Systematic Innovation

e-zine

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In this month's issue:

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

Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.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

Rule Of Three ICMM Dynamics

Is anyone else puzzled by the apparent lack of innovation these days? This is supposed to be a time of enormous innovation, and yet, when we look at the big organisations they all seem to be busy stockpiling money, battening down the hatches, squashing small upstarts, or – most puzzling of all – spending their hard-earned profits on fantasies (insert image of Level 3 autonomous vehicles here) that have absolutely no chance of being successful in the foreseeable future. Next month I'm hoping to be able to reveal our TRIZ-based plan to do something about the problem. This month, I thought it was worth spending a little time trying to understand why the world is the way it is at the moment.

As with a lot of big strategic questions, it doesn't usually take long before I'm thinking about Jagdish Sheth's classic tome, The Rule Of Three' (Reference 1). Regular readers will see it featured quite regularly in past articles and papers, most notably back in Issue 130 (Reference 2), where, relating to the characteristics of the top three companies that come to dominate a market, I said this:

*The **No. 1 company** (The 'Biggest') likely has 40-80% of the total market share. It is usually the least innovative, though it may have the largest R&D budget. Such companies tend to adopt a "fast follower" strategic posture when it comes to innovation. They tend to have the best business innovation and execution strategies of the three, but to a very large extent the majority of innovation-related activities are viewed first and foremost as insurance policies. That's insurance as in protection against the potential threat of innovation from other players. Insurance in this sense should not be taken to imply that innovation activities have any intention at all to result in actual innovation. The number one company is usually best able to protect its leading position by making sure innovation doesn't happen. If the R&D function can patent lots of solutions and maybe even purchase any outsiders that come up with something potentially threatening to the status quo in order to ensure those solutions don't come to market, then the senior management team will consider that they have done a good job. Creative scientists and engineers tend to become quite frustrated in the No. 1 player – they're allowed to do some cool stuff, just so long as it doesn't get so far along the development pipeline that it threatens the company's business. Which is making the best possible margins from doing what it currently does.*

*The **No. 2 company** (The 'Best') typically holds 20-40% of the total market share. This company is usually the one to play the 'best' card, often playing the 'smart underdog' or 'cool' or simply 'we try harder' angle with customers: we might not be as big as the biggest player, but the solutions we offer are 'better' than theirs. Innovation-wise, the No. 2 player tends to best succeed by emphasising 'better' differences to the No. 1 player. In other words, 'me too' doesn't work. If 'effective', 'efficient' and 'resilient' are the big three success drivers, whichever one the No. 1 player presents as core strength, the No. 2 will best succeed by focusing on one or both of the other two.*

This player also tends to focus their innovation activities on either executing better or insurance against innovation from smaller players. If they can make a step-change that looks like it might give them a significant advantage over the number one player, it might be allowed to happen, but as with the biggest player, the primary strategy is about protecting the current position of strength rather than rocking too many boats, and potentially capsizing everything.

CEOs operating in both No.1 and No.2 companies are very likely to adopt a defensive strategy. We often describe it as the 'not on my watch' strategy. Which works something like this: If an incoming CEO sees they might be in position for 2-3 years (the current average tenure for a Fortune 500 company in the US), one of their first questions will be 'is something bad going to happen during my period at the helm?' If the answer to that question is 'no', they are very unlikely to be pressuring the innovators inside the company to do anything other than lie low.

*Which brings us to the **No. 3 company** ('The Innovator'). Typically hovering around the 5-10% market share position, the third biggest player generally has to play the role of the most innovative. It needs to create and commercialise new solutions in order, a) try and catch up with the big two, but also, because they can see how difficult life is in the low margin trap that is the 'ditch', and need to do all they can to stay out of it. Sadly, however, its innovations are usually 'stolen' by the No. 1 and 2 companies unless it can protect them in a bulletproof manner (the big 2 tend to be good at finding loop-holes in patents!). The extent to which the third-ranked player is comfortable or precarious depends on how far away that player is from the 'ditch'. Which in turn is often transiently dictated by the state of the economy. Lots of No. 3 players – in the West in particular – presently find themselves in an innovation frenzy simply to generate or recover sufficient margins to stay afloat.*

What I want to do here is integrate this story with our Innovation Capability Maturity Model (ICMM) work, and to home in on some of the implications for the 'innovators' working within one of the Big Three organisations.

In order to do this meaningfully, we need to distinguish between innovation and 'R&D'. Innovation, per our usual definition, is all about successful step-change. For commercial organisations, 'success' is typically measured in financial terms: 'a net positive ROI' for example, or 'incremental profit', or 'net positive value'. R&D is all about the outgoings side of whatever our success equation is. In some of the big organisations I know, the success equation gets muddied somewhat by attributing value to R&D that successfully impedes the progress of a competitor. In one case, the IP Function is operated as a profit centre whereby, if they're able to slow or stop an outside patent from being granted, or can build a fence around a patent to block its advance, the financial value of that activity is counted as 'profit'. Morally and ethically dubious as such actions might be, to the accountants, they count as 'successful' and could, therefore, be said to meet our innovation definition criteria.

Taken together, it becomes necessary to identify two forms of innovation, the first being the *pro-active*, 'let's get something new into the market' version, and the second being the *defensive*, 'let's stop others from getting something new into the market' version.

Now, let's imagine we work within one of the two biggest players in our industry. The big companies for the most part do not like innovation, and have every incentive to maintain status quos wherever they can. 'Innovation' in such organisations is a 'necessary evil' rather than a business strategy. As a consequence of that, from a pro-active perspective, there is little if any imperative to build an Innovation Capability higher than Level 2. On the other hand, when it comes to defensive-innovation, the skills of a Level 4 organisation are needed. At least for the early 'creative' parts of the innovation journey. What I mean by this is that as soon as the innovators have spotted a potential threat and have designed a strategy to neutralize that threat, there is no need to do all the hard work associated with actually putting anything new into the market place. The reason for needing Level 4 ('Strategising') is that the organization needs to be able to defend itself against threat from

outside the current industry and this outward-view capability is one of the key differences between a Level 3 and a Level 4 organisation.

Consequently, a ‘good’ Big Two Innovation Capability position is to have a small pocket of Level 4 innovators working in a defence-oriented ‘observatory’, and then a larger cohort of Level 2 trained people that can blunder their way through any product/service changes that ‘have’ to be taken all the way to market. This latter group don’t need to be particularly efficient, and may well find themselves devoting their time to initiatives that no-one above them in the hierarchy cares or not whether they are successful. Some, indeed, may purely be the sort of activity you see the military embarking on to keep their troops awake: war-games. The CEO needs to be able to stand up and declare to shareholders how much money is being spent on R&D, and whatever number they declare needs to sound good, but the CEO, frankly, will be happiest if none of that spend does anything to detract from the serious business of making money from the already existing products and services. Whether you’re in the Level 2, ‘pro-active’ group, or the Level 4 ‘defensive’ group, life as in innovator in the Big Two organisations is most likely to be characterized by the word ‘frustrating’. Anyone with big ambitions to change the world, figuring they’re going to do I from within one of these large organisations, are likely to become dis-illusioned very quickly.

In theory, the better place for the innovator to base themselves is the Number 3 player. Because of their smaller size relative to the Big Two, the third biggest player in an industry has the biggest challenge earning satisfactory profit margins since they don’t have the same economies of scale advantage. The primary job of the Number Three company is to catch up and eventually beat the Number One and Number Two. Which means that they need to achieve Level 3 (‘managed’) Innovation Capability. Their focus very much needs to be about beating the current Big Two offerings. It’s not typically about disrupting the market by switching to a higher level function. If you’re the third biggest car manufacturer, for example, your ambition is to sell more cars more profitably than the second biggest player. It’s not to start offering higher-level and profoundly more difficult to achieve ‘mobility’ solutions. The organization needs innovation processes that are efficient, which means that timing has to be meaningfully calculated, and there need to be processes in place to competently transition R&D into production. This is the very definition of Level 3 ICMM. Because the Number Three player has to be so focused on catching up with and beating the Top Two, there is far less need (or spare resource) to have any kind of outward-looking defensive observatory. The large majority of Number Three players we see and work with (in many ways they are our sweetspot!) actively do not want outward, cross-industry-focused innovators.

