Systematic Innovation

e-zine

Issue 148, July 2014

In this month's issue:

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

Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.

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

Case Studies:
‘Effective Aerobic And Resistive Exercise Device’

There’s an old, undoubtedly apocryphal, story of the NASA multi-million dollar ‘space pen’ project, versus the Russian solution of ‘use a pencil’. It’s a story frequently used to remind people to think carefully about the problems they decide to work on.

The space pen story isn’t true, but this one is. Here’s a 2010 call for proposal specification put out by NASA:

NASA is looking for a novel engineering mechanism for a compact, effective aerobic and resistive exercise device. They are not looking for you to design the complete device, but just the engineering mechanism that could deliver the proper loads and stroke velocity for exercises in space under very limited or zero gravity. There are very specific size and space requirements.

Background and Introduction

Returning ISS (International Space Station) crewmembers exhibit losses in bone density, cardiovascular capacity, and muscle strength despite the prescribed exercise prescriptions to target these losses. The ability to provide effective hardware for exercise countermeasures use will be valuable in supporting safe and successful space exploration. NASA seeks compact multi-function (aerobic and resistive) exercise devices for the Constellation vehicles, in a small footprint and with minimal impact to the vehicle resources (unlike current ISS exercise devices). Constellation mission scenarios will require crewmembers to transit in microgravity and live and work in partial gravity for extended periods of time, initially with missions of approximately 14 days to missions on the order of months (and years with respect to Mars).

The Challenge is to come up with an engineering mechanism that can provide the appropriate resistive and aerobic exercises in space under low or zero gravity conditions. We want to emphasize that you do not need to design the whole apparatus but just the mechanism. We can always put a strap or a bar or pedals on it, but we need new ideas for the mechanism itself.

When exercising with a standard weight system, you push (or pull) the weights and then the weights pull back due to gravity. When there is little or no gravity, a different mechanism is needed to get resistance in both directions. Ideally, the mechanism would provide a 1:1 ratio of eccentric to concentric loading (minimum of 0.85:1.0 eccentric to concentric). The mechanism cannot be powered by any source, be less than 10-12 lb and fit inside of a small box. It should be easily

understood and easily assembled (if needed). Please see below for more detailed requirements.

Things to avoid:
The Solvers should understand that many years of research has gone into this and similar projects so the more obvious solutions have probably been investigated at some point. We do not want to rule any possibility out, but you will probably have to add some novel feature to an existing mechanism for it to be workable (i.e. just searching on the internet will probably not find a solution). We will try to guide you as much as possible away from known pitfalls, but it is impossible to list all previous and current work here.

1. *We are not interested in the many exercise gizmos and gadgets on the market today as they rarely meet our load and stroke rate requirements, require extensive room to complete or gravity to operate, and are not reliable. The Seeker envisions the solution coming from other technical fields where force and resistance are generated.*

2. *Hydraulics is probably not a possibility; unless a novel working fluid can be identified that is non-toxic. Note: Even water in relatively small quantities is a hazard in microgravity because drops can float behind electrical panels and create shorts. To contain fluids, therefore, you must provide triple containment which increases size, mass, etc.*

3. *Rubber Bands or "elastomeric" options are not ruled out, but have been thoroughly investigated. "Rubber bands", and other elastomeric components, tend to wear quickly (cycle life is not good), they tend to not have consistent loading throughout the range of motion, and they have toxicity and flammability issues.*

4. *Magnets of the size and power that would be required to create the forces required for this exercise device are expensive and potentially hazardous. Large magnetic fields can induce problems with a broad range of vehicle systems and shielding such magnets will significantly increase size and mass of the hardware.*

Any proposed solution should address the following ***Technical Requirements****:*

The engineering mechanism must:

1. *be able to fit into a 18"x10"x10" space and weigh less than 12 lb. (There may be a little flexibility here assuming all the other requirements could be met)*

2. *be capable of providing 0 - 500 lb of eccentric and concentric workloads at a minimum ratio of 0.85 : 1.0 (Ideally approaching 1.0 : 1.0 ratio). The force should be constant over the full range of motion. The loadings must be adjustable in reasonable increments throughout the load range*

3. *require no external power to operate.*

4. *be able to provide both aerobic and resistive exercises defined as:*

    a. ***Aerobic:*** *high stroke rate, low load, only concentric*

    b. ***Resistive:*** *high load, low stroke rate, concentric and eccentric in 1:1 resistance ratio.*

5. *accommodate a 1m range of motion.*

6. *be easily operated and assembled (if required) by a single individual.*

7. *be able to manufacture device from conventional materials (e.g. aluminum, cloth, plastics, etc.). If novel materials are used, such as a special working fluid, etc., then detailed information on the materials properties, manufacturer and provider should be submitted with proposal. NASA will evaluate material for space flight use. If novel materials are used,*

submitter must also provide evidence of why the special material will perform functions as claimed (provide data that proves the materials can actually perform as claimed in the proposal).

8. *be durable and require little or no maintenance.*

If nothing else, we can safely say that this is a specification that has brought together a lot of hard work and prior thinking on the part of the NASA engineers. And a deal of space-pen type psychological inertia.

Figure 1 illustrates how we might map this problem onto the Why-What's-Stopping template:

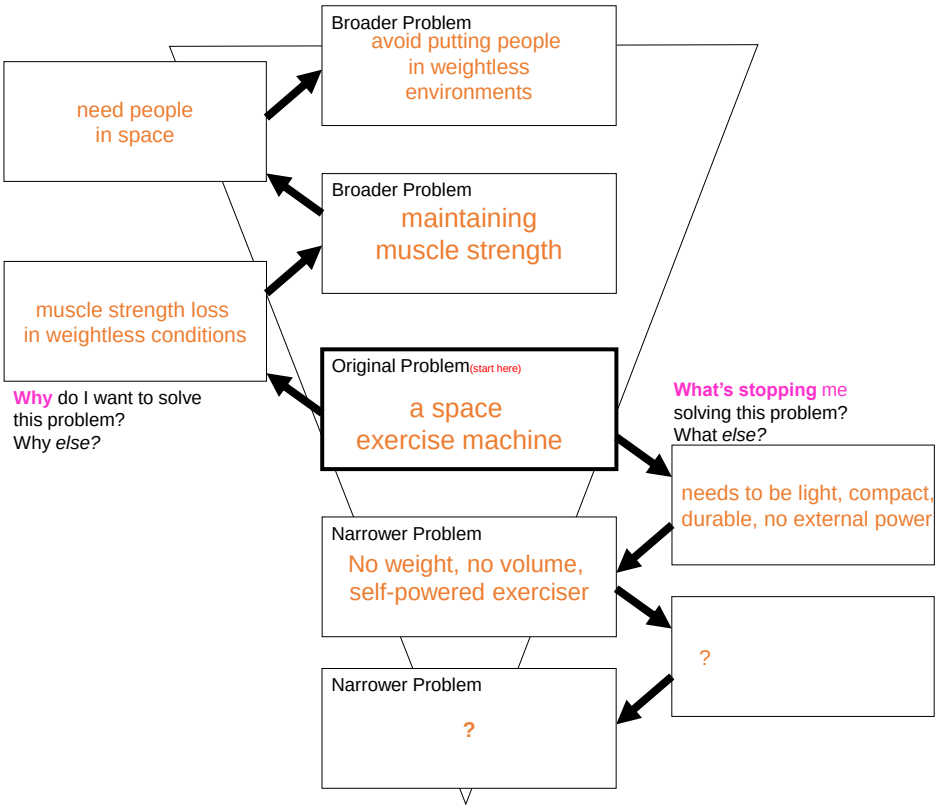


Figure 1: Space Exercise Machine 'Why-What's-Stopping Analysis

At the very least, completion of this template has revealed a batch of contradictions. Specifically at the level the problem has been posed, we can observe the need to deliver certain exercise forces in a mechanism that is light, low volume and robust. Figure 2 shows what we get when we enter these conflicts onto the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Force/Torque (15)

WORSENING PARAMETERS YOU HAVE SELECTED:

Weight of Moving Object (1) and Volume of Moving Object (7) and Reliability/Robustness (35)

SUGGESTED INVENTIVE PRINCIPLES:

35, 1, 9, 14, 13, 37, 8, 12, 15, 24, 28, 3, 31, 18, 5, 4, 40

Figure 2: Contradiction Matrix Suggestions For Initial Problem Definition

The only real problem at this stage is that it is only really possible to make meaningful use of the Inventive Principle suggestions when we already have an existing system to apply them to. Exercise machines have been designed for use in weightless atmospheres, of course, so we could simply look to, for example, take existing designs and Segment them, make them more flexible (Principle 35), incorporate Curvature or Asymmetry. But we'd still end up with some kind of mechanism.

