# Systematic Innovation

## e-zine

Issue 193, April 2018

In this month's issue:

Article – Case Study: Effectuation

Article – Paradoxical Thinking & Breakthrough Oxymorons

Not So Funny – Quite (Principle 33) Literally

Patent of the Month – Microfluidic Desalination

Best of The Month – The Innovation Illusion

Wow In Music – Strawberry Fields Forever

Investments – Piezoelectric Textiles

Generational Cycles – Anthems

Biology – Sleeping Chironomid

Short Thort

News

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Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.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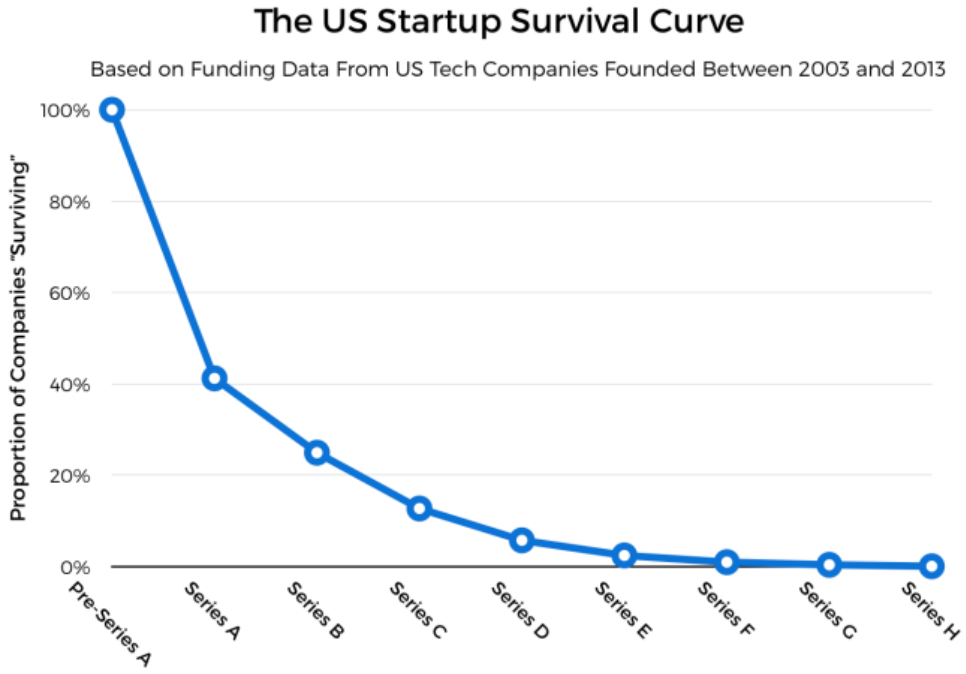
# Case Study: Effectuation




According to the business theory of good and bad capital, good money is money from investors who are willing to wait for growth in the size of the enterprise, but who are hungry for profit in the short-term. 'Hungry for profit' is indeed one of the key tenets of Clayton Christensen's Innovators Dilemma when looked at from the disrupting start-up's perspective. As with most things in life, this kind of objective comes attached with contradictions. The usual contradiction for the start-up being that there's rarely or barely enough available money to get the design of the customer offering 'right'.

When we examine this problem using the new Business Matrix, it is usually mapped as a conflict between the desire for Customer Revenue being prevented by Design Capability/Specification/Means. When we look this up in the Matrix, we obtain the following top-four Inventive Principles used by others to break out of the chicken-and-egg conflict:

7 – Nested Doll
13 – The Other Way Around
17 – Another Dimension
35 – Parameter Change

A frequent complaint from novice Matrix users is that, when a conflict is posed at this kind of highly abstracted 'I want profit, but I don't have the capability or means to design what I think the customer wants' challenge, the Inventive Principle solution suggestions. The new Business Matrix 3.0 book tries to help alleviate the problem by having a revised and expanded list of examples. Sometimes, however, a one-line description of a solution strategy is not sufficient to provide the necessary provocation to the problem solver. 'Effectuation', we're finding, is one such. Effectuation is a very elegant – and yet non-obvious – example of a Principle 13 way of solving the Revenue-versus-Capability conflict.

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The concept was first written about in depth by author, Saras Sarasvathy (Reference 1), following an investigation of how the most successful entrepreneurs were observed to behave differently to the average. The effectuation strategy is most simply described using the analogy of a chef cooking a meal. One way for the cook to serve the needs of the diner is to use a 'causation' cooking strategy. In this strategy, the diner chooses from a menu and the chef prepares this menu by looking for the right ingredients and following the recipes to make the dishes. In the effectual process, on the other hand, the approach would be rather different. 180 degrees different in fact. In that the client would not ask for a specific menu, but he asks the chef to make something with the ingredients available. The chef chooses one of the many different meals they are able to make with the available ingredients.

The most important difference between causal reasoning and effectuation is therefore that an entrepreneur using causation has a given goal and searches for means to reach his goal. If the entrepreneur uses effectuation instead, they will start with the means they have and from this point then look at possible goals.

There are five core (Principle 13) principles that define Effectual Logic. These are:

The Bird in Hand Principle. Entrepreneurs start with what they have. They will look at who they are, what they know and who they know. Their education, tastes and experience are examples of factors which are important in this stage. Besides these examples, this is also the stage where entrepreneurs look at their 3Fs, better known as friends, family and fools. From this point, they will look at their abilities. So an entrepreneur does not start with a given goal, but with the tools he or she has.

The Affordable Loss Principle. An entrepreneur does not focus on possible profits, but on the possible losses and how they can minimize those losses.

The Crazy Quilt Principle. Entrepreneurs cooperate with parties they can trust. These parties can limit the affordable loss by giving pre-commitment.

The Lemonade Principle. Entrepreneurs will look at how to leverage contingencies. Surprises are not necessarily seen as something bad, but as opportunities to find new markets.

The Pilot-in-the-plane. In this stage, all the previous principles are put together. The future cannot be predicted, but entrepreneurs can control some of the factors which determine the future.

There are inevitable dangers, of course, when we attempt to apply other peoples' solution to our own complex situation. That's the main reason for having the Contradiction Matrix tools provide output at the (first) principle level. In this way users are encouraged to think through the Principles as they might relate to their own specific and unique context. That said, we think that 'effectuation' – and the fact that it is a polar opposite to the usual 'causal' thinking – is in itself a first-principle way of looking at the world. Operational Excellence and 'continuous improvement' is in theory all about understanding existing causal relationships. When the intention is to innovate, however, its incumbent upon the team to design their way forward from where they currently are. All in all, the causal/effectual opposites sit right at the heart of the fundamental differences between the everyday OpEx world and the rather less certain Innovation World.

**Reference**

1) Sarasvathy, Saras D. 'Effectuation: Elements of Entrepreneurial Expertise', Northampton, MA: Edward Elgar Publishing, 2009.

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# Paradoxical Thinking & Breakthrough Oxymorons

Here's my new favourite delegate exercise in team-building workshops. The inspiration comes from a twenty-year old book, Paradoxical Thinking, that I found in a junk shop last year (Reference 1). Ultimately it's yet another book in the category 'would-have-been-a-lot-better-if-the-authors-knew-TRIZ', but nevertheless it contains some very nice ideas about personal conflicts and contradictions. The idea behind this article is to add one or two of the missing pieces TRIZ might have added to the story.

The exercise I've been conducting is best done as an individual one, although I have watched a couple of teams have a go at doing it for their team and it still delivered some useful insight. For speed, though, doing it yourself is faster. When I did it on myself, it took about 15 minutes.

Here are the basic steps of the process:

1) Write down a list of your 10 best characteristics
2) Write down a list of your 10 least attractive characteristics
3) Construct a Perception Map showing how each of your characteristics lead to the others
4) Looking at the loops and collectors in the map, identify your most important characteristics, and then examining pairs of these characteristics, identify the duo that seem the most contradictory, and form the pair into an oxymoron statement
5) Take the oxymoron characteristics and map the spectrum of positive and negative interpretations of each of the words
6) Use these words to build a 2x2 matrix that maps the best and worst of you and highlights how you might best solve your contradiction

As with most things, an example is the best way to see how the process works in practice. At the risk of giving away too much about myself, I've made the following example about me. If nothing else – potentially killing two birds with one stone – this will also tell readers how to get the best (and worst) out of me if they happen to read or respond to any of my future articles!