Taken all together, here’s what the Big Three players in their industry are most likely to require in terms of Innovation Capability:

	ICMM Level 1	ICMM Level 2	ICMM Level 3	ICMM Level 4	ICMM Level 5
Number One		pro-active		(defensive)	
Number Two		pro-active		(defensive)	
Number Three			pro-active		

Figure 1: ICMM Level Versus Big Three Company Position

Now, if this all sounds fairly depressing to you as an ‘innovator’ reading this, I’d tend to agree with you. Particularly if you’ve ‘seen the (TRIZ) light’ and have expectations of doing

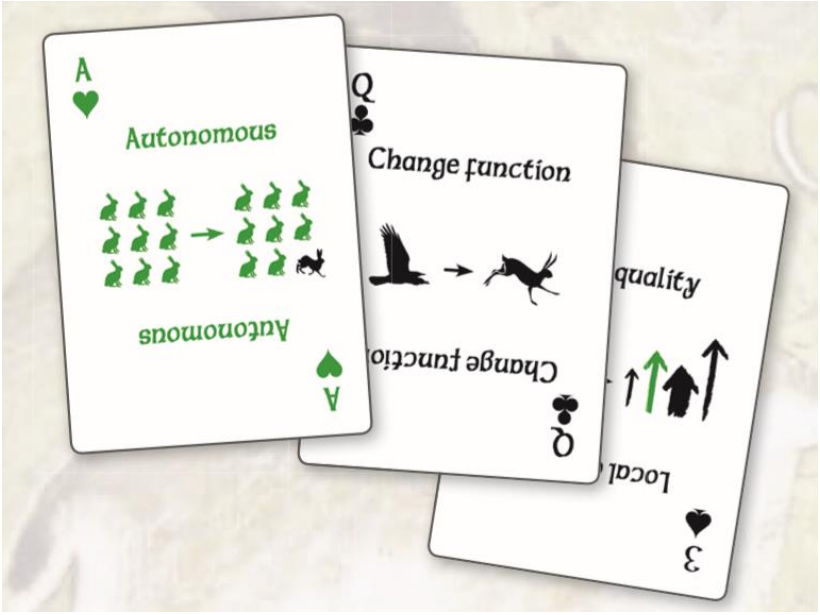
big exciting things. The TRIZ ‘Ideal Final Result’ tool, clearly tells you what the future is going to look like, and once you’ve seen it, its very difficult to know that you’re powerless to do anything about it. The IFR tool is conceptually very simple, but it is only really useful for Level 4 organisations. Of which there aren’t many. Which only then leaves Level 0 start-ups. They might benefit from some IFR thinking at the beginning of their work, but honestly their focus needs to be on mastering Level 1 Operational Excellence not being Level 4 innovators. Operational Excellence and the mundane day-to-day grind is what brings the money in to pay for the innovators to do their job.

TRIZ, in this regard, massively over-shoots the need of the vast majority of organisations on the planet. It doesn’t feel good writing those words, so I’m sure it definitely doesn’t feel good reading them. Unless, of course, you’re a real innovator. In which case you know that within every threat, bearing in mind the need to observe the von Clausewitz ‘critical mass at the critical point’ rule, there is an opportunity. The big ‘critical mass’ issue in most Big Three organisations is there is no-one at or close to the top of the hierarchy that has even the vaguest notion of what innovation is, or what I’m talking about here. That’s a big problem for anyone working as an innovator in one of these organisations. Fortunately, I don’t anymore. My ‘critical mass’ problem is somewhat different. I’ll show you how we’re thinking of solving the problem this place next month.

References

1) Sheth, J., Sisodia, R., ‘The Rule Of Three: Surviving AndThriving In Competitive Markets’, Free Press, 2002.
2) Systematic Innovation ezine, ‘The Rule Of Three And Do I Need To Innovate?’, Issue 130, January 2013.

Dividing 40 into 52: TRIZmeta



Next month sees the launch of our new 'TRIZmeta' playing cards. Readers with a very long memory may remember that, back in the early CREAX days we made a set of playing cards featuring the 40 Inventive Principles. They're something of a collector's item these days. That's been part of the intrigue of re-instigating the idea. The bigger part, however, is that we finally think we've cracked the 'TRIZ game' problem of how to make a game that teaches people about breaking rules. Details of how that's been achieved can be found at the dedicated TRIZmeta website. Meanwhile, this article tries to deal with the somewhat more practical and immediate problem of how to meaningfully divide the 40 Inventive Principles across a deck of what is fundamentally 52 cards. With the old CREAX deck, the feat was achieved by a fairly random process if we're being honest. With TRIZmeta – because of the 'meta-game' part of the story, this wasn't going to be possible any more. As any TRIZ user will attest, some of the Inventive Principles are easier to deploy than others. Some are also more 'powerful' idea generation provocations than others too, and the TRIZmeta game needed to reflect these facts.

Solving that part of the '40 into 52' puzzle actually proved relatively simple in the end: low card numbers have the easier, less powerful Principles, and the higher numbers feature the more difficult, more abstract ones.

But, what to do about the 12 'extra' cards?

The first clue came from a simple bit of mathematics: 52 = 36 + (4x4). Which means that if we could find a sensible way to repeat 4 of the Inventive Principles 4 times, one for each suit present in the deck, the remaining 36 Principles could be split across the remaining 36 cards.

The most obvious candidate for this 'split into four' requirement was Principle 35, Parameter Change. Probably most people's least favourite Inventive Principle. For the reason that it is so generic and actually covers a lot of ground from an idea generation provocation perspective. For that reason, it's also one of the most frequently observed Principles when we reverse engineer patents and, more recently, innovative business innovations. On that front, we'd recently had cause to conduct a fairly tedious task of

mapping another idea-provocation taxonomy as developed by business academics at St Gallen University. By reverse engineering several hundred business innovations, they'd identified 55 different strategies. When we mapped their 55 to the TRIZ 40, the result looked something like the picture reproduced in Figure 1, below. (Darrell also wrote this story up as a blog article you can find at Reference 1 if you're excessively interested.)

The first upshot of the St Gallen-TRIZ mapping exercise was that, because they'd only considered hundreds of cases, the 55 'different' strategies they'd observed corresponded to only 27 of the Inventive Principles. They'd missed 13 in other words. On the other hand, some of the Inventive Principles corresponded to multiple of their 55 strategies. Principle 35, Parameter Change, for example, mapped to 4 of their 55 (4? hmm). Principle 2 mapped to 5 St Gallen strategies; Principle 3 to 4; Principle 13 to about 8; and Principle 25 to 4 (that number again).

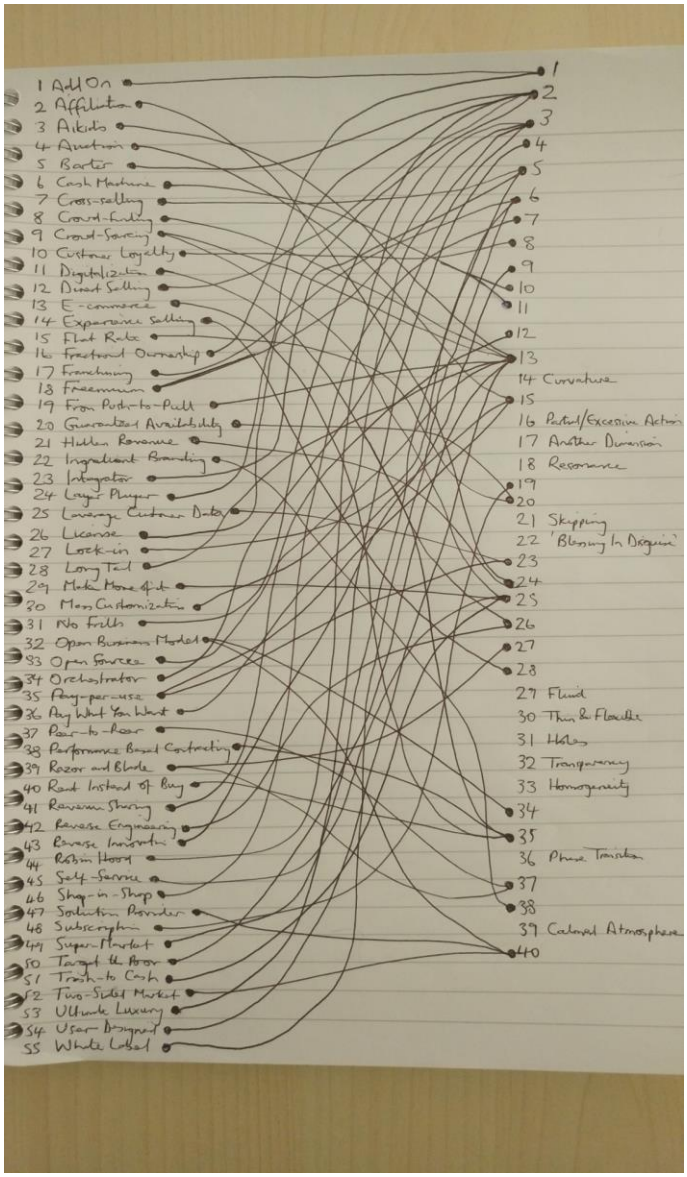


Figure 1: St Gallen To TRIZ Principle Mapping

If we take any heed of the St Gallen work, it gives us 5 candidates for the 4 Principles TRIZmeta might repeat. Perhaps not surprisingly, those 5 correspond to the most frequently observed of the TRIZ Principles, so even though 'hundreds' of case studies doesn't appear to find all the Principles, it does seem to have found the most frequently

used ones. As well as being ‘frequent’, the top-5 Principles are often the most powerful and or provocative. The problem, now, is that there are five of them and not four. Principle 35 was already decided as one of the winners. The other two ‘obvious’ choices seemed to be Principles 13, The Other Way Around, and 25, Self-Service. Principle 13 because it’s the most provocative Principle, and 25 because it’s the one that most directly points users towards Ideal Final Result oriented solutions.