The presence of Principle 13, The Other Way Around, in the list of suggestions is often a clue that others in a situation like ours have solved the problem in more radical ways: doing the opposite. But what might that mean in this case? Don't get people to exercise?

Principle 13 is probably the principle which presents problem solvers with the biggest gap between the generic solution and the eventual specific solution to the problem at hand. It is quite generic in other words. Some people train themselves over a period of time to make effective use of the abstract nature of the Principle 13 provocation. Others have learned a neat other trick.

Figure 3 illustrates the first part of that trick: '*when thinking about turning something around the other way, look at the higher level problem*':

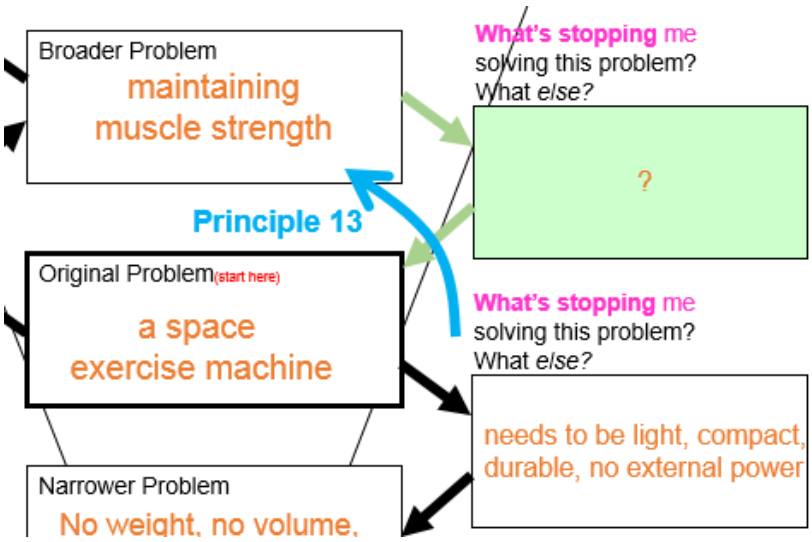


Figure 3: Principle 13 Provokes Migration To The Higher Level Problem

The second part of the trick is illustrated by the green box in the figure. In effect, inserting this new box is a way of telling ourselves, that the higher level problem also has conflicts and contradictions associated with it…

…one of which will take us back down to the original problem, but, when we ask the 'what else' question, we may find other problems emerging. Here's what happened when we did this for the exercise machine problem:

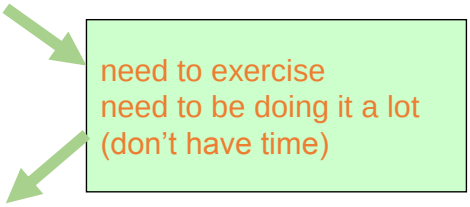


Figure 4: What's Stopping Us Solving The Muscle Strength Problem

And here's the response that got submitted back to NASA in 2010:

I hope this doesn't sound arrogant or patronizing, but after a lot of thought I came to the conclusion that you are trying to solve the wrong problem. Trying to create a lightweight gym, which in weightlessness, can maintain body strength, with only a few hours exercise a day, is not possible. This is a well-known problem with space exploration and has not only kept the best American and Russian brains occupied since the down of the space age. It has also inspired thousands of novices to come up with an apparatus that will provide a magical cure.
I am of the opinion that you are looking for Alchemy. The solutions for the problem you have defined do not exist. The problem is not making a box that fit your design criteria. That is the easy part. There are countless methods that, as far as I am aware have not been tried yet. For example: Gyroscopes such as in the Powerball (http://www.powerballs.com/)
The problem is time. You just do not have enough time you can dedicate to exercise during the day, while the rest of the time the body doing nothing. The problem is not low gravity; the problem is lack of work. You will have similar, not identical but similar, results if you induce a coma into a subject, wake him/her twice a day for a fierce exercise before inducing a coma again.
The solution is to get your astronauts doing continual exercise all the time they are in a weightless environment. On earth in normal gravity conditions, a reasonable fit person who stop what we would refer to as exercise activity for six months, will with the right diet only have limited muscle loss.
Note: I refer to a "normal" person not and extremely fit person, nor a body builder. Example: the average office worker with normal BMI. Neither fat nor thin and with moderate daily activity.
Of course as you are well aware, the reason is that we are continually exercising ourselves just to prevent us from dropping onto the floor into an odd shaped heap off body parts. I belief it is in this odd shaped heap that your solution lies. You have to find a way that transforms your astronauts into an odd shaped heap. It may sound comical but do consider for a moment;
If you can transform a person's body under low gravity into an odd shape, the person will have to exert continual force in order to maintain a comfortable pose and thus muscle is maintained because it is used.
This creates 2 new challenges

1. *How the different body parts have to be manipulated so that corrective action by the astronaut will insure the most effective replication of muscle use such as one would find under normal gravity. This should not be too difficult as it is a simple physiological exercise. However I suspect the result might show that to replicate the required forces to maintain all muscles the body needs to be manipulated in a two opposing ways.*
2. *How to do it unobtrusively, lightweight, cost effectively, and with all the other "space program" parameters. This opens a world of solutions. For example: Some form of exoskeleton, which could be anything from comfortable hi-tech body socks to a fully comprehensive space suit type. Most likely something in between which could incorporate clothing with carbon fibre leave springs or even bungees. (Regarding bungees, bear in mind that this will be tailored to each person so it will be replaced at each person's mission is ending thus do not need to be as robust.) You may even need to have two different "suits" or an adjustable "suit" to cater for different muscle groups.*
   It might even be as simple as inducing muscle resistance with electrodes. Who knows, but what certain are that this new problem will have a world of new solutions to explore.

I am sure you will agree that preventing oneself from been transformed into an odd shaped heap will be no more uncomfortable as it is for you keeping your posture reading this proposal. That is of course if you are not curling up laughing, ☺. The point is the person wearing it will get used to it as quick as they get use to low gravity and it will become second nature.
Well do give it a thought and let me know what you think. I belief that if you can pull it off, you will find that you only need a limited amount of aerobic and anaerobic exercise to keep your guys and girls in top shape.

Now every new solution concept is inherently fragile, and comes with a thousand and one new contradictions. Here's one:

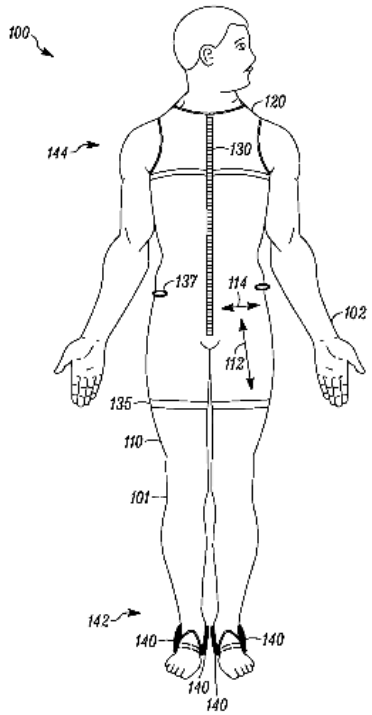
…the Russian Pingvin suit try to address the muscle strength problem by imposing vertical loading on a wearer using bungee cords. However, these suits are so physically uncomfortable that astronauts wearing them have been known to cut the bungee cords or otherwise circumvent the loading features during prolonged use.

This text comes from the background description section of US patent 8,769,712, granted to an inventor at MIT this month. Here's what the inventor has done to solve this problem:

An elastic skin suit simulates gravitational loading. By selecting material(s) of appropriate dimensions and appropriate moduli of elasticity, and optionally integrating inelastic portions to maintain a desired surface distribution, the suit can be adapted to impose a loading regime that simulates the loading of terrestrial gravity in a more continuous, shoulder-to-ankle manner than current loading suits.

In one aspect, a device described herein includes a suit shaped and sized to a body of a user and formed of one or more panels of an elastic material, the elastic material having a first modulus of elasticity along a first axis within a plane of the elastic material and a second modulus of elasticity less than the first modulus of elasticity along a second axis within the plane of the elastic material, wherein the first modulus of elasticity is oriented toward a vertical axis of the body and the second modulus of elasticity is oriented toward a circumference around the body.

The device may include a yoke attached to a top of the suit to support the top upon a pair of shoulders of the user. The yoke may include a reinforced collar. The yoke may provide an initial gradation plane that begins a variable loading regime of the suit. The yoke may be formed of an inelastic material. The yoke may include a non-stretch fabric. The yoke may be formed of a second elastic material.



Which, when you look at the Inventive Principles that correspond to the invention – Principles 35, 1 and 4 – take us uncannily back to the suggestions made for the initial problem.

Not that that's an absolute rule. What is worth remembering more generally, however, is that sometimes we have to solve a problem by first migrating up to a higher level and

solving a problem there before coming back down to the original level. And that Principle 13 is the trigger that's trying to let us know now is the time to do precisely that.