### 1) 10 Best Characteristics

The idea here is to get a top-of-mind list of things you like most about yourself. You could also get other people to make the list for you if you're unhappy thinking about what you might be good at. You could even get other people to do the exercise for you. Or compare what they come up with to how your own analysis emerges. Anyway, here are the ten things I listed about myself:

A Pattern-Finder
B Creative
C First-Principles Diver
D Persistent
E Big-Picture/Meta Analysis
F Fair/Desire-For-Justice
G Connector
H Needle-Finder
I Navigator
J Educator

### 2) 10 Worst Characteristics

I found making this list easier – indeed, I found I needed twelve items rather than ten because I struggled to eliminate any of the two extras. Again, you might find it easier to get other people to help you make your list. Here's mine:

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K Hair-Trigger/Red-Mist
L Procrastinator
M Impatient
N Selfish
O Over-Stretching
P Can't Say No
Q Taker OF The Easy Option
R Greedy
S Anti-Authority
T Cut-Nose-To-Spite-Face
U Controlling
V Lazy

### 3) Perception Map

A simple 'leads to' analysis for each of the twenty (twenty-two in my case) characteristics. I initially thought that the process would give me two loops – one connecting all of the positive characteristics and one connecting all of the negative – but what I actually got was a much more interesting single-loop picture in which there are multiple instances of positive characteristics leading to negative ones and vice versa. Here's what my final map ended up looking like:

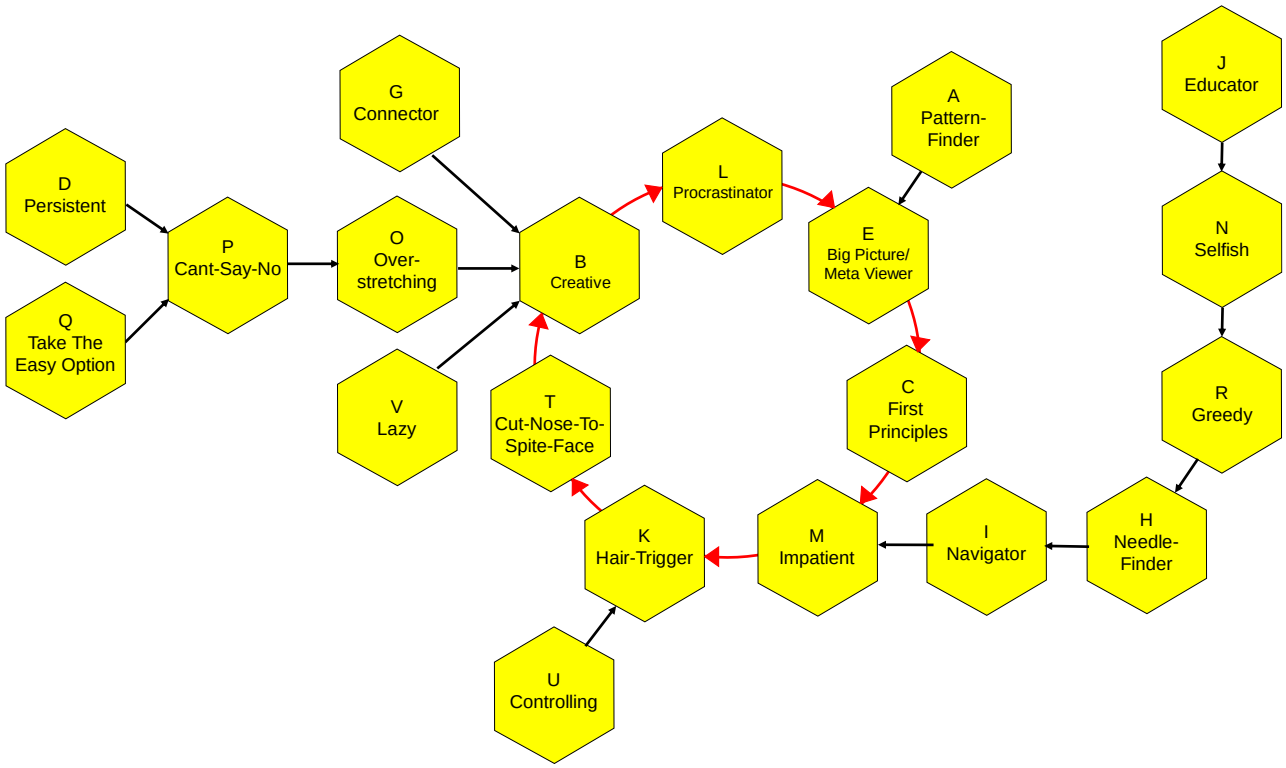


**Figure 1: Perception Map Of Personal Characteristics**

### 4) Personal Oxymoron

My Figure 1 Perception Map was quite unusual in that there were seven characteristics in the loop. Characteristic 'B', Creative was the most important one on the map, being both in the loop and also a strong collector. When I tried to formulate a conflict combining 'creative' with another characteristic in the loop, nothing really stood out to me. What did stand out, however, when I looked at the other six characteristics in the loop was that 'Impatient' and 'Procrastinator' felt like definite opposites and so I made ***'Impatient Procrastinator'*** into my personal oxymoron. These both happen to be characteristics from the negative side of my personality – when I've seen others do their version of the process on themselves it is more common for the conflict pair to be formed from one positive and one negative characteristic. There's no right or wrong answer here, firstly because it's your analysis of you, and, related to this, only you will know when you've found an oxymoron that's evocative and meaningful to you. Of course, it's always nice too to come up with an

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oxymoron statement that is intriguing to others. That's why finding oxymorons is central to the Paradoxical Thinking approach.

### 5) Oxymoron Spectrum

The key to this stage is the recognition that the words we use to describe ourselves tend to be thought of as wholly negative or wholly positive. Call someone a 'procrastinator' and its never a compliment. But – perhaps the key point of Paradoxical Thinking – being a procrastinator can also have its positive side. The aim of this part of the process, therefore, is to map out both the positive and negative sides of the words in the personal oxymoron from the previous stage. The following table shows how I made these positive and negative interpretations for my 'impatient procrastinator' oxymoron.

| | Impatient | Procrastinator |
|---|---|---|
| Positive Aspects | Unstoppable<br>Relentless<br>Progressive<br>Action-Oriented<br>Proactive<br>Dynamic<br>Desire For Progress<br>Fast-Paced/Turbo Racing | Complex Thinker<br>Sage<br>Understander Of Complexity<br>Detective/Sherlock Holmes<br>Critical Mass (of input)<br>Big Picture |
| Negative Aspects | Wheel-Spinning<br>Whirlwind/Tornado<br>Irritable<br>Rushing<br>Bull-In-A-China-Shop<br>Ill-Thought<br>Incoherent<br>Incomplete | Bumbling<br>Indecisive<br>Ditherer<br>Going-Around-In-Circles<br>Stuck<br>Confused<br>Overwhelmed |

**Table 1: Positive & Negative Ends Of 'Impatient Procrastinator' Spectrum**

### 6) Personal 2x2 Matrix

Finally, we get to have some fun constructing a 2x2 Matrix. Like all the best matrices, the two axes should represent dimensions where there is some kind of conflict – i.e. our oxymoron in this case – and have the top-right-hand quadrant represent the best-of-both-worlds situation where we 'solve the contradiction'. The fun part (for me at least) is deriving some evocative labels for each of the four quadrants. The matrix shown in Figure 2 is what I ended up with when selecting words (and in some cases evolving them) from Table 1.

The labels I derived for each quadrant then say, at my worst, I am an 'irritable ditherer'. This is the me that specifically doesn't solve my 'impatient procrastinator' conflict. Conversely, the best of me – the times when I am able to solve the conflict – I'm an 'unstoppable detective'. I think I like this option better. Especially in light of the book 'The Art Of Procrastination' we reviewed a few years ago (Reference 2). Whether I'm able to achieve it all the time I'm not sure, but what this top-right quadrant label gives me is a target I need to be aiming for in order to solve my impatient procrastinator problem.

If I only get one of the two characteristics 'right' I'm either a 'bumbling dynamo' or an 'incoherent sage', two more oxymorons that I can use as a warning sign that I'm not being the best version of myself that I can be.