That leaves Principles 2 and 3 for the remaining ‘top 4’ place. In many ways, the two Principles are closely allied to one another: Principle 2 says to ‘separate’ entities, and Principle 3 in effect says to separate them unevenly. Principle 2, Taking Out/Separation, however, also forms an important component of the Physical Contradiction separation strategies, of which there are several. With this in mind, the blinding flash of the obvious involved choosing Principle 2 as the ‘fourth’ TRIZmeta multiply-by-four choice, and to ‘relegate’, Principle 3 to its rather more specific role as a provocation for forcing users to look for things that are ‘all the same’, and to then make them not all the same.

So much for the ‘Top 4’, the final part of the TRIZmeta jigsaw puzzle was then to decide how to divide the four into four different cards. That’s what we’ll look at next. Starting with…

Principle 35, Parameter Change
The original Soviet definition of Principle 35 contains multiple variants, which we’ve subsequently added to and altered in the business and IT version of TRIZ. Consequently, there was no shortage of options as far as choosing four for the TRIZmeta cards. There was also, we felt, the opportunity here to add a long-missing part of the Inventive Principle story. Anyone that has read the TrenDNA book will know that we took the opportunity there to re-think the 40 Principles and get them down to, as it transpired, eighteen. We also wrote up the rationale for this in Reference 2. A part of the thinking there was that, if there was ever a case for a 41st Principle it would come from the relatively rare situation in which innovation happens by exapting a solution designed to deliver one function to a different function (think Viagra for an all-time iconic example). TrenDNA thus includes the 41st provocation, ‘Change Function’. We decided it needed to be present in TRIZmeta too, especially in light of the primary intended use of the cards in a ‘meta-game’ context. The other three TRIZ meta cards, were then a case of merging and selecting the best of the other existing Principle 35 variants. We ended up with ‘change size’, ‘change surroundings’ and ‘change form’, again to make the best connection to the game context and make it easier for newcomers to make connections to the provocation instruction.

Principle 2, Taking-Out/Separation
Principle 2 is very closely connected to the Physical Contradiction part of TRIZ. Last year (Reference 3) we finally got around to updating that part of the TRIZ story. The biggest insight I think we had was in recognizing that the various ‘separation’ strategies present in the Soviet version of the tool were confusing people – separation in space and time, people ‘got’, but ‘separation on condition’ easily causes confusion since – blinding flash of the obvious – space and time are also ‘conditions’. The Reference 3 solution involved reverting to the Space-Time-Interface pillar of modern TRIZ, and so three of our four TRIZmeta ‘separation’ cards could simply refer to each of the space, time and interface provocation possibilities. Which then made the choice of the fourth card easy: the ‘Taking Out’ part of the Principle title.

Principle 25 – Self-Service
Splitting this Principle immediately makes sense because 25A and 25B in Classical TRIZ are quite different and don’t necessarily make sense as the ‘same’ idea generation

strategy. 25A is about the ‘self’ part of the story, while 25B is focused on making use of ‘waste’ resources. This split allowed us to divide the TRIZmeta need for four cards into two. As far as the ‘self’ part is concerned, especially thinking about the application of TRIZmeta and an audience that in all likelihood won’t know TRIZ, we have ended up with two variants, one focusing on the ‘self’ word, and the other on its cousin, ‘autonomous’. For the ‘waste’ side of the Principle, we made another two-way split and thought about the 7idea of recycling – i.e. turning waste into a useful something – and the somewhat bigger idea of ‘regeneration’. With this latter provocation, the inclusion of a graphic image on the cards proved to be especially beneficial:

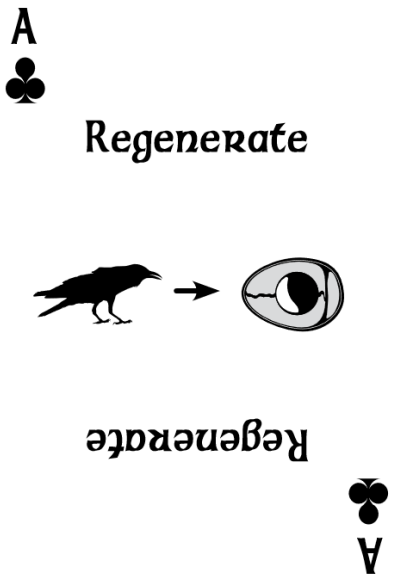


Figure 2: Ace Of Clubs & ‘Regeneration’

Principle 13, The Other Way Around
The original TRIZ description divides Principle 13 into three variants: ‘opposite action, make-movable-fixed-fixed-movable, and ‘upside-down’. The first and last of these rarely cause users any difficulty in interpretation, while the middle one often does, being in some ways an overlap with Principle 15, Dynamics. An additional factor when it comes to the effective use of Principle 13 – especially in light of what we did with it in Reference 2 – is that it often combines with other Principles. Or rather, many of the Principles have a (Principle 13) opposite. So, Principle 38, Enriched Atmosphere’ is the opposite to Principle 39, Calmed Atmosphere; 5 is the opposite of 2; 3 is the opposite of 33; 19 is the opposite of 20, and so on. Principle 13, in other words, is kind of a ‘meta-Principle’. Hence, to honour the original ‘generic provocation’ intent and to best enable the Principle 13 TRIZmeta cards, we simply ended up using labels that were the most generic and easiest for people to connect to either other Principles, or to use in their own right: ‘Other Way Around, Reverse, Do The Opposite, and Upside-Down’.

Hopefully, this re-assures TRIZniks that TRIZmeta has stayed true to the spirit of the original 40 Principle descriptions. The cards are – hopefully – going to find an audience wider than just TRIZ. Hence there was an opportunity to choose some Principle names that were more commonplace than the ones found in Soviet TRIZ. TRIZniks will no doubt still be able to connect each card to its respective Principle, but, lest there be any doubt, here’s how the final TRIZmeta deck maps to the original Soviet list:

	Hearts	Diamonds	Spades	Clubs
Ace	Autonomous (25)	Self-Organise (25)	Recycle (25)	Regenerate (25)
King	Other Way Around (13)	Reverse (13)	Do The Opposite (13)	Upside-Down (13)
Queen	Change Size (35)	Change Surroundings (35)	Change Form (35)	Change Function
Jack	Separate (2)	Separate In Time (2)	Split Connection (2)	Take Out (2)
10	Empathy (18)	Phase Transition (36)	Fields (28)	Dynamize (15)
9	Merge (5)	Enrich (38)	Prior Counteraction (9)	Calm (39)
8	Remove Tension (12)	Bad To Good (22)	Periodic Action (19)	Composite (40)
7	Another Dimension (17)	Hole (31)	Continuous (20)	Nested Doll (7)
6	Colour Change (32)	Balance (8)	Re Sequence (10)	Intermediary (24)
5	Curve (14)	Fluid (29)	Feedback (23)	Hurry (21)
4	Copies (26)	Universal (6)	Thin & Flexible (30)	Relative Change (37)
3	Asymmetry (4)	Disposable (27)	Local Quality (3)	Discard & Recover (34)
2	Same (33)	Slightly More/Less (16)	Segment (1)	Protect (11)

Figure 3: Mapping The 40 Principles To The 52 TRIZmeta Playing Cards

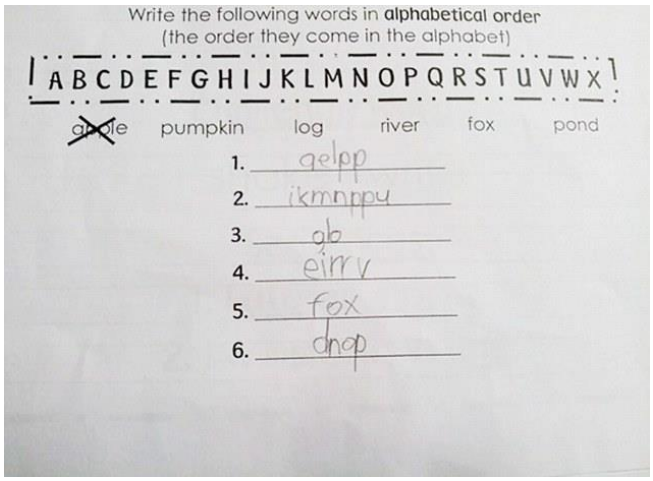
References

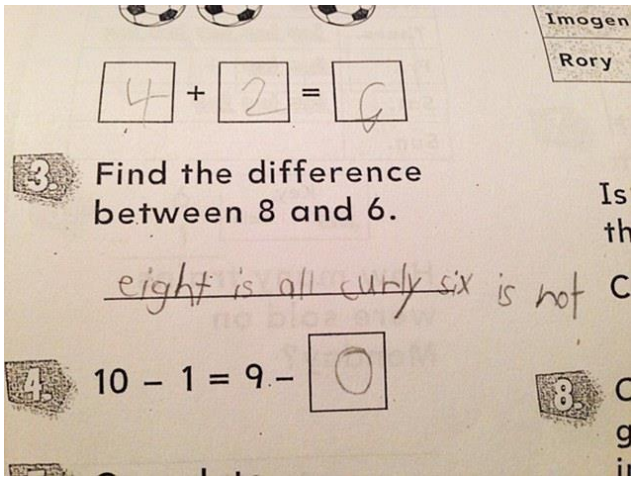
1) Mann, D.L., ’55 Business Model Patterns & TRIZ’, blog article, www.darrellmann.com, 20 July 2018.
2) Mann, D.L., ‘Rethinking The Inventive Principles’, part of ‘Evolving TRIZ Using TRIZ And NLP’, TRIZCON, 2002.
3) Systematic Innovation ezine, ‘Re-Thinking Physical Contradictions #1: Technical Problems’, Issue 181, April 2017.