Many thanks to Kobus Cilliers for sharing the initial part of this story with us.

Case Studies: ‘Did Not Attend’s

‘Did not attends’ (DNAs) are doctor or hospital appointments to which patients do not show up. In an average year, almost seven million patients fail to keep hospital appointments, costing the NHS around £700 million. There is therefore a lot of pressure on healthcare professionals to do something to reduce the size of the problem.

Of all the clients we have the privilege to work with, it is rare indeed to come across a cohort of people displaying the extraordinary levels of passion and desire to do the best for others as can be found in the healthcare system. And yet somehow all of that positive energy seems to result in some pretty dismal outcomes. Best intentions are rarely enough to ensure positive outcomes. Especially in systems as complex as the NHS.

W Edwards Deming once famously said, ‘If we rely on our best intentions to improve quality, we leave much of the outcome up to chance. It follows then that if we’re going to take continual improvement seriously, we need to have formal methods for improvement, and everyone has to adopt them and practice them every day.’

Couple best intentions with a propensity to ‘do something’ rather than sit around and watch a problem happen and you end up with signs like the one at the head of this article. Or this one, which we saw in a local doctor’s surgery recently:

Figure 1: Missed Appointment Statistic Poster

On one level, notices like this are a logical response to the DNA problem: DNA's are bad, people shouldn't do it, so shame them into turning up. It's certainly a valid example of 'doing something'. Sadly, the results of this kind of notice are that they inadvertently make matters worse and become part of the reason DNAs continue to increase.

Last month we described a case study looking at 'compliance', an aspect of the DNA problem that made use of a 'formal method of improvement': the recognition that peoples' behavior is dominated by intangible factors, that people do things for 'good reasons and real reasons', and that improving systems is more likely if problem solvers are able to empathise with the tangible and intangible factors present in a patient's mind.

This month, we examine another 'formal method' that we believe also has a significant potential impact on outcomes. That method is our derivation of Dr Clare Graves work on thinking styles, and specifically the piece of meta-research we did to identify which types of communication were likely to work and which weren't (Reference 1).

Figure 2 reproduces the main findings of that research. The essence of the finding is that, if we take each of the eight main distinct thinking styles Graves' work uncovered and plot combinations of the thinking style of a person providing a message versus the thinking style of the person receiving the message in order to identify the combinations where there is a possibility that the communication will be acted upon.

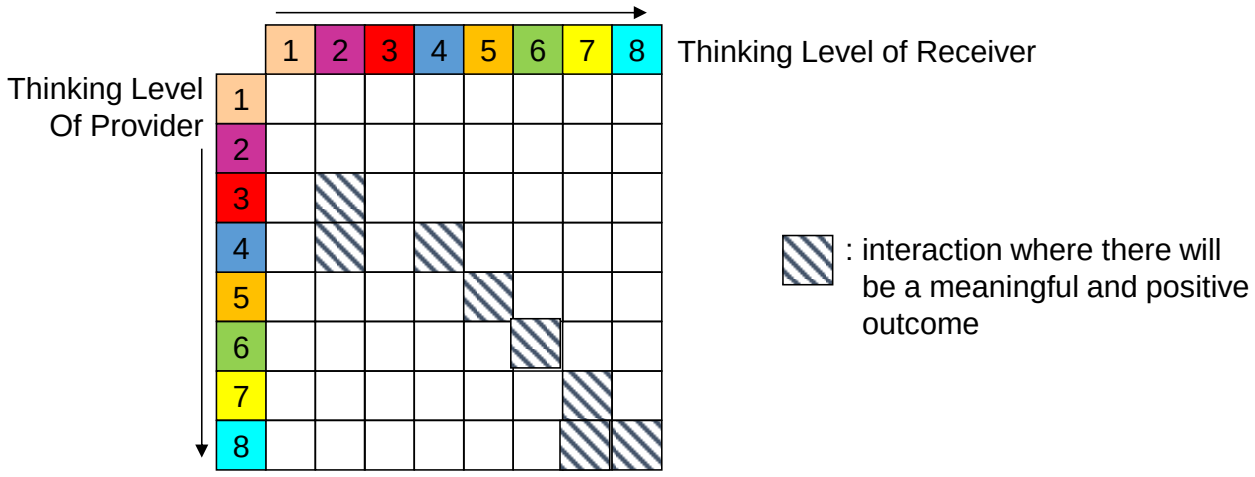


Figure 2: Thinking Style Combinations With The Potential To Deliver Positive Communication Outcomes

The sentiment and wording of the Figure 1 notice, represents the typical thinking of the fourth, Blue, 'Order' mode of thinking. This is the mode of thinking associated with doing things 'the right way', where that way is seen in very black and white terms. DNAs are bad, therefore shame people into changing their behavior.

So much for the thinking style of the people making the poster, what about the thinking style of the patients that are going to see it? In theory this is a more difficult question to answer. The population at large consists of a rainbow blend of all of the different thinking styles, so how can we make any judgment about the prevailing mode of someone walking in to the surgery?

Well, first up, we could make a similar statement about the reception staff. They could be people thinking in any of the thinking styles. Their problem, if that's what we need to call it, is that their receptionist role demands the Order thinking style. i.e whatever their preferred thinking style might be, their job forces them to put on a Blue, 'Order' mask.

Can we make an equivalent set of statements about patients? A couple of months ago (Reference 2), we talked about 'the sick switch' and the idea that people make a discontinuous switch in their behaviours when illness strikes and that switch is flicked. In reality, that sick switch causes people to flip their thinking style in one of two ways:

1) If their ailment isn't 'too bad' – typically they could be classed as 'walking wounded' – they shift to the third, Red, 'Feudal' style.
2) If their ailment is more serious, their thinking style will regress right back to the first, Beige, 'Survival' mode – all they are thinking about is quite literally, survival.

Now, because this is a doctor's surgery we're talking about, we are almost inherently talking about the 'walking wounded' category of patient. Which means the reception staff are going to encounter a Red, Feudal person. Figure 3 maps this impending interaction on the Figure 2 grid:

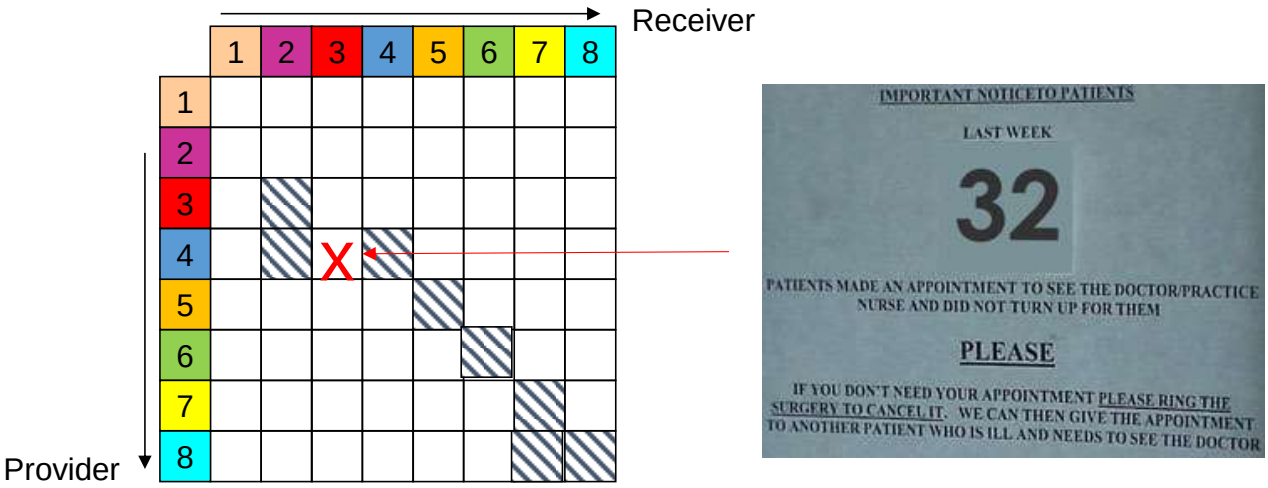


Figure 3: The Reception-Staff-To-Patient Interaction

Straightaway, this map tells us that the DNA notice will not produce any kind of meaningful result. In fact, worse than that, if we look at the third, Red, column in the grid, it is completely blank. In other words, it doesn't matter what we say to the person thinking in this Red, 'Feudal' mode, they're not listening to what we're saying. This DNA reduction game was over before it even began: sick people aren't listening! Trying to shame them into doing the right thing in fact is only going to achieve the opposite effect. What the poster in effect says to a person thinking in the Red, Feudal mode is 'if all those other people are missing appointments, it must be okay for me to do the same'.