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And that's ultimately the point. No-one is perfect all the time, but at least if we know what our big conflicts are, and where we sit at any moment in our 2x2 matrix, we can at least begin to recognize what we need to do next.

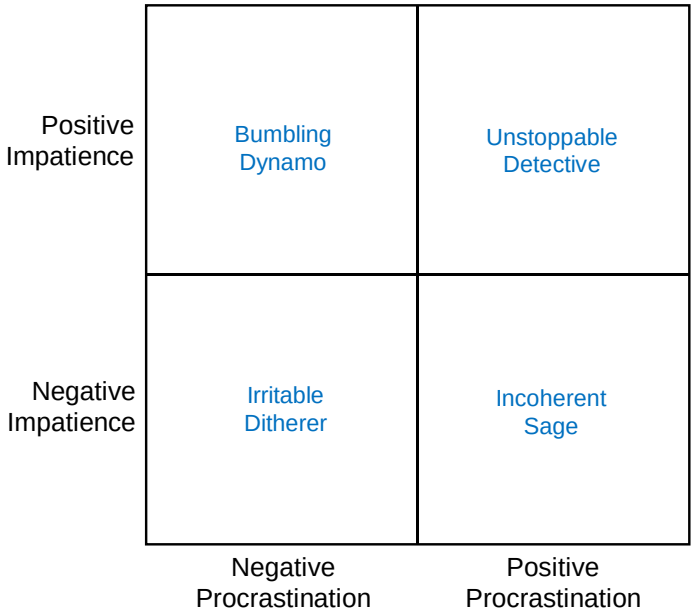


**Figure 2: 2x2 Matrix Of 'Impatient Procrastinator' Characteristics**

If any readers out there find themselves with a spare quarter of an hour in the next month, I heartily recommend you try making your own analysis. You might just find out something about yourself that you didn't know. If any of you are feeling particularly brave, we'd love to see your 2x2 matrices. Who knows, maybe, with your permission, we might even publish a few of them (anonymized or not according to your wishes) in a follow-up article?

## References

1) Fletcher, J., Olwyler, K., 'Paradoxical Thinking: How To Profit From Your Contradictions', Berrett-Koehloer Publishers Inc., 1997.
2) Systematic Innovation E-Zine, 'Book Review: The Art Of Procrastination', Issue 133, April 2013.

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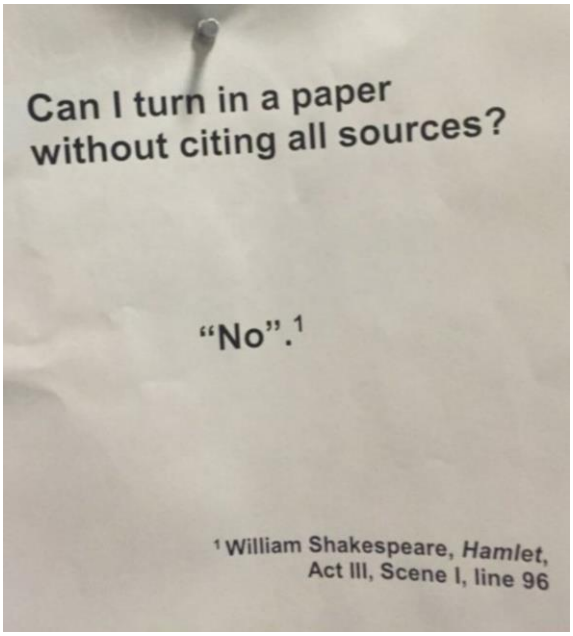
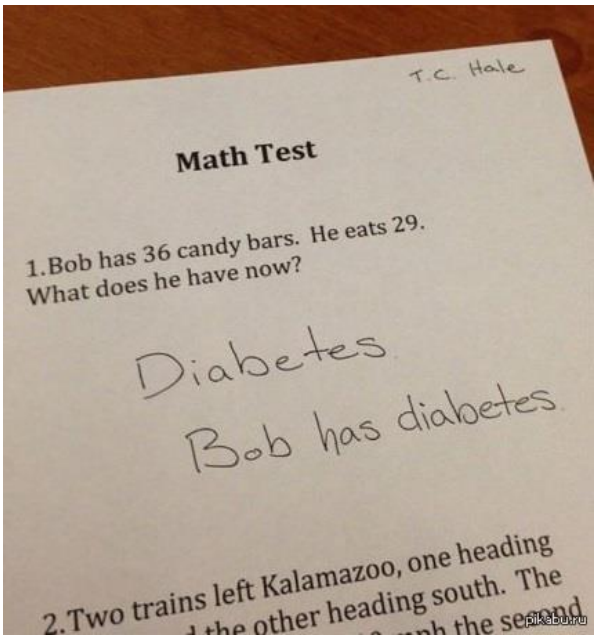
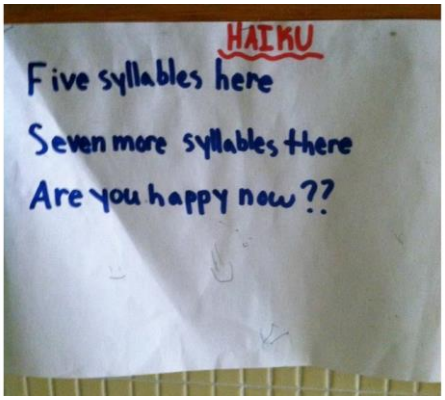
**Not So Funny – Quite (Principle 33) Literally**

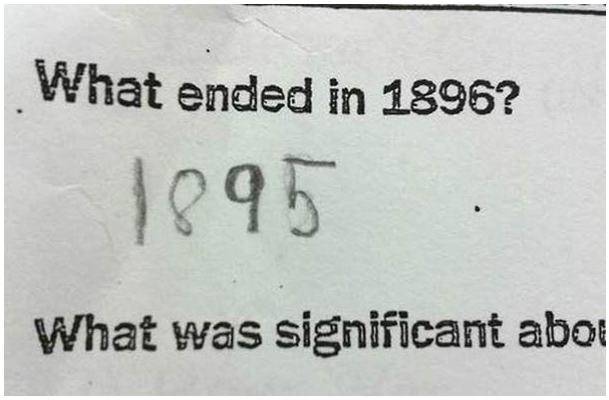
No-one likes a smart-arse. The battle is rarely more intense than the one between teachers and their students…




…more often than not, the pupils tend to be the more persistent…




…some of whom get to grow up to be bakers…

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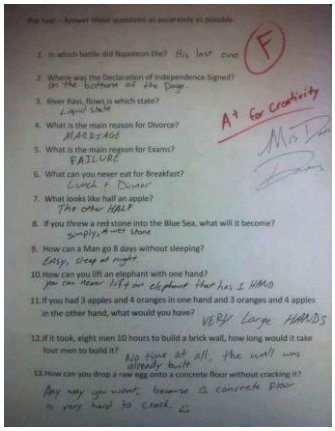
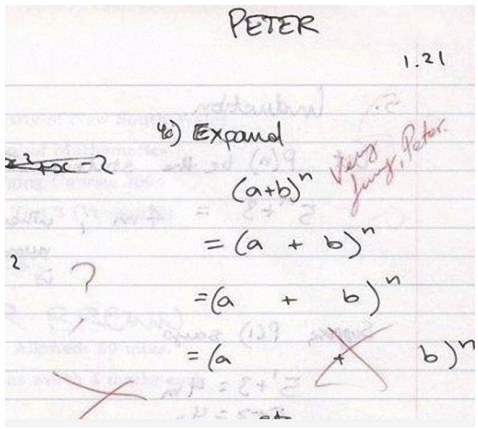
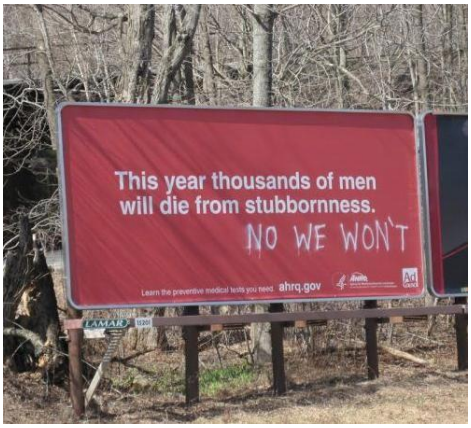
…some will be safety operatives…