Not So Funny – Literally Principle 12

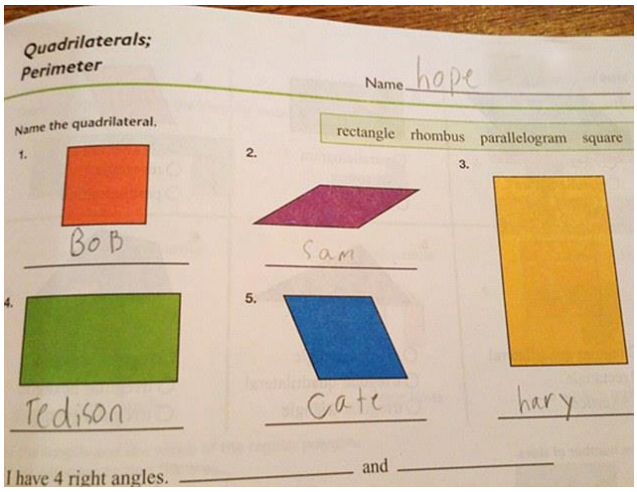
Principle 12, Equipotentiality, is all about removing tension within systems. When someone is given an instruction and they don't follow it precisely, we could interpret their discrepancy as a tension. Which is a bad thing. Consequently, we should consider removing the tension by eliminating the discrepancy. If someone gives us an instruction, we should follow it exactly. As in exactly. And, hey presto, equipotentiality…

…the learning starts at school…

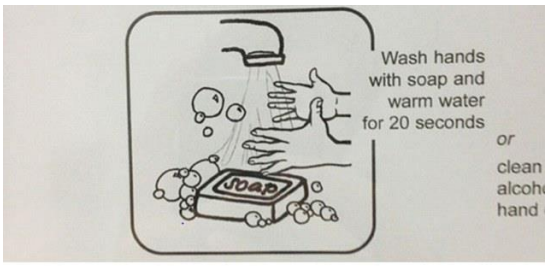


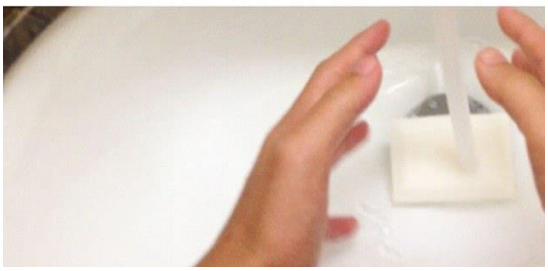


…or…



(Picture on the left: 'don't you dare put a foot outside'.)
Then we 'grow up'…





Then we really grow up…

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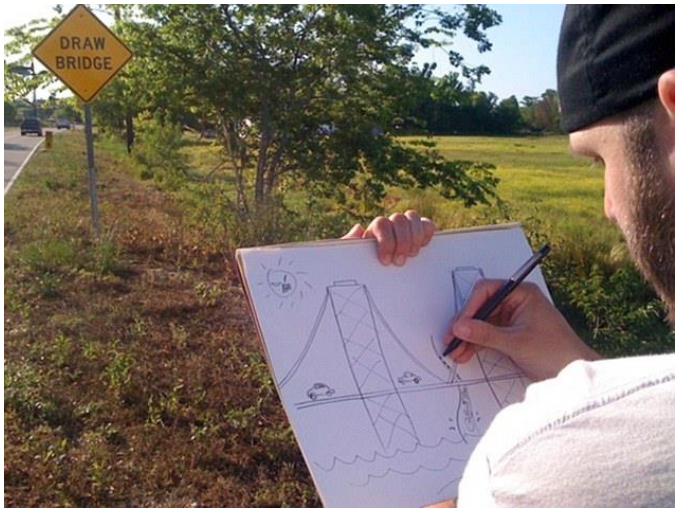
Then we regress…



Then, finally, we reach this point… Equipotentiality Nirvana…

SYSTEM ATIC INNOVAT ION

Patent of the Month – Tissue Preservation System

Currently, doctors have to throw away more than 80 percent of donated tissue used for joint replacements because the tissue does not survive long enough to be transplanted. Now, following a recent study, University of Missouri School of Medicine researchers have had their patent granted for a new technology that more than doubles the life of the tissue. This new technology was able to preserve tissue quality at the required level in all of the donated tissues studied, the researchers found.

“It’s a game-changer,” said James Stannard, co-author of the study and J. Vernon Luck Sr. Distinguished Professor of Orthopaedic Surgery at the MU School of Medicine. “The benefit to patients is that more graft material will be available and it will be of better quality. This will allow us as surgeons to provide a more natural joint repair option for our patients.”

The technology, called the Missouri Osteochondral Allograft Preservation System, or MOPS, more than doubles the storage life of bone and cartilage grafts from organ donors compared to the current preservation method used by tissue banks.

In traditional preservation methods, donated tissues are stored within a medical-grade refrigeration unit in sealed bags filled with a standard preservation solution. MOPS utilizes a newly developed preservation solution and special containers designed by the MU research team that allows the tissues to be stored at room temperature.

In the study, clinical outcomes of the standard preservation approach and the new MOPS technology were assessed. Researchers found that by using MOPS, the storage time for donor tissue could be extended to at least 60 days, versus the current storage time of approximately 28 days.

“Time is a serious factor when it comes to utilizing donated tissue for joint repairs,” said study co-author James Cook, director of MU’s Comparative Orthopaedic Laboratory and the Missouri Orthopaedic Institute’s Division of Research. “With the traditional preservation approach, we only have about 28 days after obtaining the grafts from organ donors before the tissues are no longer useful for implantation into patients. Most of this 28-day window of time is used for testing the tissues to ensure they are safe for use. This decreases the opportunity to identify an appropriate recipient, schedule surgery and get the graft to the surgeon for implantation.”

The patent in question was granted as US10, 039,277 on 7 August. In addition to James Cook and a colleague from the University of Missouri, the list of inventors also includes a pair from Columbia University in New York.

Here’s what the background description has to say about the problem being solved:

Allograft or other tissue samples are used to treat many diseases and/or defects. These grafts are procured from organ donors and must be stored to allow for viral and bacterial testing for safety prior to shipping to surgical centers for implantation into patients. Based on studies looking at viability of the cells in the grafts, recommendations have been given for implanting tissues as soon after harvest as possible in order to maximize success. Safety testing takes a minimum of 7 days and more often 10-14 days for final clearance. Storage of tissue, such as allograft tissue, for transplantation or other scientific or medical purposes allows time for medical testing, recipient patient preparation, or to preserve tissues for other purposes. Storage conditions for allograft or other tissue samples may influence tissue viability, integrity, and/or sterility.

SYSTEM ATIC INNOVAT ION

Here's how we might best map the problem onto the Contradiction Matrix – 'Duration of Action' being the primary attribute the invention is trying to improve, and stability (or lack thereof) being the attribute causing the inadequate preservation life.

IMPROVING PARAMETERS YOU HAVE SELECTED:

Duration of Action of Stationary Object (13)

WORSENING PARAMETERS YOU HAVE SELECTED:

Stability (21)

SUGGESTED INVENTIVE PRINCIPLES:

5, 35, 39, 24, 3, 12, 31

And here's the inventive steps used to create the solution:

…A process for osteochondral tissue preservation comprising storing the osteochondral tissue at room temperature in a container comprising a serum-free culture medium comprising dexamethasone for from about 7 days to about 70 days prior to implantation, wherein at least 70% of the cells of said osteochondral tissue remain viable after said storing compared to the viability of the cells of the osteochondral tissue at day 0.

Essentially, we get two illustrations of Principle 35, Parameter Change, in action here. The first is a switch in the culture medium in which the tissue is preserved. The second is somewhat more counter-intuitive and relates to the increase in temperature from the refrigerated convention to 'room temperature'. As such I think it represents just what Principle 35 is all about: changing a parameter – temperature in this case – to such an extent that a non-linear effect is achieved. It is not, in other words, about optimizing a parameter, but using variation of that parameter to cross some kind of non-linear boundary. This inevitably involves some kind of bravery. The level steps up even further when, like the team of inventors here, they try changing the parameter in the 'wrong' direction.