So, does this mean DNA reduction is a futile goal? Well, the answer from the compliance problem last month was clearly no. Tapping in to our innate intangible need to be 'in control' can produce some very positive results.

We can see a potent clue as to how knowledge of the thinking styles might also help the DNA problem by examining the famous 'don't mess with Texas' litter reduction campaign from the 1980s – Figure 4. The reason this campaign has been, and still is, an extremely successful initiative of the Texas State Government is because they've understood that the prospective litter thrower is the person thinking in the Red, Feudal mode and that telling them to stop throwing litter is merely an effective way of getting them to drop more litter. Probably throwing it at the 'don't drop litter' sign. What the State Government did instead was recognized that the only way to get the Red thinker to do what you want is to

get them out of the Red thinking mode. And the easiest way to do that is to get them in to the second, Purple, 'Tribal' mode:

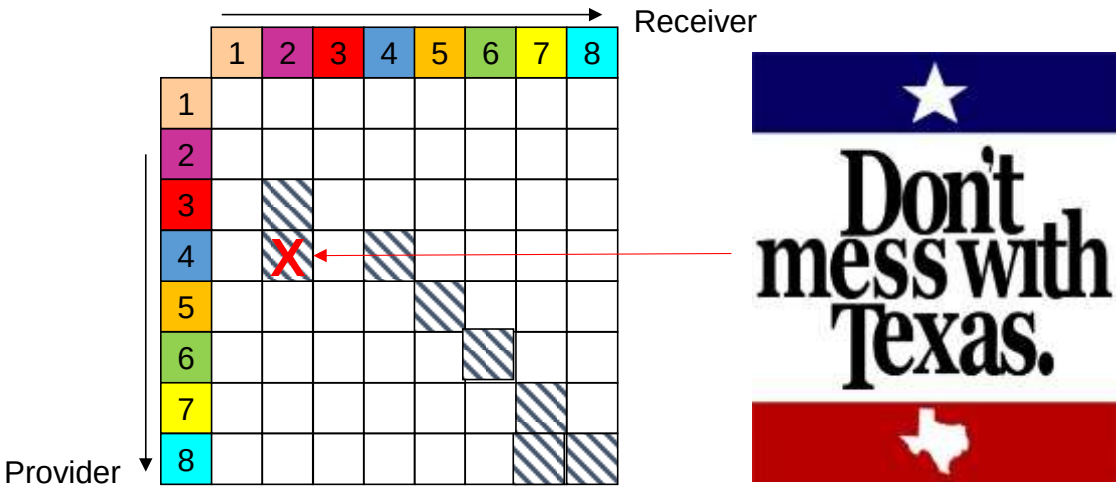


Figure 4: Don't Mess With Texas And Thinking Styles

In classic, 'someone, somewhere already solved your problem' fashion, the generic solution to the DNA problem in the NHS as discovered by the Texas State Government, is stop trying to punish Red behavior, start trying to play on our innate desire to belong to the tribe.

So how to do this?
The first thing to try: turn the message around the other way – don't put up posters showing how many people missed appointments, put up posters displaying how many people *made* them. Don't mention those that didn't turn up at all.

(When this was tried recently in Bedfordshire in the UK, just this simple idea helped reduce DNAs by 30%.)

And that was before anyone really gets smart about what Tribal thinking means. The NHS is one of the few things left that British people are intensely proud of – see the opening ceremony at the 2012 Olympics. The NHS is 'ours' – the ultimate Tribe! Tribe members respect other members of the tribe. Likewise, the doctor's surgery exists within a community, and that too is a tribe. There are many tribes. Few people want to be part of a tribe all of the time, but when they're sick, it makes for the perfect place to be. NHS staff instinctively know this. And yet they find themselves working in a system that puts up ridiculous anti-Tribal signs like the one shown at the head of the article. Take down the Blue, Order signs, start tapping in to the way people actually think. It costs nothing and, in case the Blue, Order thinking healthcare professional skeptics feel concerned that it all sounds too easy to be effective, remember it's a strategy that has been proven through thousands of generations of 'clinical evidence'. It's who we are.

References

1) Mann, D.L., 'If TRIZ IS So Good, Why Isn't Everyone Using It, Part 7', Plausible Deniability & Spiral Dynamics', TRIZ Kongress, Mainz, Germany, June 2005.
2) Systematic Innovation E-zine, 'The Sick Switch', Issue 144, March 2014.

Not So Funny – Generation Identification Short-Cuts

What's the quickest way, people often ask us, to work out what generation someone belongs to, even if you can't necessarily see them? Here's a pair of quick and simple guides:

Company Names:

H Pigney belongs to the Silent Generation (Artist)…

…Mark Russ Federman, the third-generation proprietor, belongs to the Baby Boomer generation (Prophet)…

…Jodie Walvin is Generation Y (Hero).
Jodie Walvin's Dad is Generation X (Nomad).

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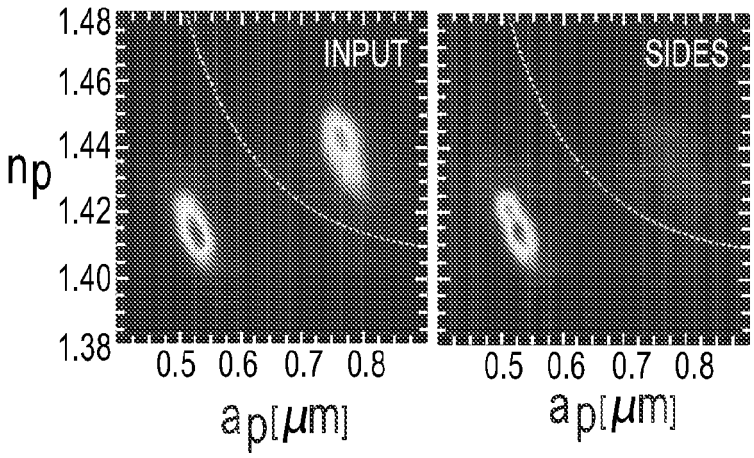
Baby On Board:

The owner of this car belongs to Generation X (Nomad)…

…The owner of this badge belongs to Generation Y (Hero)…

…The owner of this car is a dick.

Patent of the Month – Optical Fractionation



Patent of the month this month is a rather more obtuse offering than our usual selections, but we think it looks like an important 'new means of delivering a function' invention, and as such, being a relatively rare thing these days for us to be adding anything new to the Function Database, we thought it offered a timely reminder that someone, somewhere will eventually find some new of delivering the functions we need to be delivered in life. The inventors in question this time around are a trio of researchers at New York University. US8,766,169 was granted to the team on July 1.

Here's what the background section of their invention disclosure tells us:

The motion of a driven Brownian object in a periodic force field has been studied extensively for half a century, not only because of its intrinsic interest, but also because of its close relationship to such disparate physical phenomena as charge transport in Josephson junctions and the kinetics of chemical reactions. Most studies have focused on biased diffusion in one-dimensional systems, the tilted washboard problem providing the archetype for the field. Even this much-studied model continues to yield surprises, with giant enhancement of thermal fluctuations recently having been discovered for particles that are marginally trapped by the washboard.

Higher-dimensional systems have a substantially richer phenomenology because the driven particle enjoys the additional freedom of selecting its course through the force landscape. The force field itself can have a richer variety of characteristics including multidimensional symmetries and solenoidal components that give rise to interesting non-equilibrium effects. Because the particle can move around obstacles, the force landscape can even consist of impenetrable barriers. How a Brownian particle finds its way through such structured terrains remains incompletely understood.

Which, if you ignore all the difficult bits, can be interpreted as, 'we looked at a very familiar thing through new eyes and our invention came from that'. Here's the connection the team has made:

Prismatic optical fractionation provides a practical method to sort colloidal particles that offers highly advantageous resolution and previously unavailable sorting modalities. Design criteria are provided for optical landscapes that implement specific sorting protocols and reveal ramifications of practical departures from idealized models. The following drawings illustrate selected aspects of preferred embodiments which are described in more detail hereinafter.

So, the basic idea, as far as the Function Database is concerned, is use of an optical field to separate solid particles. The word 'field' is the first clue that something important has been discovered here. Sure, there are already multiple ways in which fields have been used to separate particles (electrostatic precipitators, for example, have been with us for almost a century), but to date, they've all tended to be energy-hungry. Making use of light would appear to get around such hurdles – it comes quite high in our league table of preferred fields!

Here's the main claim of the patent:

A method for controlled fractionation of particles having particle attributes, comprising:
providing a sample having a plurality of particles;
preparing a uniform array of optical traps having a selected array lattice constant;
inputting the plurality of particles to the uniform array of optical traps at a driving direction angle φ_T; and
separating the plurality of particles along different directions Θ_v based on selected variable ones of the particle attributes.

Which is about as general as it's possible to get… another sign that this is a novel way of delivering the desired function: the inventor gets to own some pretty broad IP territory.