…and some will just never grow up…






Finally, just in case anyone is thinking of writing in with any comments…

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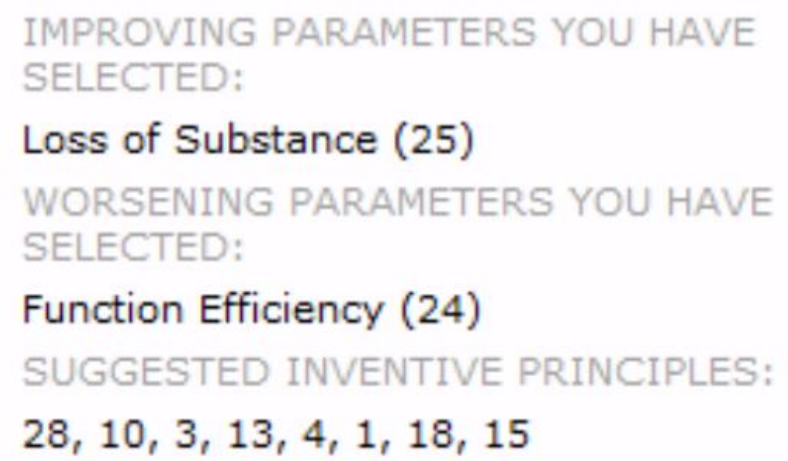
**Patent of the Month - Microfluidic Desalination**

Patent of the month this month takes us to a trio of inventors at the University of Texas. US9,932,251 was granted on April 3. The wonderfully succinct background description describes the motivation for the invention as follows:

*The global demand for freshwater is growing rapidly. Many conventional sources of freshwater, including lakes, rivers, and aquifers, are rapidly becoming depleted. As a consequence, freshwater is becoming a limited resource in many regions. In fact, the United Nations estimates two-thirds of the world's population could be living in water stressed regions by 2025.*

*Currently, approximately 97% of the world's water supply is present as seawater. Desalination--the process by which salinated water (e.g., seawater) is converted to fresh water--offers the potential to provide dependable supplies of freshwater suitable for human consumption or irrigation. Unfortunately, existing desalination processes, including distillation and reverse osmosis, require both large amounts of energy and specialized, expensive infrastructure. As a consequence, desalination is currently expensive compared to most conventional sources of water, and often prohibitively expensive in developing regions of the world. Therefore, only a small fraction of total human water use is currently satisfied by desalination. More energy efficient methods for water desalination offer the potential to address the increasing demands for freshwater, particularly in water stressed regions.*

The contradiction here is best seen through the lens of the conventional 'mechanical' (i.e. physical barrier) means of achieving the salt-separation function. Here's what that contradiction looks like when mapped on to the Contradiction Matrix:




And here's the solution found in the new patent in Claim 1…

*A microfluidic device comprising (a) a desalination unit comprising an inlet channel fluidly connected to a dilute outlet channel and a concentrated outlet channel, wherein the dilute outlet channel and the concentrated outlet channel diverge from the inlet channel at an intersection; and (b) an electrode in electrochemical contact with the desalination unit in proximity to the intersection; wherein the electrode is configured to generate an electric field gradient in proximity to the intersection.*

It's another good example of the significance of Principle 28, Mechanics Substitution and the replacement of a mechanical solution (i.e. the membrane) with a 'field'. Using an 'electrical field gradient' is, of course, not the only field-based attempt at the desalination

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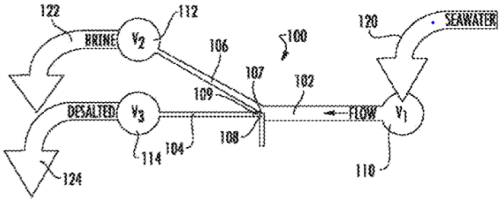
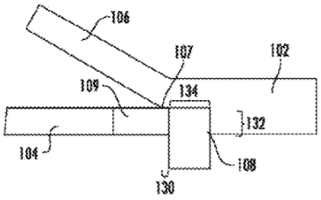
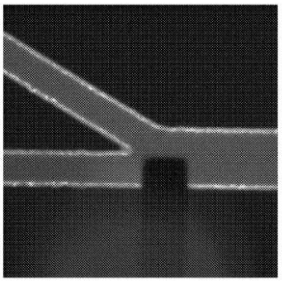
problem (see ‘capacitive desalination’), but what I think makes this one stand out is the (Principle 3, Local Quality) shift to solving the problem at the micro-scale:



Making ‘fields’ work over large distances is not so easy; making them work to achieve a function over a few microns makes all the difference. Then the only need is to economically configure lots of these micro-features. Which is where the micro-fluidics part of the story comes in.

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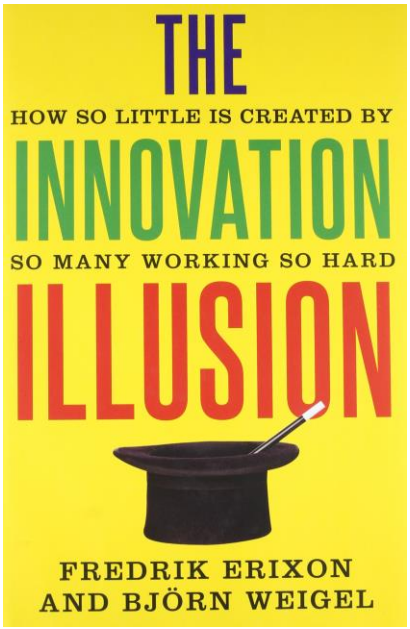
**Best of the Month – The Innovation Illusion**




Here's one of those best-of choices that comes with a health-warning: This book might cause prospective innovators to believe that all of their innovation efforts are futile. This is a depressing book. Mainly because, rather than our SI research focusing on millions of individual innovation attempts, the authors of The Innovation Illusion focus on the meta picture. And what a depressing picture that is. Capitalism is supposed to encourage innovation, but now, because of the emergence of hundreds of intermediary rent-seekers, effectively becomes a locked-in system increasingly incapable of allowing disruptive or breakthrough innovation to occur. Depressing as it might be, our view is that every prospective innovator needs to know what Erixon and Weigel (respectively, a Swedish economist and an entrepreneur) have to say. The book provides no semblance of answers, but yet, we still believe inside every piece of bad news is some important information regarding how we might – might! – beat the system.

Conventional wisdom holds that Western economies are on the threshold of fast-and-furious technological development. Fredrik Erixon and Bjorn Weigel refute this idea, bringing together a vast array of data and case studies to tell a very different story.

With expertise spanning academia and the business world, Erixon and Weigel illustrate how innovation is being hampered by existing government regulations and corporate practices. Capitalism, they argue, has lost its mojo. Assessing the experiences of global companies, including Nokia, Uber, IBM, and Apple, the authors explore four key themes: declining economic dynamism in Western economies; growing corporate reluctance to contest markets and innovate; increasing specialisation, and excessive regulation limiting the diffusion of innovation. At a time of low growth, high unemployment, and increasing income inequality, innovation-led growth is more necessary than ever. This book unequivocally details the obstacles hindering our future prosperity.

In theory, meanwhile, the developed world stands on the brink of technological revolution. Evangelists of the New Machine Age predict that within just a few years robots will be doing the most dirty, dangerous and dull jobs, freeing workers for more rewarding tasks. Clever machines will fuel a new burst of global productivity that will restore fragile