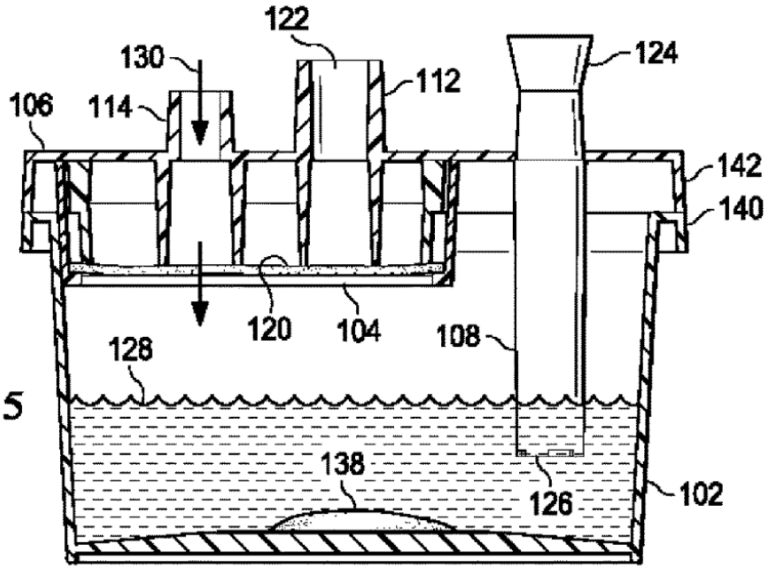


FIG. 5

Not to mention the later claim concerning the container. Check out Principles 24, 31 and 39 in this description:

…A method for preserving osteochondral tissue at room temperature in a chamber comprising a serum-free culture medium comprising dexamethasone prior to implantation, the method comprising: placing the osteochondral tissue in a chamber base with said culture medium, the chamber base configured to maintain the tissue and the serum-free culture medium comprising dexamethasone; forming a tissue preservation chamber by covering the chamber base with a lid to form a barrier to contaminants, the chamber comprising at least one filter, a media inlet coupled to at least one filter for maintaining a sterile environment inside the chamber, and a media outlet, the media outlet including a media outlet conduit that extends into the chamber to permit removal of media; wherein the media outlet comprises a one-way valve to prevent reentry of culture medium exiting the chamber; and storing the osteochondral tissue at room temperature for from about 7 days to about 70 days prior to implantation…

It's the real thing, people…

Best of the Month – 13 Ways Of Looking At The Novel

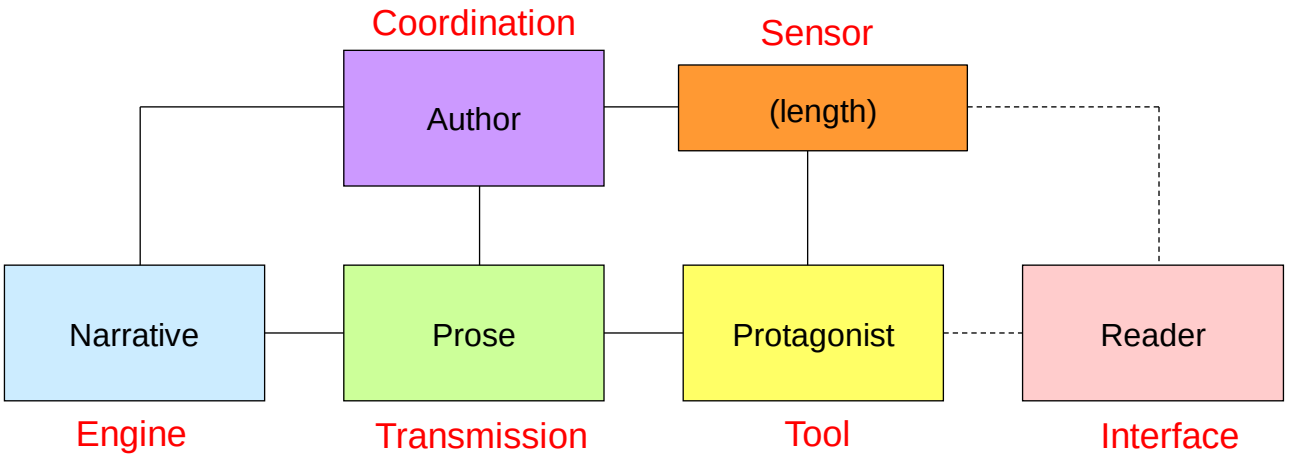
A slightly tangential 'best-of' this month. Albeit one that is very TRIZ-like in its desire to look across wide swathes of data in order to find patterns. Jane Smiley's search territory is literature. And, what she comes back with makes for a fine complement to Joseph Campbell's lifelong study of the same subject.

Bogged down in the midst of writing a novel she didn't much like, fearing at age 52 that she was running out of inspiration, Smiley (Horse Heaven, 2000, etc.) decided in 2001 to read 100 novels—not a "Hundred Greatest," she is quick to stipulate, "only a list of individual novels that would illuminate the whole concept of the novel." The resulting book offers 12 chapters on various aspects of the form ("The Origins of the Novel," "The Novel and History," etc.) and a 13th with 101 short essays on individual titles (Jennifer Egan's Look at Me got added after Smiley read it on a post-project vacation). Naturally, the author's selections and judgments reflect her sensibility and artistic convictions. She's capable of appreciating a modernist classic like Ulysses, but she writes far more enthusiastically about other works, from The Princess of Cleves to Zadie Smith's White Teeth.

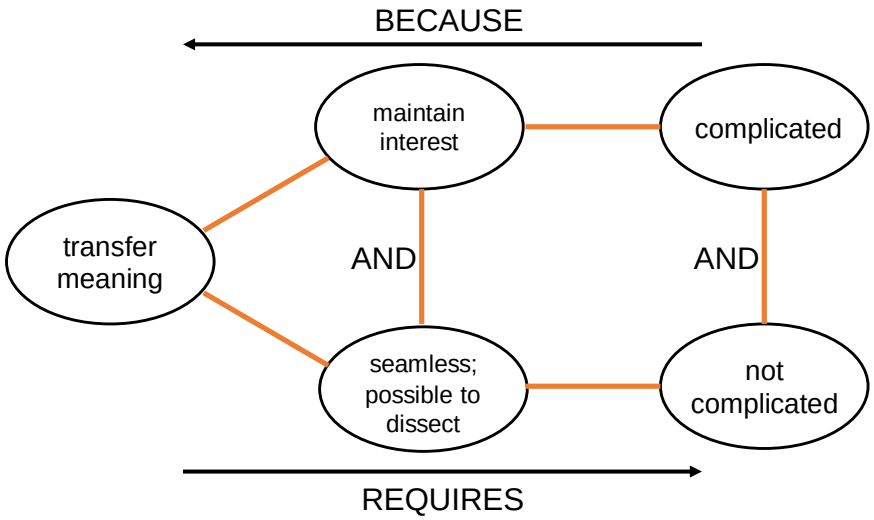
Whether praising or damning – The Great Gatsby is among the books that get severe though never nasty appraisals – Smiley approaches literature in a refreshingly direct, unpretentious way. She considers Lady Murasaki and Boccaccio her peers just as much as John Updike and Ian McEwan; you never forget in her down-to-earth assessments that novels are written by and about human beings. She likes Daniel Defoe for "his habit of giving advice and yet forgiving his characters' trespasses"; she dislikes Henry James's "prissy, domineering manner." There are funny, apt phrases on every page, and Smiley's analysis of the novel's evolution over a millennium is cogent and convincing. Her "case history" of Good Faith (2003), the manuscript whose bumpy progress prompted her 100-novel intermission, offers a fascinating look at the working writer's life. What ties together the casually organized text is Smiley's profound love for her chosen genre, an art form she believes is accessible to everyone because "the novel is based on the most primal human materials, emotion and language."

SYSTEM ATIC INNOVAT ION

Read with a knowledge of TRIZ reveals a number of intriguing connection points. A novel, for example, is a ‘system’:



Novels should be ‘complicated and not complicated’:



And, of course, the novel must be built around a dilemma. We’ve been down this road several times before, but the big advantage of reading Smiley’s book is that she is first and foremost a novelist and so we get the dilemma story from a novelist’s perspective rather than someone theorizing about literary dilemmas. 13 Ways Of Looking At The Novel thus flows beautifully and every word is a pleasure to read. At 570 pages, that makes for a lot of pleasure, if you’re willing to devote the time.

Like a lot of great innovations, I suspect this book exists thanks to an accident. An accident involving writer’s block, and the need to head down a different road to try and find the way back to a career that, following the accident, is still producing sparkling creativity nearly 20 years later.

Wow In Music – Say A Little Prayer (x2)

This month saw the sad passing of singer, Aretha Franklin, a woman who was blessed with arguably the greatest singing voice in the history of recorded music — and with it, the superhuman ability to make songs better than they were originally conceived.

“I Say a Little Prayer,” written by Burt Bacharach and Hal David, is one of those songs. Originally recorded by Dionne Warwick and released in the fall of 1967, “I Say a Little Prayer” was a hit for Warwick, reaching No. 4 on Billboard’s Hot 100 and remaining on the charts for 13 weeks.

But Aretha Franklin, who released her own version of the song in the summer of 1968, completely transformed it:

The arrangement allows Franklin to show off her one-of-a-kind voice, transforming the song into something that climbs, yearns, and builds. It’s as if somewhere in her soul, she truly believes the person she’s singing to is the only one for her.

In a candid 2010 interview with NPR, David and Bacharach both laughed trying to describe how good Franklin’s version was. “It’s a better record than the record we made,” Bacharach told Fresh Air host Terry Gross. “Mmhmm. We did, yeah. And we did a great record, but she topped it,” David added.

When Gross prodded them a little more, they told her to listen to it, that you can just hear it in the effortless way Franklin sings and how the arrangement is crafted to enhance that. That Franklin sings the song as if it were a dress designed just for her.