As is often the case, these kinds of 'new function delivery' solution come attached to an administrative contradiction ('we know what we want to do, but we don't know how to do it') rather than a specific problem. Were we, however, to map the problem as a conflict between the desire to accurately separate solid particles and simultaneously wanting to reduce the amount of energy required to so do, we might map it on to the Contradiction Matrix as follows:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Loss of Substance (25) and Manufacturing Precision/Consistency (42)

WORSENING PARAMETERS YOU HAVE SELECTED:

Energy used by Stationary Object (17)

SUGGESTED INVENTIVE PRINCIPLES:

19, 12, 2, 18, 26, 28, 21, 35, 13, 30, 24, 3, 31, 17

Re-assuring to see that Principle 28, Mechanics Substitution is on the list. Ditto Principle 12, Equi-potentiality, and, slightly more obscure, Principle 17, Another Dimension – a clue to the Brownian motion re-think insight that started this whole thing off perhaps?

Best of the Month – The Disruption Machine

A free read for you this month in our 'best of' section: Jill Lepore's piece in the June 23 issue of The New Yorker can be found here: http://www.newyorker.com/reporting/2014/06/23/140623fa_fact_lepore?currentPage=all

Not only is it a beautifully written piece, but it presents a terrific counter to the work of Clayton Christensen. Regular readers of the ezine will know that we're pretty big fans of Professor Christensen. They'll know, too, that one of our core research philosophies involves running towards contradictions. So when someone – Ms Lepore in this case – highlights certain, ahem, shall we say 'flaws' in Christensen's work, we were immediately intrigued. Is everything the esteemed Professor has been preaching to the C-suites of the world for the last twenty years wrong?

Well, we'll let you read the New Yorker piece and make up your own mind. Here's a short excerpt to hopefully entice you to follow the link:

Disruptive innovation is a theory about why businesses fail. It's not more than that. It doesn't explain change. It's not a law of nature. It's an artifact of history, an idea, forged in time; it's the manufacture of a moment of upsetting and edgy uncertainty. Transfixed by change, it's blind to continuity. It makes a very poor prophet.

From our perspective, whenever we experience these kinds of contradiction – two smart people who clearly know what they're talking about, coming up with near opposite conclusions – is that they were either answering the wrong question, or, more likely, there is a higher level model of the world that resolves the contradiction. If we may be so bold, the higher level resolution in this case come from TRIZ.

TRIZ tells us that the dynamics of the s-curve is the core universal at the heart of innovation of all kind, whether sustaining, breakthrough or disruptive. If you don't understand these dynamics you leave yourself open to getting things wrong. Christensen for his part found something important about those situations where the 'next s-curve' is 'inferior' to the current one, but it certainly was never a universal rule. Which is why we mention the Innovator's Dilemma with some of our clients, but not with most. Whether the Innovator's Dilemma is relevant to you and your organisation depends on a whole gamut

of interwoven things. Not least of which – if we can be permitted to blow our own trumpet for a second – is the Innovation Capability Maturity Model. Disruptive Innovation is for Level 4 organisations or lucky start-ups.

In presenting counter stories to nearly all of the ones Christensen used to create the Dilemma, all Lepore has actually done is demonstrate that if organisations don't possess the requisite capabilities, they will fail. Irrespective of whether they are incumbents or disruptors.

Sadly for her, she isn't aware of either ICMM or, even more importantly, Jagdish Sheth's book, 'The Rule Of Three'. The latter is relevant when reading through her investigations in that it provides a clear set of heuristics to help organisations understand their best innovation strategy. The innovation task of the biggest companies in a market, for example, is to avoid innovation if at all possible. They should be doing lots of R&D, and also spending lots of time up in the corporate crow's nest on the look-out for prospective disruptors, but in both cases essentially as insurance policies. Then, if a candidate disruptor appears on the horizon, their job is to make sure they have deep enough pockets to go buy them, ideally before, but most likely after they pass their Tipping Point.

Is Christensen right? It depends.
Is Lepore right? It depends.
Because he didn't understand the bigger picture, Christensen was (wildly) wrong about iPhone. And will very likely be wrong too about his predictions for the education system (you read it here first!).
Because she doesn't understand the bigger picture, Lepore has only been able to diligently dig into the guts of Christensen's 'research' and demonstrate how he artificially created a 'universal' model that he's had to spend the next twenty years paper over the cracks to try and hide the fact that only a small part of it (s-curve dynamics) actually is.

The overall point here – per the theme of our longstanding favourite overall innovation text, The Halo Effect – is the parallel need to challenge theories, and, most important of all, recognize that in a complex world, there's no such thing as either/or. Success – we think – comes from cramming as many conflicting ideas and theories into your head as you can possibly stand without the overwhelming urge to run screaming to the hills, and then letting the higher level truth emerge.

Read The Disruption Machine article and experience what we mean.

Wow In Music – Earworms, Carly Rae Jepsen & Mariah Carey

Earworm: a catchy piece of music that continually repeats through a person's mind after it is no longer playing. Also known as a brainworm, *musical imagery repetition*, *involuntary musical imagery*, and *stuck song syndrome*. The word is a calque from the German *Ohrwurm* and was, according to Oliver Sacks, first used in the 1980s.

Earworms might be thought of as a kind of musical wow. A recent article in the Guardian newspaper by Ohrwurm-meister, Owen Pallett of the band Arcade Fire offered up a wonderful inside look at a couple of recent earworms. Here's Owen's article, interspersed with our own TRIZ/Inventive Principle interjections:

The most frustratingly oblique device in pop criticism: "packed with hooks", "it's an earworm", "so very catchy" and so on. No music writer is without guilt. It is a vivid metaphor: the listener is a fish, the melody a snare. But it's so frustratingly unspecific. What exactly makes one song hooky, and another not?

Carly Rae Jepsen's Call Me Maybe is widely regarded as the catchiest catch of the last five years. To my ears, it's all about the chorus – the arching (Principle 31) *pause on the ache of the "craaaazy" and "baaaaby", slipping into the perfunctory, coquettish "Here's my number/ So call me maybe"* (Principle 3)*. There is nothing more arresting than the tease of a "maybe"* (Principle 9)*. This tease is in the musical material as well; the song fidgets and never sits still. Like Katy Perry's Teenage Dream, Call Me Maybe's chorus avoids any proper conclusion to the tonic chord of the song* (inverse Principle 12)*. Big major-key string glissandos plummet always to a deception. "One" or "root" chords appear only in passing. There's rhythmic deception in this chorus, too, as the voice and strings scarcely ever alight on the downbeat* (Principle 37)*. Only at the beginning of each phrase do the strings synchronise with the kick and put your ear in its place – rhythmically, it's like a trampoline flip that lasts eight bars.*

Let's get up to date and talk about the new Mariah Carey single. The truth about Mariah is this: her upper register is the musical equivalent of black truffle. You could shave it on to any shit and we'll still order it. It can bear aloft even the most uneventful material, but her new single, You Don't

Know What To Do, is a proper tune. This song has the makings of a hit, from the Donna Summer-y intro, the bold melisma… even guest rapper Wale sounds like he's having "just enough" fun, instead of his customary "too much". Most of all: this song has a great hook.

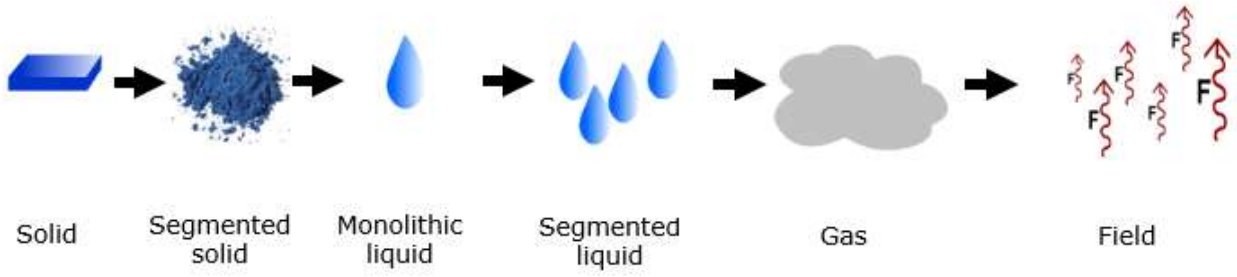
First, the chorus has a surprise incongruity, just like Carly's "crazy"/"maybe" rhyme: Mariah's swallowing of the word "what". "Know what" is compressed into a single diphthong – "you don't know'it/ to do" (Principle 2)*. Mariah punches that phrase in the sternum every time it tries to escape her lips. Were it not the title of the song, would we even know what she was saying?*

Second – and this is tougher to describe – but the quality of a good hook is often not measured in a melody's intrinsic features, but the context in which it appears (as decribed in last month's article!)*. A terrifically catchy melody like Ylvis's The Fox could become fatally annoying, if not given an effective foil, a counterweight* (Principle 8)*. The repeated "You don't know'it/to do", taken on its own, is about as pleasant as a car alarm. But balanced with the dextrous, low-register second stanza – "First you want to leave/ Then you never go"* (Principle 4) *– that car alarm becomes dancefloor singalong perfection.*

The point being that the heart of the wows in both of these songs is in breaking expectancies… and how, thus far, we only know a pretty small number of resolution strategies that are able to do the job. As we can see here, the more strategies we can see evidence of, the bigger the potential wow.