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economies still bruised by the Great Recession. Except that the revolution predicted by these technology prophets is not happening on the scale or at the speed they would have us believe. According to The Innovation Illusion, the world is not about to grow fat on a feast of innovation. Instead it should be steeling itself for a famine. The blame, they argue, lies in a system of capitalism which, far from fostering Joseph Schumpeter's creative destruction, has become a counter-revolutionary force: middle-aged, fearful of risk and cut off from the entrepreneurial spirit that once drove truly disruptive change. Our ability to adopt and spread the use of innovative products and services has been paralysed by this hidebound system. Erixon and Weigel know how to make their case seductive and entertaining. They describe the four horsemen of capitalist decline riding down innovation before it has any chance of reaching the wider world. The first horseman is Gray Capital, anonymous corporate owners — such as institutions and sovereign wealth funds — who have replaced the original risk-taking entrepreneurs. The second follows naturally in Gray Capital's wake: institutional owners need predictability and security so they encourage Corporate Managerialism. Managers focus on meeting targets and reducing uncertainty, while the potentially great rewards of high-risk innovation are shunned. Globalisation is the less predictable beast, initially spurring competition but eventually leading to such high degrees of specialisation that it is difficult for disruptive innovators to establish a presence; and finally Regulation, which has become so complex that the rules favour incumbents and deter challengers. The tale is liberally sprinkled with colourful examples — such as the Belgian politician who used regulations to force a charity to cancel a distribution of free food to the needy at Christmas because it planned to use drivers from Uber, the taxi hailing app. The narrative is also nourished with statistics. The book cites Robert Gordon, author of The Rise and Fall of American Growth, who found that apart from a brief period between 1996 and 2004, when productivity soared, levels have for roughly the past 40 years trended significantly below those achieved after the industrial revolution and the second world war — despite the spread of computerisation and the internet. Innovation is no longer driving productivity as it once did, Gordon suggests. Our impression has been of great technological progress, but Erixon and Weigel argue many innovations have been more "fun than fundamental". Mobile gaming has grown at a far faster rate than industrial robotics, for example. The book is eloquent at laying out the thesis. Capitalism has fallen victim to rentiers. Big business is increasingly innovation-allergic (71% of new Fortune 500 companies, the book tells us, were started by individuals that had failed to convince their big-business employers that they should disrupt themselves, and so left to do it themselves). The authors are on weaker ground when they tackle possible solutions. Mainly – of course – because they don't seem to understand the concept of contradictions or contradiction-solving. Their 'solution' thoughts, as a result are scant and some are fraught with difficulty. Dual classes of ownership, for example, have in the past been used to discriminate in the interests of a few rather than innovate for the gain of many. They are also open to challenge when playing down the technological revolution. There is barely a mention of big data, which could give new innovators, big and small, far greater power to meet consumers' needs and at far less cost. Understanding where the value lies in this brave new world will take time. There will also be significant social questions (contradictions – naturally!) to be resolved as old jobs go and new ones are created. The transition may not be fast or fun. But it will be fundamental.

Still depressing, but essential reading nevertheless.

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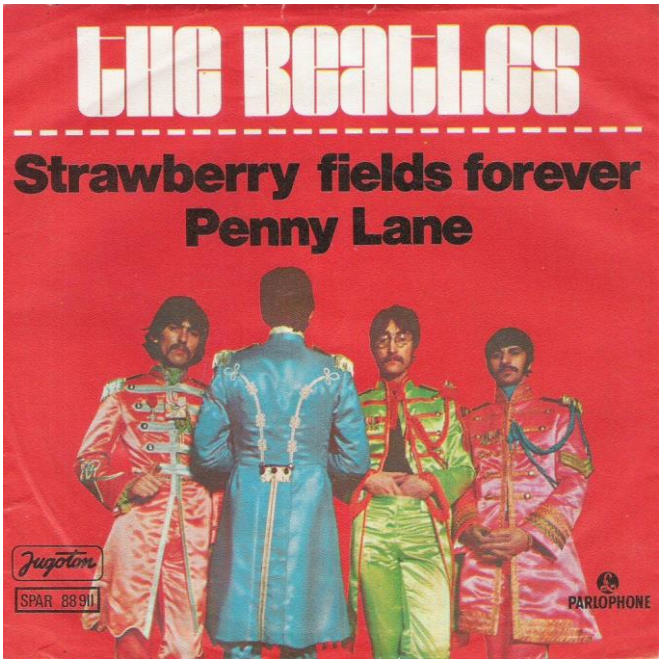
**Wow In Music – Strawberry Fields Forever**

One of the greatest singles of all time. An enduring classic that it is difficult to tire of listening to. Why is that?




Let's start the investigation somewhere else. Somewhere a long way from the Beatles… The Pearl Jam song 'I Got Id'. The lyrics to which describe a man trapped in his own mind, unable to discern reality from imagination. As suggested by the song's title, he lacks the ability to rationalize conflicting desires. Verse 1 opens by describing the physical manifestations of his anxiety, "My lips are shaking, my nails are bit off, been a month since I heard myself talk." He describes his confused mental state in metaphorical terms, e.g. "an empty shell seems so easy to crack . . . picture a cup in the middle of the sea." His memories clearly haunt him - "I got memories, I got shit" - and these memories affect his dreams, "so I'll just lie alone and wait for the dream where I'm not ugly and you're looking at me." The central memory that seems to be the source of his torment involves the lover to whom the song is addressed. The chorus' description of this memory suggests that the singer feels regret about an unspecified decision: "I walked the line when you held me in that night." By the end of the song we learn that the memory itself may be pure fantasy as the singer replaces words in the chorus to sing, "I walked the lie . . . never held you in real life." This (Principle 17, Another Dimension) final twist of the lyrics adds another layer of uncertainty and invites the audience to similarly question the line between reality and imagination. Sigmund Freud (1917–1919) describes our psychological reaction to such reality-bending moments as "Unheimliche," or uncanny.

Beyond the lyrical contradiction twist, the main reason for including the song in this article about Strawberry Fields Forever is that the song's primary musical progression participates in its own kind of uncanny process. As shown in Figure 1, the opening D-major chords alternate with B-major chords with stationary Ds in the top and bottom voices.

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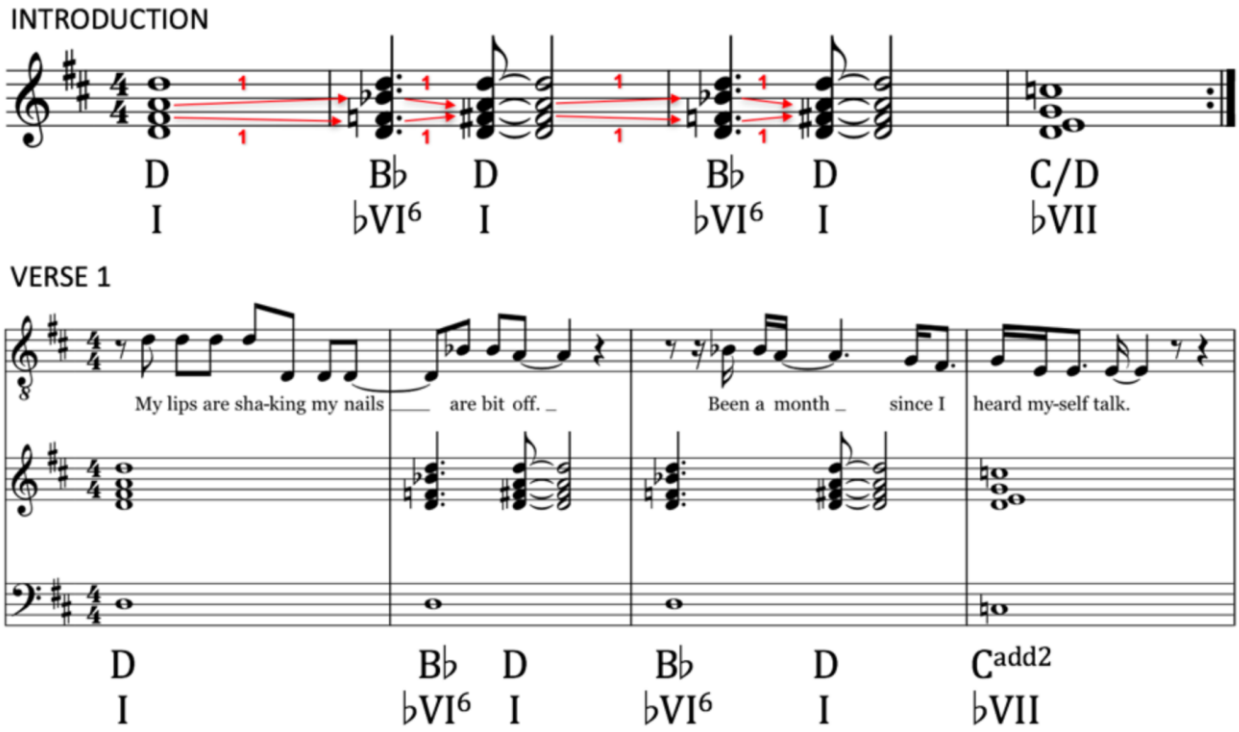
**Figure 1: Pearl Jam, 'I Got Id'**

The voice leading between the tonic and its chromatic submediant features a peculiar kind of parsimony, namely, two voices moving by half step in opposite directions (Principle 37, Relative Change). In tonal music, this type of motion is typically reserved for progressions between dissonant and consonant intervals. However, the contrary motion of half steps in the Pearl Jam example occurs between two consonant triads, inviting the listener to question the line that divides consonance and dissonance into two mutually exclusive categories, which, contradiction-wise forces a more intriguing (Principle 1, Segmentation) resolution in the listeners mind.