“It’s just more natural,” Bacharach said. “We were talking about our changes and time changes on the chorus of ‘forever and forever, you stay in my heart, and I will’ — you know, that’s going (Principle 37, Relative Change) 4-4, 3-4, 4-4, 3-4. Then regard the way it was treated by Aretha, because Aretha just makes it seamless, the transition going from one change to another change. You never notice it.”

We hear more Principle 37 in the way Aretha let’s her backing singers finish off verse lines. Leaving her to drop a fraction of a beat (Principle 16) on her return, or extend a note longer than you expect (Principle 20), or double a call-and-response (Principle 5). To say the performance offers a masterclass in is something of an understatement.

Perhaps the irony is that “I Say a Little Prayer” was actually a bigger hit for Warwick, even though its creators believe Franklin made the better song. (Franklin’s version peaked at a

not-too-shabby No. 10.) Warwick, as is her style, is smoother and doesn't feature the 'in the pocket', angularity of Franklin's version. On the other hand, the time signature in Warwick's version is even more intricate, featuring two measures of 4/4, one measure of 10/4, and two measures of 4/4 for verses, and 11/4 for its chorus.

Both versions are a music fan's delight. The odd time signature is probably a big part of what makes us want to come back and listen again, but mainly because they're done so seamlessly, you can listen a hundred times and still not be able to quite work out what's happening, and why, the moment the song has finished, you want to go back and play it again.

Rest In Peace, Lady Ree, Rest In Peace.

Investments – Recycling Lithium Batteries

Lei Pan's team of chemical engineering students had worked long and hard on their research project, and they were happy just to be showing their results at the People, Prosperity and the Planet (P3) competition last April in Washington, DC. What they didn't expect was to be mobbed by enthusiastic onlookers.

"We got a lot of 'oh wow!' responses, from eight-year-olds wanting to know how it worked to EPA officials wondering why no one had done this before," says senior Zachary Oldenburg. "My response to the EPA was, 'Because no one else had a project leader who's a mining engineer.'"

Pan, an assistant professor of chemical engineering at Michigan Technological University, earned his graduate degrees in mining engineering. It was his idea to adapt 20th century mining technology to recycle lithium ion batteries, from the small ones in cell phones to the multi-kilowatt models that power electric cars. Pan figured the same technologies used to separate metal from ore could be applied to spent batteries. So he gave his students a crash course in basic minerals processing methods and set them loose in the lab.

"My mind goes back to the beginning, when nothing was working," says Trevyn Payne, a chemical engineering senior. "A lot of times it was, honestly, 'Let's just try this.' Sometimes when things worked out, it was kind of an accident."

Oldenburg provides an example. "We were trying all kinds of solvents to liberate chemicals, and after hours and hours, we found out that plain water worked the best." But eventually, everything came together. "You can see your results improve experiment by experiment," explains doctoral student Ruiting Zhan. "That's pretty good. It gives you a sense of achievement."

The team used mining industry technologies to separate everything in the battery: the casing, metal foils and coatings for the anode and cathode, which includes lithium metal oxide, the most valuable part. The components can be returned to the manufacturer and re-made into new batteries.

"The biggest advantage of our process is that it's inexpensive and energy efficient." Ruitang Zhan

"For the purpose of remanufacturing, our recycled materials are as good as virgin materials, and they are cheaper," Oldenburg adds.

The fact that their process is tried and true is perhaps its most attractive quality to industry, Pan notes. "We saw the opportunity to use an existing technology to address emerging challenges," he says. "We use standard gravity separations to separate copper from aluminum, and we use froth flotation to recover critical materials, including graphite, lithium and cobalt. These mining technologies are the cheapest available, and the infrastructure to implement them already exists."

Passers-by weren't the only ones at the P3 competition impressed by the students' effort. AIChE's (the American Institute of Chemical Engineers) Youth Council on Sustainable Science and Technology (YCOSST) has announced it will be presenting the team its YCOSST P3 Award, which recognizes the project "that best employs sustainable practices, interdisciplinary collaborations, engineering principles and youth involvement, and whose design is simple enough to have a sustainable impact without requiring significant technical expertise of its users."

The team members, including Oldenburg, Payne, Zhan and undergraduate Lucille Nunneley, will be given the award in October, at the AIChE annual meeting in Pittsburgh, where they will also present their results. The award includes $1,000 to help cover student travel costs.

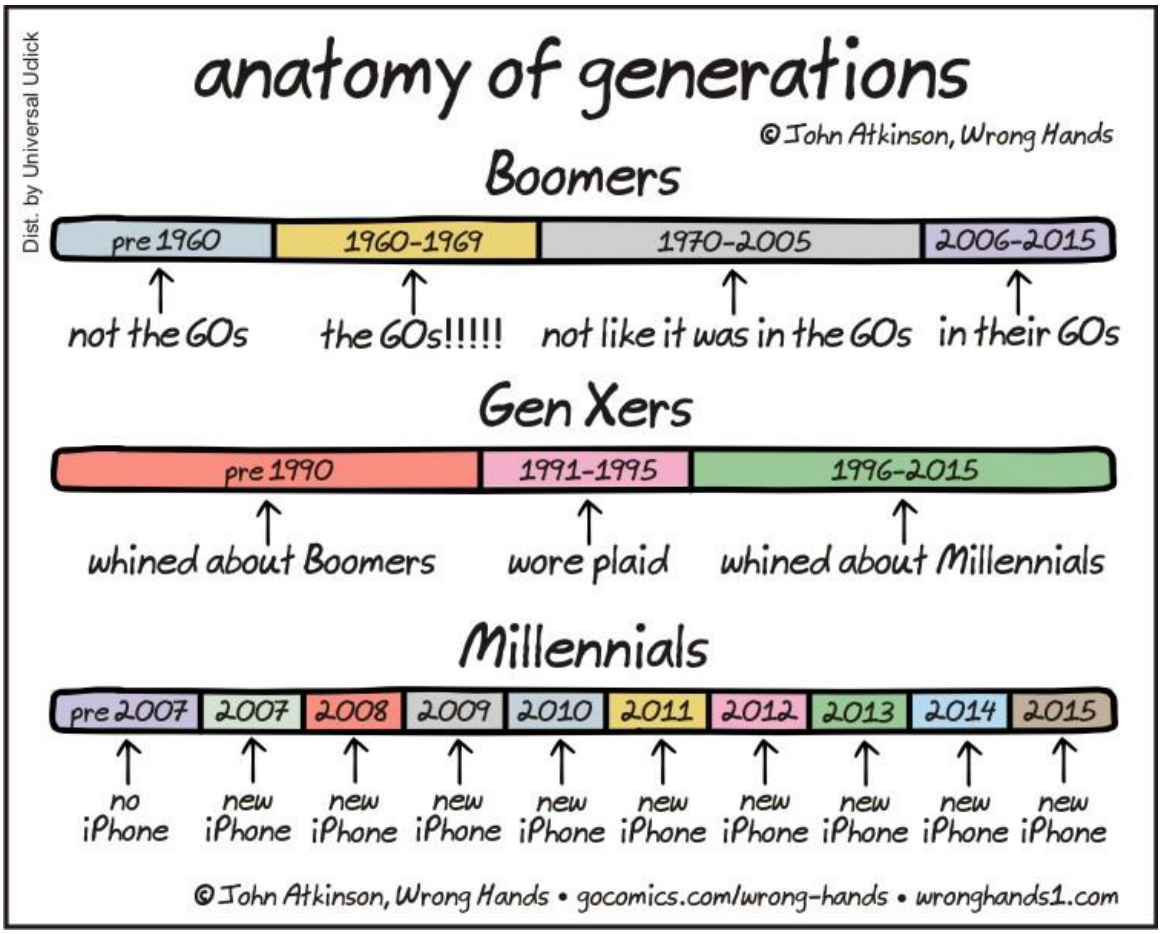
To advance their research, Pan has received funding from the Michigan Technological University Translational Research and Commercialization (MTRAC) statewide Innovation Hub.