Listen to the two songs here:
http://www.youtube.com/watch?v=fWNaR-rxAic – for Carly Rae.
http://www.youtube.com/watch?v=rJXAA2tw-BA – for Mariah.
More about her in future months, when we talk about other ways of uncovering 'wow' in music: guilty pleasures. Have a think about some of your own and see if you can find the hidden 'wow's.

Investments – Injectable Foam



Without prompt care, a badly wounded soldier can easily bleed to death while being transported to a distant medical station. Two traditional treatments - tourniquets and medicated gauze pads - often cannot stop the blood loss from a deep wound at the neck, shoulder or groin.

To give these soldiers a fighting chance at survival, Johns Hopkins undergraduates have invented an injectable foam system designed to stop profuse bleeding from a wound where a limb or the head is connected to the torso. The students' invention is designed to apply pressure and curb blood loss during the critical first hour during which a wounded soldier is moved to a site that provides more advanced medical help.

The new battlefield treatment is needed, the students say, because a tourniquet or a gauze pad with a clotting agent are difficult to apply effectively to deep wounds at these junctional body sites. In addition, the precise source of blood loss in such wounds is not always easy to find.

"The problem is that damage from bullets and bone fragments deep inside a junctional wound is not always visible from outside the body, and a regular clotting agent may not be able to reach the origin of the bleeding," said Sydney Rooney, leader of the biomedical engineering student team that sought to solve this problem. "We came up with a foam injection system that fills the wound area and blocks the blood loss."

She said the goal is to prevent wounded soldiers from losing more than half of their blood volume before they reach a medical facility. The aim is to reach such a facility within 60 minutes, the so-called golden hour during which trauma care is most successful.
"Our project has been dealing very literally with a life and death matter," Rooney said. "At the end of the day, that provided some extra motivation for our team."

To get a sense of what happens when soldiers are wounded, the students first conducted experiments with a gel that mimics the consistency of human tissue. The students used a rod to create "blood vessels" filled with water within the gel. Team members then carved "wounds" into the gel to simulate the bleeding process. To stop blood loss from such a wound, the students identified two liquid chemicals that, when mixed, rapidly form a polyurethane foam.

"The foam fills up the wound opening, hardens and applies pressure to the walls of the cavity," said Allie Sanzi, who participated in the project during her freshman year. "This should lead to more effective targeting and treatment at the source of the bleeding."

The two chemicals that produce the foam - a polyol and a diisocyanate - remain in canisters that are stored separately within the injector device before they are needed. The

students designed the canisters to keep the chemicals stable in military conditions at temperatures up to 100 degrees F for at least one year. The injector is about the size of a whiteboard marker. On the battlefield, the soldier administering the treatment would mix the two chemicals with a mechanism inside the injector. Then, pushing down the plunger would insert the expanding foam into the wound to reduce bleeding.

The students' project was proposed and supervised by two surgeons at All Children's Hospital, a Johns Hopkins Medicine facility in St. Petersburg, Fla. All Children's serves as a clinical training site for medics in the Green Berets, Navy Seals, Army Rangers and Marine Special Forces who require pediatric emergency response experience. This allowed the student inventors to meet with these teams and the surgeons to discuss the project and prototypes. One of the sponsoring surgeons, Paul D. Danielson, a military veteran who is now medical director for pediatric surgery at All Children's, said the students' device looks quite promising, even though it's still at the prototype stage.
"I don't think it's pie in the sky at all," he said. "I think it's a very viable solution to a problem that's been plaguing us on the battlefield."

According to the Object Segmentation evolution trend, we tend to agree with Dr Danielson. We also suspect the idea will have relevance some distance beyond just the battlefield. Why wouldn’t you want such a device in every ambulance on the planet?

Generational Cycles – Quarter-Life Crisis?

Each of the four different generation archetypes – Artists, Prophets, Nomads and Heroes – tend to struggle more or less with certain of the inevitable life transitions that come our way. Artists find them all difficult, Prophets have a really tough time at their mid-life crisis, and Heroes (Generation Y) tend to find themselves struggling most with a Quarter-Life Crisis.

Quarter-Life Crisis? An expression that will have most GenX Nomads and Baby Boomer Prophets scratching their heads in confusion. What's one of those?

According to multiple different anthropology authors (start with Gail Sheehy or Barry Levinson) it's a transition occurring somewhere between our late 20s and early 30s. The transition is associated with the ending of a divergent exploration period of our early adulthood – our exposure to the big-wide world reveals myriad possibilities and options – and the commencement of a convergent period of our adulthood proper: the time when we need to start making some decisions about who we are and what we are going to do with our lives.

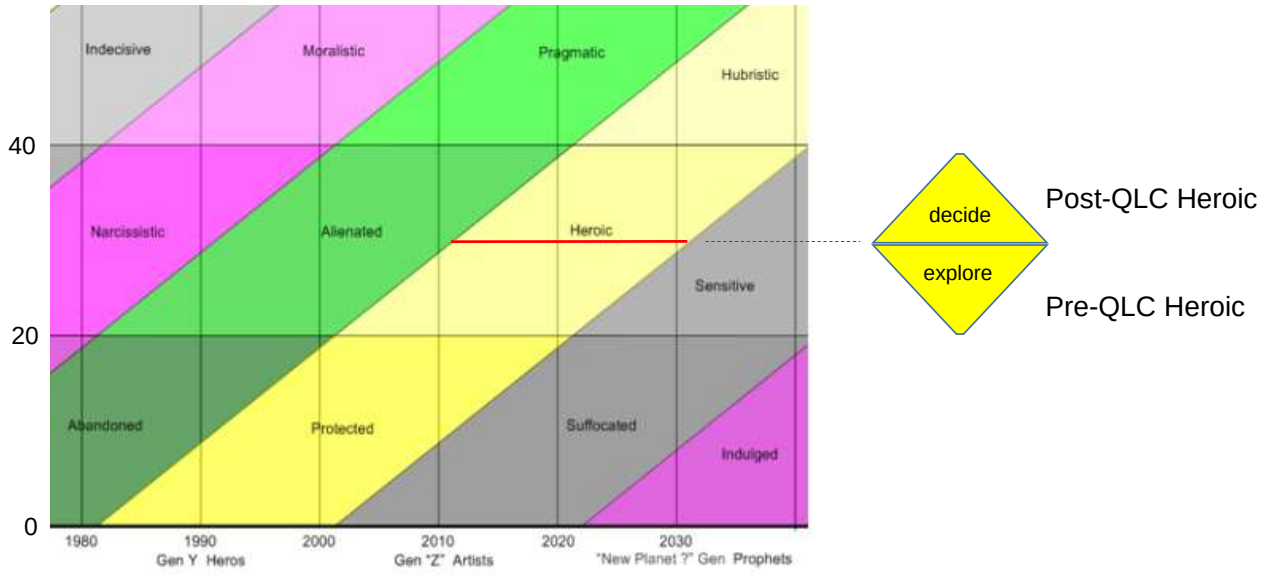
Neither the Nomads nor the Boomers tended to take much notice of this divergence-convergence transition. For the Boomers it was because the convergence decision was very clear: you can't trust society, so look after number one. For the Nomads it was all about reacting to what they saw happening to their Boomer parents: rule one for GenX was 'whatever you do, don't sell out'.

For the Generation Y 'Heroes' the whole divergence-convergence thing proves to be much more traumatic for a host of reasons. First up, thanks to their 'protected' upbringing, they've in effect been told 'you can be whatever you want to be, you don't have to compromise' and consequently they've been able to diverge a lot. The protection has also brought with it an extraordinary level of emergency back-up should the going ever have become tough: financial problems – the bank of mum and dad is there to help; housing difficulties – you're always welcome at home with mum and dad. All things taken together, Heroes have the opportunity to safely diverge more than any other generation. So much so that, when they hit their late 20s and a dawning that, hey, wait a minute, if you try to be everything, you end up being nothing, the need to converge on something can very easily become paralyzing.

The true crisis, however, is usually triggered by a stark reality check. Parents can only protect so much, and one day, much as they'd like to be always on hand, the back-up system isn't there. It's the day when you've just crashed your car and your mum and dad tell you, 'sorry, we can't afford to replace it for you, you'll have to sort something out yourself'. Or it's the day the Hero gets fired at work. Or can't get the job they 'deserve'.