Principle 37, Chromatic, major-third root movements comprise a special class of triadic progression. The contrary motion of half steps, described as 'PL voice leading', produces a perceptual paradox that simultaneously destroys any sense of background diatonic collection and forces irreconcilable interpretations of consonance and dissonance. Several composers since the 19th Century have used the effect, but arguably, it was when John Lennon used it in Strawberry Fields Forever, that the modern songwriter got the message and started using the 'wow' evoking trick more often.

"Strawberry Fields Forever" features the chromatic major-third root movement between the subdominant chord and a chord that has no clear function in the governing tonality. One of the most effective text-painting moments in the song occurs in the chorus at the line "Nothing is real" (where the lyric sets up a parallel contradiction). The accompanying G7 chord supports the notion of non-reality by drawing the tonic pitch, B, into what we might call an "identity crisis". The G7 might be heard as an altered submediant (VI7) or as a V7/ii that resolves deceptively to IV. As Figure 2 demonstrates, the oscillation with the subdominant chord, E major, plays out the Principle 37 effect. In the context of this song, the E chord clearly serves a functional role. The song's introduction sets up IV–I as the normative cadential pattern just before the music in the figure. Similar to the introduction of Pearl Jam's "I Got Id" explored earlier, the alternation with the functional E chord further marks the G7 as an "unreal" harmony. Therefore, just as the lyrics in Lennon's song elaborate on the concept of non-reality, so does the chord progression. (Perhaps the truly

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uncanny contradiction set-up moment is when we realize John Lennon is asking us to accept non-reality as (Principle 39?) “nothing to get hung about.”)

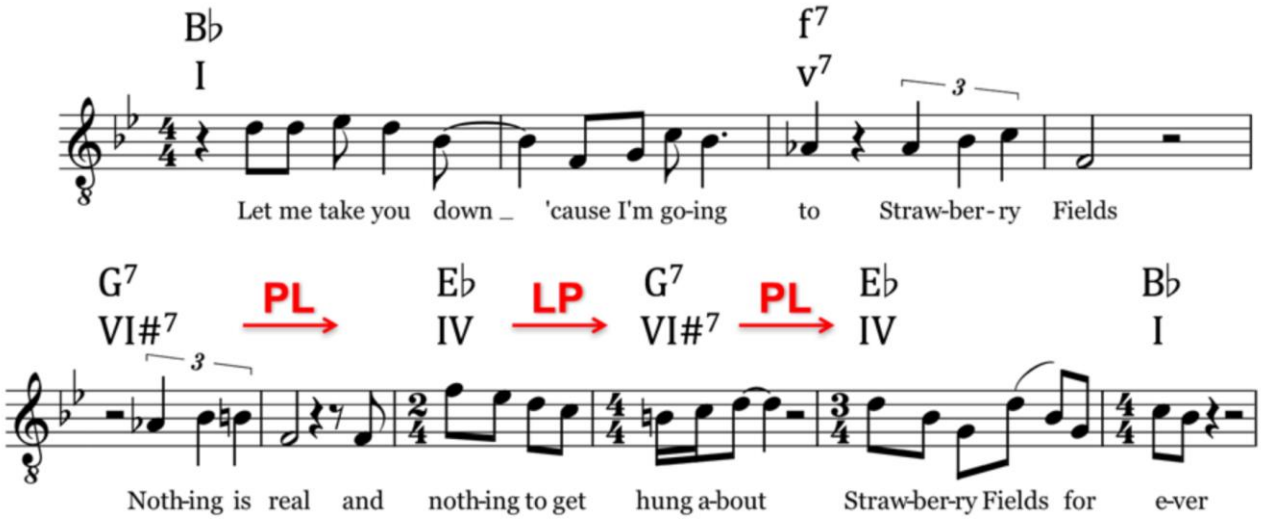


**Figure 2: Beatles, ‘Strawberry Fields Forever’**

You can read the whole Principle 37 perceptual paradox story in a truly fascinating dissection of a host of other examples at:
http://mtosmt.org/issues/mto.17.23.4/mto.17.23.4.forrest.html

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**Investments – Piezoelectric Textiles**

Working up a sweat from carrying a heavy load? That is when the textile works at its best. Researchers at Chalmers University of Technology have developed a fabric that converts kinetic energy into electric power, in cooperation with the Swedish School of Textiles in Borås and the research institute Swerea IVF. The greater the load applied to the textile and the wetter it becomes the more electricity it generates. The results are now published in the Nature Partner journal Flexible Electronics.

Chalmers researchers Anja Lund and Christian Müller have developed a woven fabric that generates electricity when it is stretched or exposed to pressure. The fabric can currently generate enough power to light an LED, send wireless signals or drive small electric units such as a pocket calculator or a digital watch.

The technology is based on the piezoelectric effect, which results in the generation of electricity from deformation of a piezoelectric material, such as when it is stretched. In the study the researchers created a textile by weaving a piezoelectric yarn together with an electrically conducting yarn, which is required to transport the generated electric current. "The textile is flexible and soft and becomes even more efficient when moist or wet," Lund says. "To demonstrate the results from our research we use a piece of the textile in the shoulder strap of a bag. The heavier the weight packed in the bag and the more of the bag that consists of our fabric, the more electric power we obtain. When our bag is loaded with 3 kilos of books, we produce a continuous output of 4 microwatts. That's enough to intermittently light an LED. By making an entire bag from our textile, we could get enough energy to transmit wireless signals."

The piezoelectric yarn is made up of twenty-four fibres, each as thin as a strand of hair. When the fibres are sufficiently moist they become enclosed in liquid and the yarn becomes more efficient, since this improves the electrical contact between the fibres. The technology is based on previous studies by the researchers in which they developed the piezoelectric fibres, to which they have now added a further dimension.

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"The piezoelectric fibres consist of a piezoelectric shell around an electrically conducting core," Lund says. "The piezoelectric yarn in combination with a commercial conducting yarn constitute an electric circuit connected in series."

Previous work by the researchers on piezoelectric textiles has so far mainly focused on sensors and their ability to generate electric signals through pressure sensitivity. Using the energy to continuously drive electronic components is unique.

"Woven textiles from piezoelectric yarns makes the technology easily accessible and it could be useful in everyday life. It's also possible to add more materials to the weave or to use it as a layer in a multi-layer product. It requires some modification, but it's possible," Lund says.

The researchers consider that the technology is, in principle, ready for larger scale production. It is now mainly up to industrial product developers to find out how to make use of the technology. Despite the advanced technology underlying the material, the cost is relatively low and is comparable with the price of Gore-Tex. Through their collaboration with the Swedish School of Textiles in Borås the researchers have been able to demonstrate that the yarn can be woven in industrial looms and is sufficiently wear-resistant to cope with the harsh conditions of mass production.

Check out the video: https://vimeo.com/256577138/422cb3db26

Reference:
Anja Lund, Karin Rundqvist, Erik Nilsson, Liyang Yu, Bengt Hagström, Christian Müller. Energy harvesting textiles for a rainy day: woven piezoelectrics based on melt-spun PVDF microfibres with a conducting core. npj Flexible Electronics, 2018; 2 (1) DOI: 10.1038/s41528-018-0022-4

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**Generational Cycles – Anthems**

When Roger Daltrey sang, ‘I hope I die before I get old’, he sounded what was to become the clarion cry of the rising Baby-Boom teenager. The Who’s song ‘My Generation’ quickly established itself as the anthem for the Boomers. That was 1965.

