENTIVE PRINCIPLES:

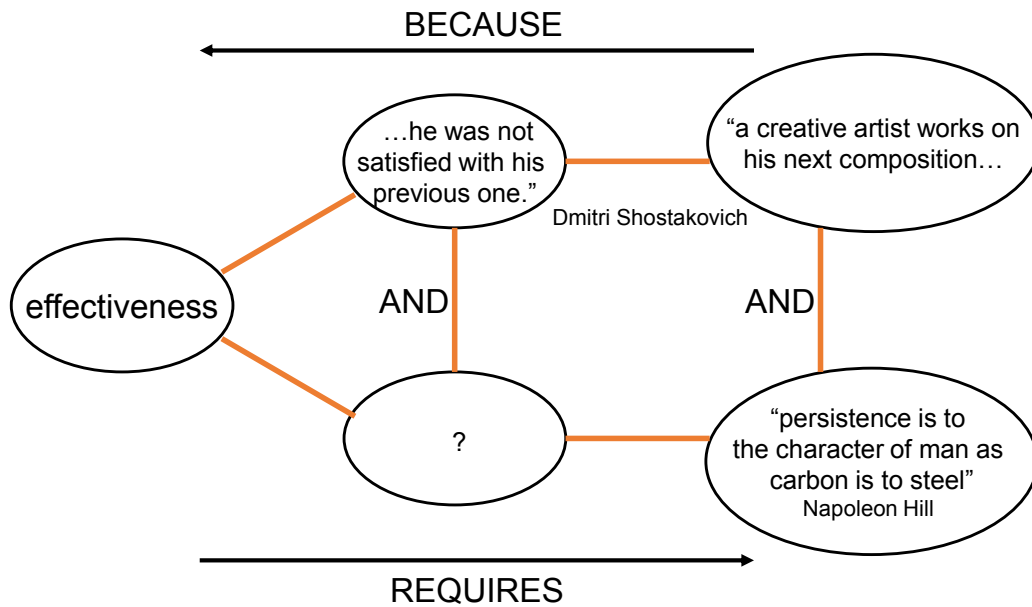
28, 7, 26, 24, 10, 1, 35, 25, 15

The cunningly-engineered promiscuity-reduction proteins sounds like a pretty good illustration of several of the Inventive Principles suggested by the Matrix. If I had to choose, Principles 28 (introducing a (chemical inhibitor) field), 7 (Nesting) and/or 24 (Intermediary) all sound pretty good.

Read the full paper here:

Yannick Pauchet, Natalie Wielsch, Paul A. Wilkinson, Scott K. Sakaluk, Aleš Svatoš, Richard H. French-Constant, John Hunt, David G. Heckel. What's in the Gift? Towards a Molecular Dissection of Nuptial Feeding in a Cricket. *PLOS ONE*, 2015; 10 (10): e0140191 DOI: [10.1371/journal.pone.0140191](https://doi.org/10.1371/journal.pone.0140191)

Short Thort



News

InnoMeto

The best innovation conference in Australia next year now has a live website - <http://www.innometo.com/>. March 15 and 16 in Byron Bay. Book early. You know it makes sense.

University Of Buckingham

Great to hear that the next cohort for the Lean Masters programme is all set to start in January. Darrell will be teaching a session during their first week. He's also set to teach a three-day workshop to the current cohort in their final week. Aside from IMechE public programmes, this is likely to be Darrell's only SI workshop of 2016... if anyone is interested in attending, you'll need to contact Darrell directly.

Lean Educators Conference

Speaking of Buckingham, Darrell has been invited to keynote at the big UK Lean conference of 2016. 14 September is the date for your diary.

Chartered Surveyors

Speaking of keynotes, Darrell has also been invited to talk at the Danish Chartered Surveyors conference in February (5th). More details on the website as soon as we have a title for the presentation. Probably something to do with passion. And measuring stuff.

eBooks

The SI Shop e-book page is now properly live. Many thanks to the pioneering customers who were willing to run the first water through the pipes. Your custom and support is greatly appreciated.

Greek Matrix+, EvPot+, PercepMap+

Just a little ahead of the new web-based software tools comes a Greek version of our three main downloadable tools.

New Projects

This month's new projects from around the Network:

- Construction – Patent design-around/bulletproofing

- Automotive – SI Certification workshops

- FMCG – PanSensic study

- FMCG – Technology development R&D project

- Medical Devices – SI Certification workshop

- Healthcare – PanSensic dashboards

- Healthcare – Patient Insight PanSensic study

- Financial Services – 'Bank of the Future' Study

- Education – Interactive PanSensic dashboards

- Government – PanSensic dashboard development