Or – most common of all – the Heroes decide to have their own baby heroes, and when the precious little bundle arrives they very quickly learn the true meaning of '24/7'.

In terms of the generation timeline map, we've recently taken to adding a new line in relation to the Hero generation's quarter-life crisis:



The line is important we think, because it tells us there are two distinct types of Hero generation at their Heroic stage of life: First is the pre-Quarter-Life-Crisis, twenty-something; second is the post-Quarter-Life-Crisis thirty something.

The Pre-QLC Heroes are the high maintenance, low persistence, trophy-demanding, butterflies that cause prospective employers to pull their hair out in frustration. The Post-QLC Heroes are the ones that 'get it'. They're the ones that heroically persist, heroically

do what needs to be done, and don't expect a chest full of gold stars in the process. They're the ones that come to give the Heroes their name. They're the ones that will do what's necessary to get the world out of its Crisis period.

Nomad-born, Hero-audience popstar, John Mayer got to write the QLC anthem first:

"Why Georgia"

I am driving up 85 in the
Kind of morning that lasts all afternoon
just stuck inside the gloom
4 more exits to my apartment but
I am tempted to keep the car in drive
And leave it all behind

Cause I wonder sometimes
About the outcome
Of a still verdict less life

Am I living it right?
Am I living it right?
Am I living it right?
Why Georgia, why?

I rent a room and I fill the spaces with
Wood in places to make it feel like home
But all I feel's alone
It might be a quarter life crisis
Or just the stirring in my soul

Either way I wonder sometimes
About the outcome
Of a still verdict less life

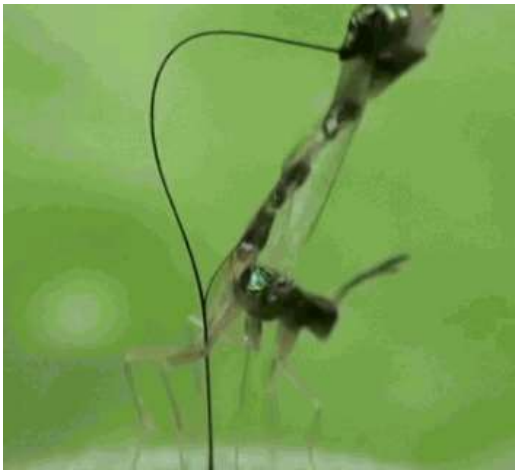
Am I living it right?
Am I living it right?
Am I living it right?
Why Georgia, why?

So what, so I've got a smile on
But it's hiding the quiet superstitions in my head
Don't believe me
When I say I've got it down

Everybody is just a stranger but
That's the danger in going my own way
I guess it's the price I have to pay
Still "everything happens for a reason"
Is no reason not to ask myself

If I am living it right
Am I living it right?
Am I living it right?
Why Georgia, why?

Biology – Fig Wasp



Another wonderful example of biomimetics this month, this time from work being done by mechanical engineers at the Indian Institute of Science in the biomedical domain. The big idea is that future surgeries requiring a doctor to dive deep into the body might be made considerably less invasive. The biological precedent is a parasitic fig wasp.

The research team had been investigating the reproductive process of Apocryta westwoodi grandi, a wasp that deposits its eggs inside a developing fig fruit next to those of another species of wasp. When the eggs hatch, they feed on the larvae of the non-parasitizing wasp before growing and emerging into the world.

While the interactions of the two wasp species and the plant are biologically interesting in their own right, the part that caught the eyes of researchers in Namrata Gundiah's biomechanics laboratory was how the parasitic wasp deposited its eggs deep within the fruit.

Like many insects and some other animals, the parasitic wasp deposits its eggs through a long tubular organ called an ovipositor. But this particular wasp must pierce the skin and bore through the tough tissue of an unripened fig, to leave eggs as deep as possible within the fruit. The depth problem offers up a first contradiction: how to inject eggs deeper than the size of the wasp. Here's what this problem looks like when mapped on to the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Length/Angle of Stationary Object (4)

WORSENING PARAMETERS YOU HAVE SELECTED:

Length/Angle of Moving Object (3)

SUGGESTED INVENTIVE PRINCIPLES:

3, 1, 4, 19, 17, 15, 35

The solution to this first problem, as illustrated in the right hand picture at the head of the article, is to make the ovipositor flexible – a simple illustration of Inventive Principle 15, Dynamics.

So far so good. But then there's another problem to overcome:

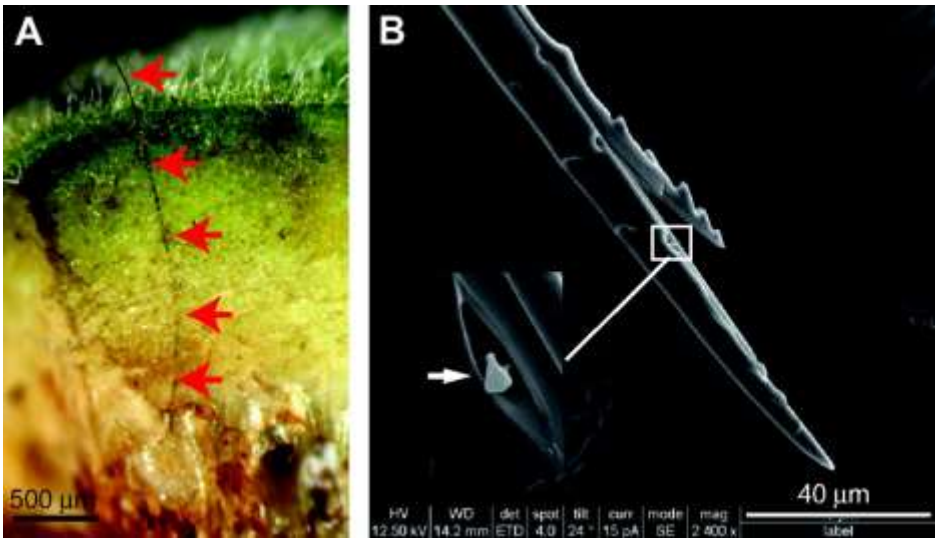
SYSTEM ·ATIC INNOVAT· ION

“From a mechanical perspective, it’s really interesting how this insect can penetrate a needle that is really quite flexible into hard material,” doctoral student Lakshminath Kundanati said, “so we looked at the structure of the needle and whether any parts on it are specifically adapted to help.”

From a contradiction perspective, this new problem is a clear physical contradiction – we want the ovipositor to be flexible and rigid…

The team, whose findings were published on June 1 in The Journal of Experimental Biology, found a number of interesting parts. The needle anatomy is composed of three parts that slide along each other’s lengths and are connected by rail guides using dovetail joints. These moving parts help the needle pierce and cut tissue.

The front of the ovipositor needle is actually a drill bit, with projecting teeth that are hardened against wear and stiffened by enrichment with the metal zinc. At the same time, the ovipositor tissue behind the bit is embedded with hole-like structures that absorb energy and let the organ bend so it can be steered as it bores.



Steerability of parasitoid ovipositor in the fig substrate. (A) Tracings showing the curved path taken by the ovipositor in the fig substrate that illustrate maneuvering of the ovipositor inside the substrate. (B) SEM images of the parasitoid ovipositor showing the dorsal and ventral valves that comprise the ovipositor. The inset shows a possible mechanical stopper sensillum, indicated by the white arrow, which may be useful in limiting displacement between the two ovipositor parts. Courtesy L. Kundanati/J. Exp. Biol.

The wasp stretches and manipulates its abdomen until it resembles nothing as much as an oil derrick tower, a structure built by people to position drills to bore for petroleum.

Kundanati says the wasp uses its derrick and body movements to steer its drill through the fruit. Also, one part of the animal’s drill tip is curved, “so when it pushes that one part forward it gets more of an angle and more steering,” he says. “There can be a 20- to 30-degree deflection from the needle’s starting angle to where it ends. That’s quite a lot.”