Spool forward to the early 1990s, and we get a new generational anthem. Or possibly three. GenXers perhaps love(d) music more than their Boomer forebears. The first rallying call was Nirvana’s ‘Smells Like Teen Spirit’. Here the defining Xer script had nothing to do with being a Boomer Peter Pan, but rather saw the world as a tad more difficult:

*Here we are now, entertain us*
*I feel stupid and contagious*
*Here we are now, entertain us*
*A mulatto, an albino, a mosquito, my libido*
*A denial, a denial, a denial, a denial, a denial*

If you had to pick one GenX anthem, this would probably be it. Being a contrary bunch, however, there would be many Nomads who would say there were two more representative anthems. Radiohead’s debut single, ‘Creep’ in 1992, which contained the immortal…

*But I'm a creep, I'm a weirdo.*
*What the hell am I doing here?*
*I don't belong here.*

Or, wait another year, and we get Beck and ‘Loser’…

*Soy un perdedor*
*I'm a loser baby so why don't you kill me?*

So, why these songs in particular? Why not a song by Elvis Presley? Or Bob Dylan? Or The Sex Pistols? Or Patti Smith? Or (I’m joking) Coldplay? The answer is because popular music follows a half-generation cycle. This happens because musicians tend to be slightly older than their target listeners. In the first half of a cycle, you get members of one generation singing to youngsters from the next generation. Then, in the second half, you get members of the generation singing to younger members of their own generation. Its during this second half that we seem to get generation anthems. Only someone in the same generation truly understands what life is like for their peers.

Or maybe. If the theory is right, we should have had a Millennial anthem by now. Early Millennials had prospective anthems written by Nomads (Oasis, Wonderwall for example, or Blur and Song 2. Or Boys & Girls?), but they don’t count because the band members are all Nomads. An internet search for ‘Millennial anthem’ reveals little more than a depressing dearth of candidates. Rather, Millennials, when given the option to express their opinions, seem to opt for cheesy, upbeat songs from the Boomers. Hero generations aren’t typically characterized by their creativity of course, so maybe there’s the problem. If I had to pick something that fits the Millennial zeitgeist, I might be tempted to opt for Amy Winehouse’s ‘Rehab’. She was a tad too old, though, and probably fell on the Nomad side of the generational cusp. Arctic Monkeys’ classic, ‘I Bet You Look Good On The Dancefloor’ might do the job. If we were talking about albums as anthems, then maybe

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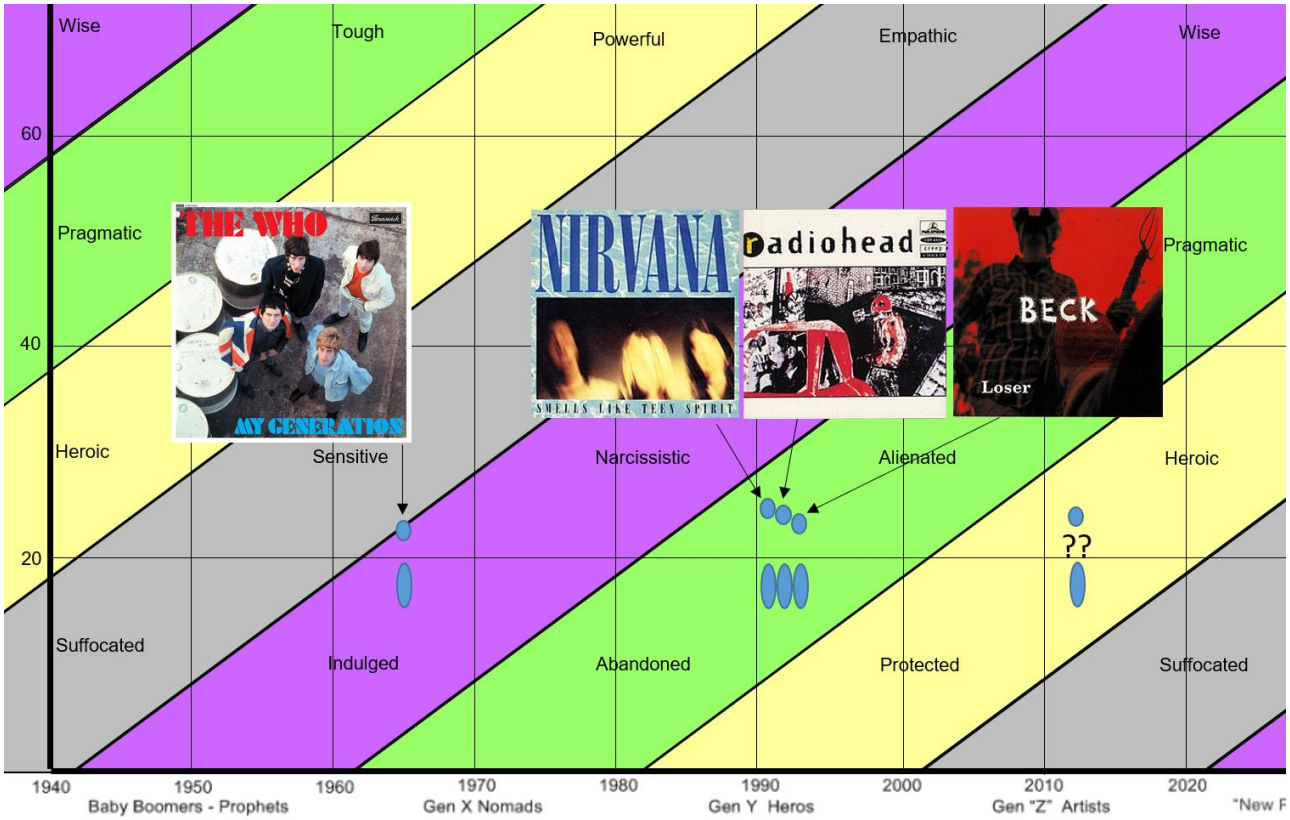
their debut is a candidate? Then, how about Taylor Swift ('the GenY answer to Bob Dylan, Bruce Springsteen and Kurt Cobain' according to several music journalists)? Or Adele? Do any of their songs carry the hallmark lyrics of an anthem?

How about Taylor Swift's, 'Shake It Off'?

*'Cause the players gonna play, play, play, play, play*
*And the haters gonna hate, hate, hate, hate, hate*
*Baby, I'm just gonna shake, shake, shake, shake, shake*
*I shake it off, I shake it off…*




Or maybe, just maybe, we're still waiting for Ed Sheeran to write it?
All we can be clear about, is the Millennials are running out of time. If they're not careful, they'll end up with (Baby-Boomers) Hall & Oates and 'You Make My Dreams Come True' as 'their' legacy – as re-popularized in the film 500 Days Of Summer. And every other Millennial-targetting advert on the TV at the moment. And on that note, I'd say I'm only half joking.

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**Biology – Sleeping Chironomid** (Polypedilum vanderplanki)

Polypedilum vanderplanki or the sleeping chironomid, is a dipteran in the family Chironomidae (non-biting midges). It occurs in the semi-arid regions of the African continent (e.g. northern Nigeria and Uganda). Its larvae are found in small tubular nests in the mud at the bottom of temporary pools that frequently dry out during the lifetime of P. vanderplanki larvae. Under these conditions, the larvae's body desiccates to as low as 3% water content by weight. In the dehydrated state the larvae become impervious to many extreme environmental conditions and can survive temperatures from 3 K to up to 375 K, very high (7000 gray) levels of gamma-rays, and exposure to vacuum. It is one of few metazoans that can withstand near complete desiccation (anhydrobiosis) in order to survive adverse environmental conditions. This species is considered the most cold-tolerant insect species, able to survive liquid helium (−270 °C) exposure for up to 5 min. with a 100% survival rate when desiccated to 8% water content.

The larva of the sleeping chironomid, has long been known for its post-desiccation recovery skills. However, the genetic mechanisms the insects use to achieve this feat, and, especially is the identity of the master gene that induces desiccation tolerance have remained largely elusive. Now, researchers from an international collaboration including Oleg Gusev of the RIKEN Innovation Center and collaborators from NARO, Kazan Federal University (Russia) and Skoltech University (Russia) have discovered that a gene called heat shock factor – which is present in some form in nearly all living organisms on earth – has been coopted by the species to survive desiccation.

Heat shock factor – which exists in a single form in invertebrates but multiple forms in vertebrates (e.g. Late Embryo Abundant (LEA), anti-oxidant) – is an essential part of the ability of living cells to survive stressful conditions such as heat, cold, radiation, and, it turns out, desiccation. In desert insects, the researchers found, the gene is able in certain conditions to upregulate itself, and this upregulation leads to a number of downstream processes, including the synthesis of heat shock proteins that are able to protect proteins in the cell from misfolding.