The project was funded by a $15,000 grant from the Environmental Protection Agency and an article on their work, "Recovery of Active Cathode Materials from Lithium-Ion Batteries Using Froth Flotation," authored by Pan, Zhan and Oldenburg, was published online June 15 in Sustainable Materials and Technologies. Get the whole shebang here:

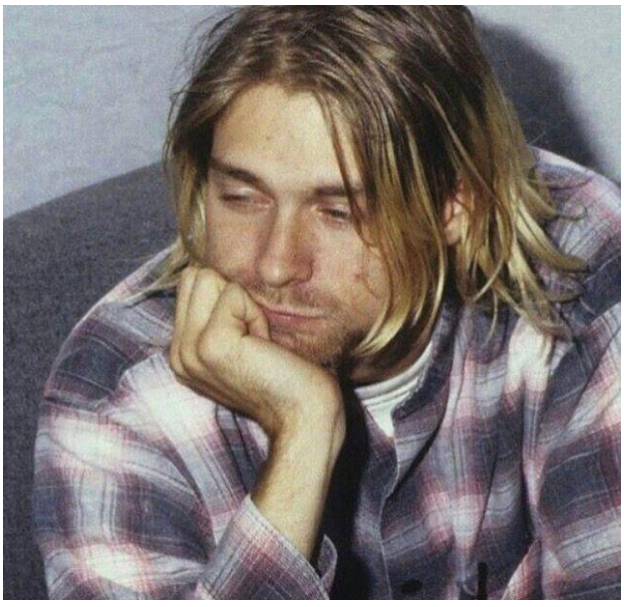
Ruiting Zhan, Zachary Oldenburg, Lei Pan. Recovery of active cathode materials from lithium-ion batteries using froth flotation. Sustainable Materials and Technologies, 2018; 17: e00062 DOI: 10.1016/j.susmat.2018.e00062

Generational Cycles – Plaid

One of my favourite Generation X characteristics is the reluctance to be labelled. I hadn't connected the issue to fashion until I saw this little gem of a generational generalization:



Then it became obvious…



…GenX wants to be defined and not defined. And plaid solves the contradiction… infinite variety *and* all the same…

Biology – Hedgehog

We love hedgehogs here at SI HQ. Despite the fact that helping to feed them can get expensive when a family of twenty-plus taking refuge in our garden decide they like only the best cat food, and only top-quality meal-worms to eat. Still, the sight of them all scuttling around after dark is something of a joy. And the noises during mating season are also pretty amusing.

If you ever find yourself watching hedgehog go about its day, you'll notice that they tend to fall out of trees — a lot. Wild hedgehogs climb trees as high as 30 feet, looking for insects and food to eat. Sometimes they fall by accident, other times they fall on purpose to evade a predator or because falling is a lot faster than climbing down.

As a hedgehog falls toward the ground, it keeps itself safe by rolling into a ball to surround itself with "spines" that absorb the impact. (Hedgehog spines are colloquially referred to as "quills," which is the official term for what porcupines have. Hedgehog spines function differently, however, than porcupine quills.) It's an effective method of protection — and one that humans want to steal.

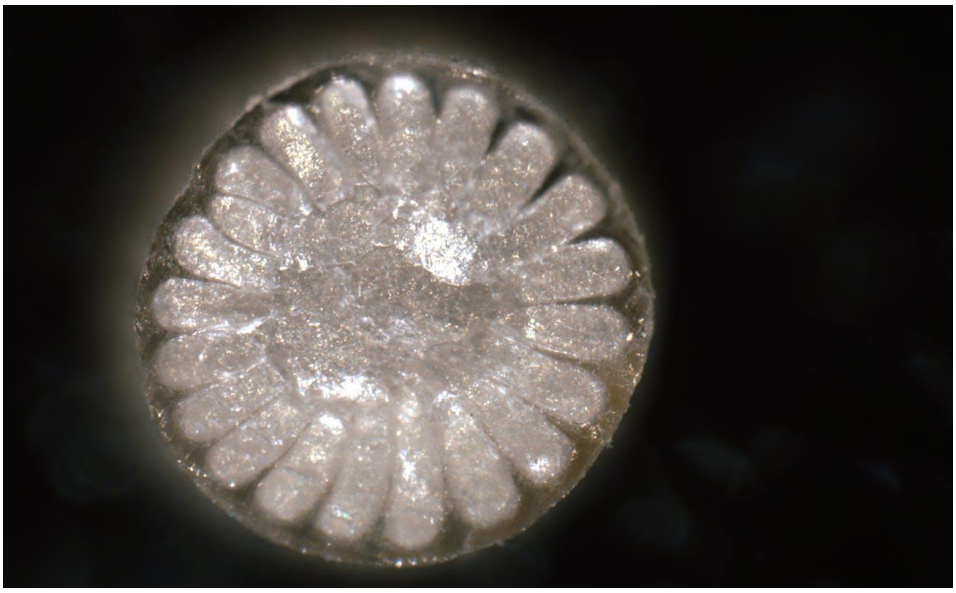
"The animal walks away uninjured," says Nathan Swift, chief operating officer at Hedgemon, a company that designs hedgehog-inspired helmets. Hedgemon is one of a growing number of organisations whose inspiration comes from biomimicry. The project to use hedgehog-inspired biomimicry to craft better helmets began about four years ago with a group of students in a class co-taught by professors from the University of Akron and the Cleveland Institute of Art. The idea was to find a biological model to address impact protection, says Swift.

He explains that in any helmet, such as for football or cycling, there are usually three main layers: an outer shell, often made of polycarbonate, a middle layer for shock absorbency, and an innermost layer for padding. Hedgemon is working to improve is the middle layer. "Today's helmets generally are inadequate when it comes to multi-hit durability to withstand multiple impacts and perform at the same level every time," says Swift.

Moreover, he adds, they do little to protect against concussions.
A concussion happens when the brain not only knocks against one side of the skull (which happens in a straight-on hit to the head), but also when the brain bounces around, twists, turns, and gets dismantled from its regular position. “Most hits are not perfectly straight. You get those off-kilter hits that cause twisting or rotational movement,” Swift says.

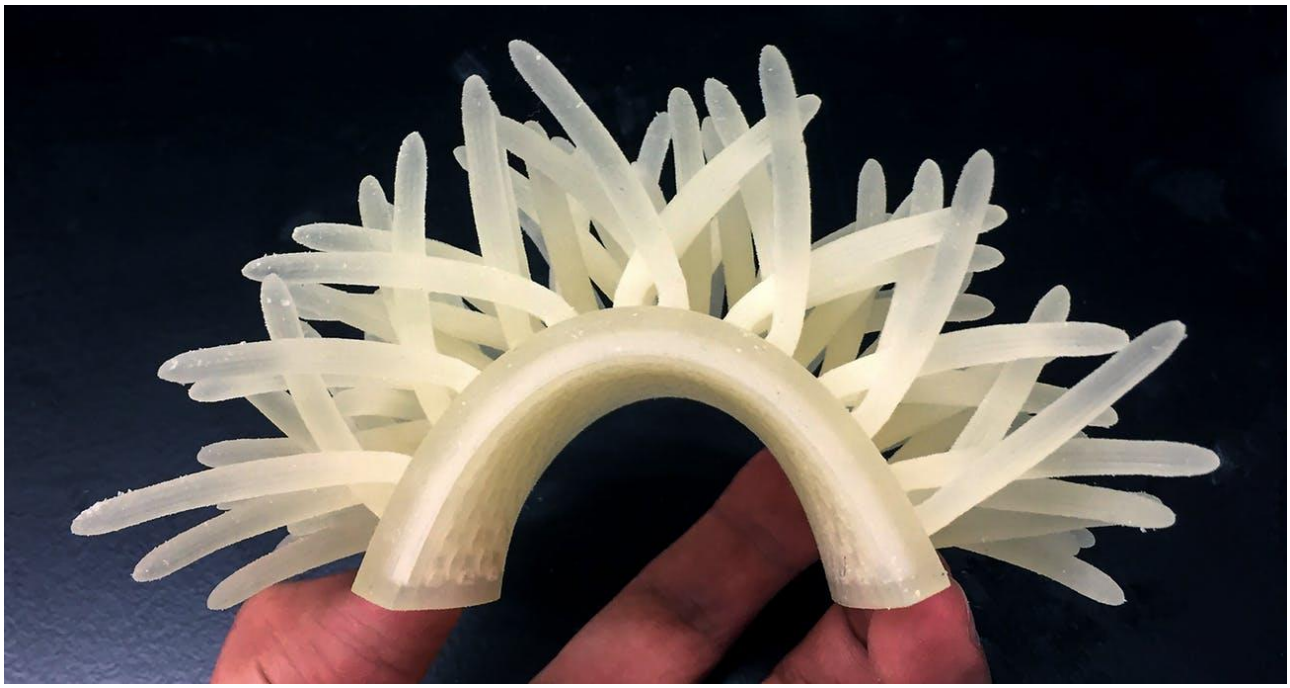
The rotational movement of the brain is much more damaging than linear movement, but none of today’s helmets have any kind of rotational give. Though they can absorb impact head on, if a person hits their head hit off-center, the helmet fails to absorb that rotational energy and passes it onto the victim’s head.

Hedgemon wants to add a rotational component to helmets to fix this, and to improve general impact absorbency and multi-hit durability. Their solution is a middle layer that emulates a hedgehog’s spines. “We’re not planning to make a full helmet, we’re just making the liner,” says Swift, adding that they’ll sell that liner to other helmet companies.



Currently, Hedgemon is testing four by four squares of the liner, which will eventually be integrated into helmets. The liner itself has quills on it that bend and twirl around each other in order to not only absorb impact, but also to lessen the impact of a hit that would ordinarily cause the brain to rotate within the skull. The quills also are able to go in all different directions, depending on the hit.

“Each individual quill has an intricate, internal structure that reinforces it and allows it to buckle elastically and return back to its original state,” Swift explains. That’s just part of how the helmet layer emulates an actual hedgehog. “The other part has to do with layout: the hedgehog has about 7,000 spines. That’s not just strength in numbers, but the spines also overlap and interact with each other,” he adds. That helps spread the impact of the hit: if you push one spine, it pushes on three of its neighbors, which push on their neighbors, causing a domino effect. “It helps alleviate a lot of the force, but also strengthens the material and helps with absorption in that way,” Swift says. The helmet quills/spines will be made out of a polymer material that is similar in structure and layout to what’s on a hedgehog, he says.