From a contradiction-solving perspective, we can see excellent illustrations of several (separation in space and condition) Inventive Principles here:

1 - Segmentation
3 – Local Quality – twice!
12 – Equi-potentiality (turning its abdomen into the derrick structure)
14 – Curvature

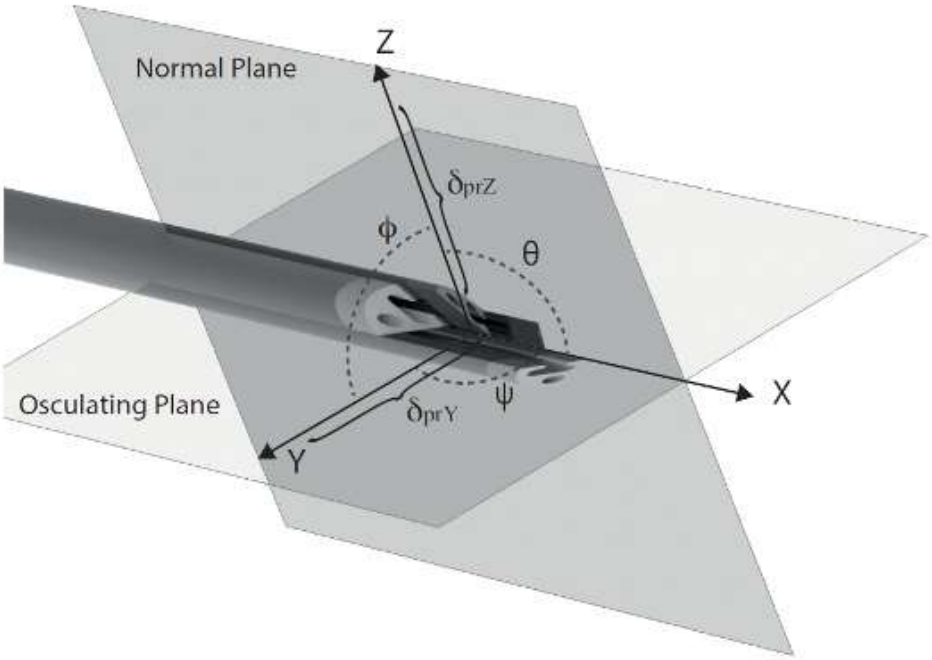
Oh, and if that wasn't enough…

… the scientists also found that chemical and mechanical sensors at the bit and along the ovipositor send back environmental information. The insect uses this data to home in on another wasp's eggs so it can precisely deposit its own.

Let's call that a Principle 23 solution to a placement versus unknown whereabouts of other eggs conflict.

All in all, a pretty amazing piece of evolution. Of course, as with all things, there's always a next contradiction. In this case it is probably the fact that the whole injection process from inserting the needle into the fig to depositing eggs and removing the organ can take five to 10 minutes. If you see any fig wasps scratching their heads, you might like to point them in the direction of the Contradiction Matrix.

And now for the biomimetic part: The 'Sting' (Soft Tissue Intervention and Neurosurgical Guide) project at Imperial College has used the mechanical part of the fig wasp's evolved design to create a very elegant steerable brain probe:



Check them out at :
http://www3.imperial.ac.uk/mechatronicsinmedicine/stingproject

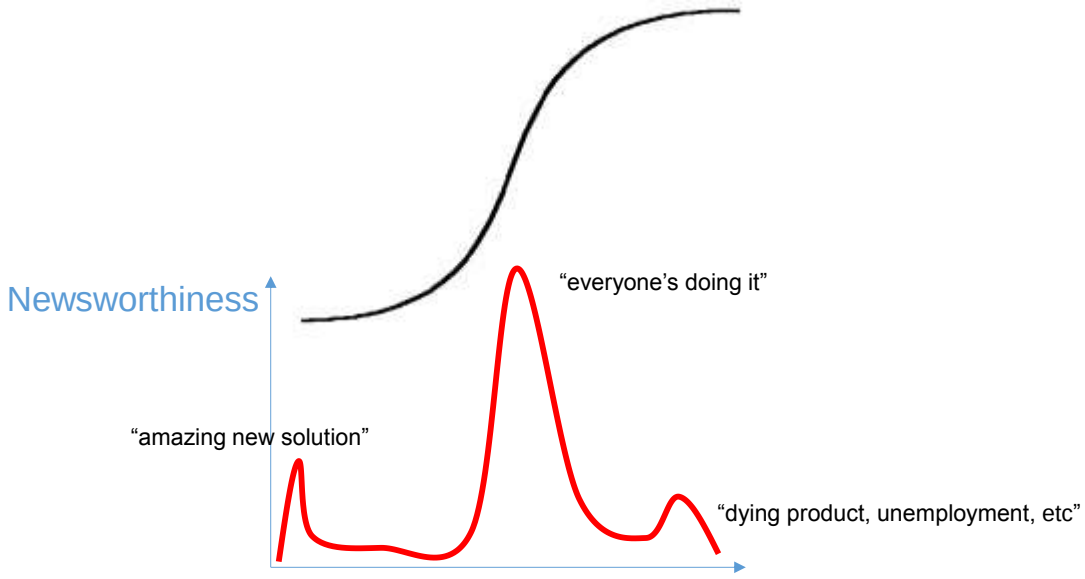
Short Thort

If we believed some of the prediction of futurologists from the last 20 years:

- *We'd all own three iPhones*
- *Everyone would be clinically obese, and, on average, we'd weigh over 250lb*
- *Every marriage would end in divorce*
- *Every new baby would be born out of wedlock*
- *Average age of first-time mothers would be almost 40.*
- *Everyone would have, on average, 1.5 allergies*
- *90% of teachers would be out of work*
- *All of our high street shops would be closed down*
- *All flights would be free*

The world has always been s-curve shaped.
For most of mankind's existence, the rate of progress was slow enough that assuming it was straight-line shaped was okay.
We've evolved to be able to extrapolate along straight lines.
Today, in most industries, things have speeded up to such an extent that extrapolating along straight lines doesn't work any more.

Couple this problem with the fact that trends are at their most newsworthy when the linear extrapolation model is least relevant, and what we have is a perfect storm that pretty well guarantees futurologists get things very badly wrong.



News

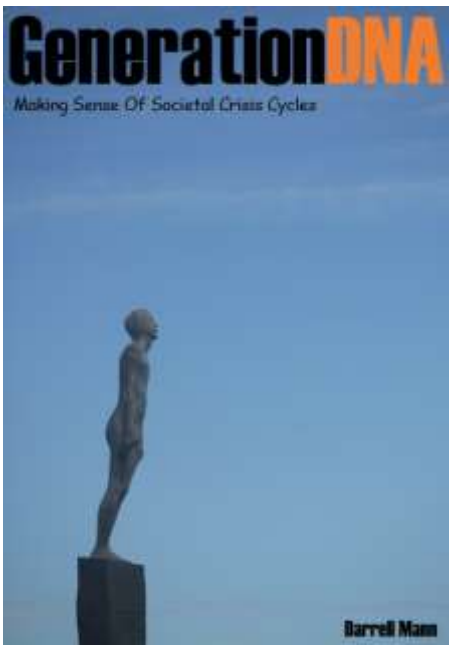
India Visit

It looks like Darrell's next India visit is now confirmed as the period from 10-20 December. Feels like a long way away, but half of the days have already been confirmed with clients and several more have asked us to reserve days for them. The long and short being that allocation of the days will be on a 'first-come, first-served' basis. If you think you might want Darrell to come and do something with your team, please let him know.

Hong Kong Office
We are very happy to announce the opening of a Systematic Innovation office in Hong Kong. One Midtown, Tsuen Wan, New Territories is the place, Simon Tong is the person to contact. (852)93267828 is his number.

Generation Z Book…
..in case you haven't already done so, can be downloaded for free at: http://www.happen.com/48-hr-book/download-the-48hr-book. If you want a special, limited edition hard-copy version of the book, you can find it in the SI Shop.

GenerationDNA Book
Can also be pre-ordered from the online shop too. Along with – hopefully! (he said) – an A0 double-sided poster of the generation timeline map.



Website/Blog
Eagle-eyed SI followers may have noticed movement on our website… it's never going to be much more than an expanded business card with a tera-byte of free papers and articles at the back, but hopefully it now tells a more coherent story of who we are and why. Darrell has also promised to be more pro-active in updating his blog. Something you can link to through the website, or access directly at www.darrellmann.com.

23-24 September
We don't run that many public workshops in the UK any more, preferring instead to work on real problems during in-house sessions. That said, there's been a recent spike in enquiries and so we've decided to run a Certification session at our Clevedon HQ in September. Details on the website, or let Cara know if you're interested in reserving a place. As ever, we'll be restricting the session to a maximum of 12 delegates.

New Matrices
Rumour has it there are a number of Contradiction Matrix updates heading our way. We're not sure where such rumours might have originated, but let's set the record straight. Ahem, albeit in our usually wrong predictions of when new things will appear. Anyway, as things currently stand:

- Version 3 of the Business Matrix = Q4, 2014
- All new 'market/societal-trend conflict' matrix = Q2, 2015
- New version of the technical Contradiction Matrix ('Matrix 2016') = Q4, 2015

(That's' for the English language versions: other languages will depend on our ability to coordinate with translation/production teams in other countries.)

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

Transport – PanSensic-driven strategy study
Consulting – Sales-lead prospecting tool development
IT – ICMM assessment
Government – GenerationDNA workshops
Pharma – SI Certification workshops
Automotive – SI workshops
Financial Services – Strategy workshops
Healthcare – PanSensic study
Healthcare – PanSensic study
Transport – 'Innovation Intermediary' project support