To perform the research, published in the Proceedings of the National Academy of Sciences, the researchers compared data on RNA expression in the sleeping chironomid with a closely related species, Polypedilum nubifer, which is not capable of surviving desiccation. They found that in the sleeping chironomid, hundreds of genes, including

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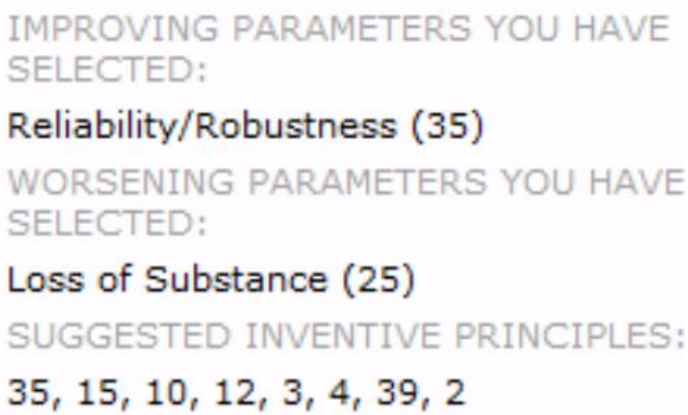
genes known to be involved in forming a "molecular shield" against damage due to dehydration, were already expressed during the early stages of desiccation. They discovered that a certain DNA motif, TCTAGAA, which is the binding site for HSF, was strongly enriched around the transcription start site of the genes activated by desiccation in the sleeping chironomid, but not the other species. Intriguingly, they found that in the desiccation-tolerant species, but not the other, genes responsible for the synthesis of trehalose – a sugar that can stabilize cells in a dry state – contained the TCTAGAA motif. To shed further light on the role of trehalose, they treated a cultured cell line from the sleeping chironomid with the sugar, and found that many of the genes activated by desiccation were also activated, and further, that the trehalose treatment led to the activation of the HSF gene. This effect of trehalose was prevented by knocking down the HSF gene, showing the HSF was clearly involved in the response.

According to Oleg Gusev, who led the group, "The discovery that heat shock factor is an important regulator of gene expression in response to desiccation was very interesting for us. It seems that these extremophilic insects in the process of evolution have coopted a very conservative transcription factor and its action for their own needs to survive without water by evolving a special gene structure and "adjusting" their genome sequence for these "needs." Our data suggests the following story: HSF is activated during dehydration, and then HSF actually self-activates by binding to the upstream region of its own gene. This leads to the activation of the downstream genes that allow the insects to survive desiccation. What was very surprising to us was the finding that trehalose itself can activate HSF."

Looking to the future, he continues, "One potential application of this finding will be in preserving cells outside the body in a dry state, if we can active the HSF gene. We now have a good understanding of how it works in this insect, so we will want to investigate if this is true for other organisms as well."

From a TRIZ perspective, the sleeping chironomid's desiccation-recovery trick can best be modelled as a conflict between the desire to preserve life and the loss of the substance water. Here's how we can map that problem onto the Contradiction Matrix:




Not sure what your opinion is, but by my reckoning the 'Heat Shock Factor' and chironomid story carries elements of all five of the most frequently used Inventive Principles used by others. Call it a 'full-house'. That's a first, I think.

Journal Reference:
Pavel V. Mazin, et al., 'Cooption of heat shock regulatory system for anhydrobiosis in the sleeping chironomidPolypedilum vanderplanki', Proceedings of the National Academy of Sciences, 2018; 115 (10): E2477 DOI: 10.1073/pnas.1719493115

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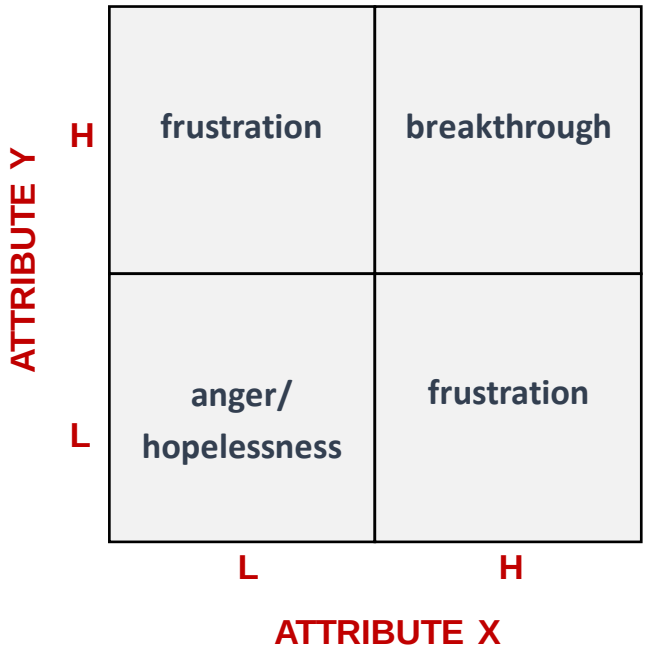
## Short Thort

Whenever we experience a pair of potentially conflicting attributes – creativity and patience, say, or resourcefulness and naivety, or X and Y – its always possible to construct a 2x2 matrix. When we solve the conflict and get the best of both attributes, we find ourselves in the 'breakthrough' quadrant. This is where we'd like to be.




The most common situation, if we can't solve the conflict is we get one-out-of-two – either X is good and Y is bad, or vice-versa. These are the 'frustration' quadrants. This is when our innovation opportunity is most visible. These are the zones that cause us to describe frustration as the mother of innovation.

The place we don't really want to be is the worst-of-both-worlds quadrant. This is the anger or hopelessness zone. Neither anger nor hopelessness are the mothers of innovation. They usually mean we've already conceded defeat, or, more likely, don't know how to get started. When we exhibit anger or hopelessness its usually a sign that our creative brain has shut down.

## News

**Minneapolis/St Paul**
We're happy to announce that Darrell will be teaching a three-day Level 1 Certification SI workshop in the Twin Cities on 1-3 May. Register at:
https://www.eventbrite.com/e/2018systematic-innovation-three-day-conference-level-1darrell-mann-tickets-42877941076

**Business Matrix 3.0**
Many thanks to the early purchasers of the newly available book! We had a very encouraging pile of orders received on the same day we received the first edition consignment from the printers, sufficient to make the new title our fastest-selling launch ever. Hopefully, the first readers will have received their copies by the time this ezine is

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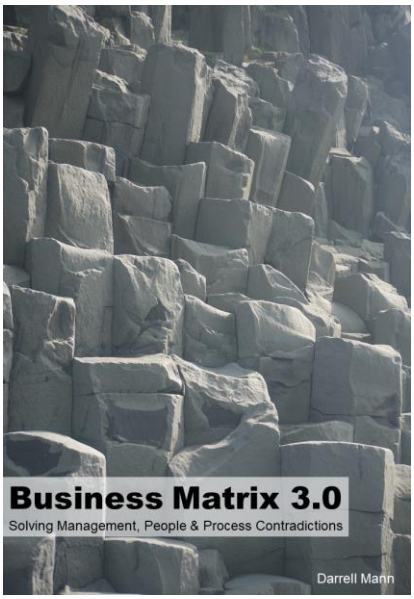
released. If anyone is interested in writing a review or sending feedback, we will be very happy to receive any and all contributions.




**Sweden**
Darrell will be working in Stockholm during the week of 2 July. Three of the five possible days have been allocated for client work, but this still leaves two possible additional days. If anyone in the vicinity (Scandinavia?) is interested in doing something on one of the other days, please get in touch with Darrell directly.

**ETRIA**
We are happy to say that our collaboration with the esteemed Professor Toru Nakagawa will be presented at this year's ETRIA TRIZ Future conference, to be convened in Strasbourg. The paper's title is "World TRIZ Sites Project for Building and Maintaining a Compendium of Global TRIZ Resources". Self-explanatory, hopefully.

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

- Transport – SI Certification Workshops
- Education – SI Certification Workshops
- Financial Services – TrenDNA Project
- Food – Strategic Study
- Healthcare – 'AntiFragile Systems' Project
- Consumer Electronics – SI Workshops
- Retail – Breakthrough Problem-Solving Workshop
- Chemical – Future Technology Mapping Project
- Utility – Design/Make Project

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