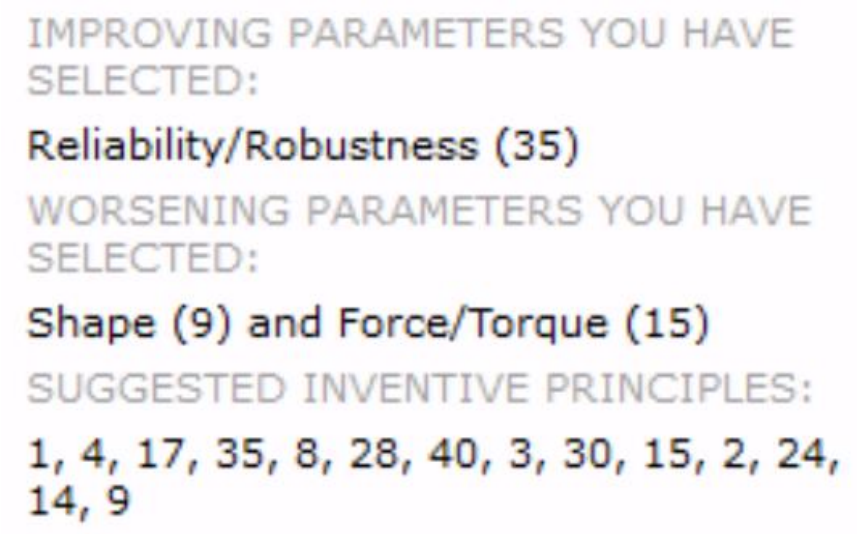


To test the material, the researchers at Hedgemon drop a weighted piece of metal from a certain height straight onto the middle layer material they’re crafting. They measure the force return and use a high-speed camera to see how the material reacts, says Swift.

Hedgemon’s study, entitled “Dynamic impact testing of hedgehog spines using a dual-arm crash pendulum,” was the first to look at “the impact energy absorption capability of hedgehog spines beyond anecdotal biological evidence.” They found that greater impact speed decreases durability but not initial energy absorption. “When samples are arranged in an orientation analogous to the natural model, hedgehog spines demonstrate impact absorption capabilities that confirm their role in the protection of hedgehogs during falls,” the researchers wrote. “This study demonstrates that in certain conditions, hedgehog spines can absorb as much, if not more, than industry standard impact-absorbing foam.” Hedgehog-inspired helmets made to absorb rotational hits and protect against concussions would be particularly useful for football players. “The NFL has a gigantic problem right now. The concussion rate is through the roof, and we’re continuously seeing the detrimental long-term effects on retired players,” says Swift. “There are numerous

lawsuits involving both the NFL and the helmet manufacturers, and the sport is losing both players and viewers, not to mention all the bad press the NFL gets. If this works, they'll be interested, they want nothing more than for this problem to go away as quickly as possible."

Here's the hedgehog's problem expressed as a conflict: the need to be able to reliably and safely drop from a large height is a robustness-versus-force problem, with an element of shape thrown in to the mix:

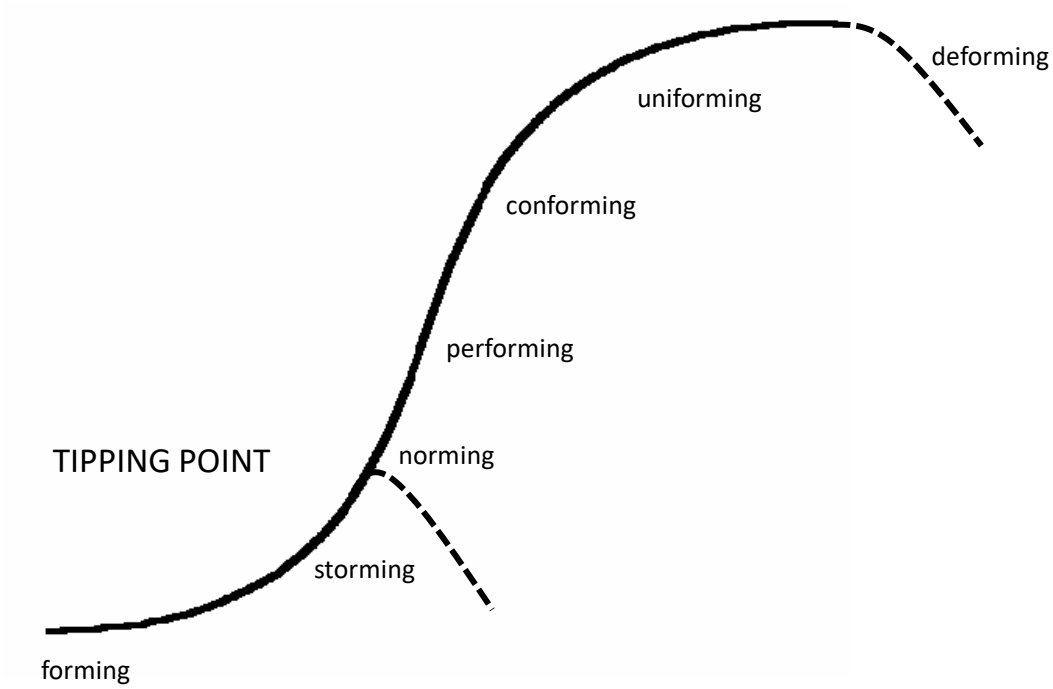


All in all, a pretty good proxy for the hedgehog evolved solution – lots of spines (Principle 1, Segmentation), spines at different angles and orientations (Principles 3, 4 and 17), curved cross-section and profile (Principle 14), thin and flexible (30), dynamic – i.e. they deflect (asymmetrically) when impacted (Principle 15). Only the very elegant concept of successive deflection – the first deflected spine impacts the next ones to progressively cushion the impact – is probably missing from the list of Matrix recommendations, but even there its possible to make an argument that Principle 8, Anti-weight, is analogous to what's happening.

All in all, I think I'm impressed enough to keep buying the mealworms and expensive cat food in the Autumn.

Short Thort

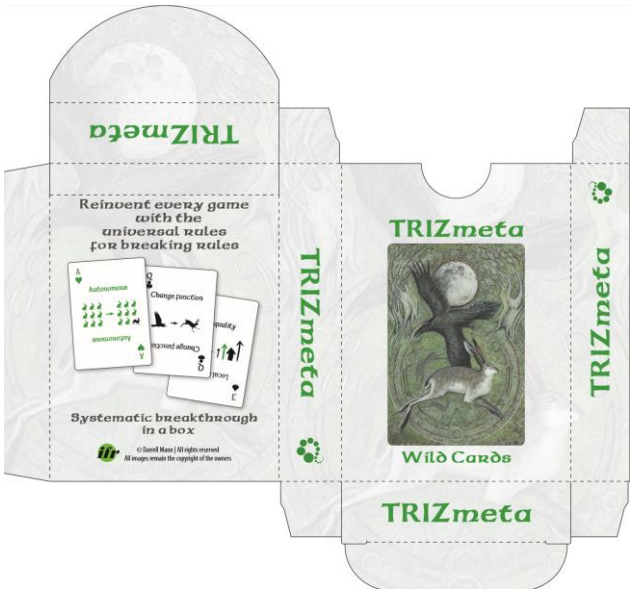
"Forming-Storming-Norming-Performing"
is a well-known evolution pattern in teams.
The sequence forms the first half of an s-curve.
Few teams think about the second half…



News

TRIZmeta

The final artwork for our new TRIZ game has now been approved and the card deck is with the printer for final production. The official launch date is the ETRIA Conference at the end of October. The cards, however, should be available to purchase from the SI shop from the end of next month. Here's the artwork for the box, by way of subtly leading people into temptation…



…with a following wind, we might even get the TRIZmeta website live next month. trizmeta.com will be the place to visit.

DTU
…the first official recipients of the cards will be the EMBA programme participants during our workshop at the Danish Technical University in Copenhagen on the 19th and 20th of October.

Congratulations
(of the belated variety) Lynn Lamers at TIES in Minneapolis successfully completed her Level 3 Certification a few months ago. Darrell lost the photo, but now we have it back again. Congratulations to Lynn for all the hard work in her inspiring trio of projects.

Sustainable Innovation '19
Darrell will be presenting a paper, 'Never Make Predictions, Especially About The Future: What TRIZ Tells Us About Sustainability In 2030' at the annual 22nd International Sustainable Innovation conference. Next year's event will be held on the 4th and 5th of March at the University for the Creative Arts Business School in Epsom.

Oman
It looks like a second cohort of 100 graduates will be taught our bespoke Systematic Innovation curriculum, working through our good friends at the country's Industrial Innovation Centre. The likely start date is the first week of November. More details at the IIC website.

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

- Housing – TrenDNA/PanSensic Study
- Finance – Team Psychometrics Study
- Homeware – Design/Make Project
- Homeware – SI Certification Workshops
- Retail – TRIZ Workshops
- Transport - Innovation Strategy Project
- Food – Innovation Strategy Project
- Healthcare – ICMM Assessment