Systematic Innovation

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

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Readers' comments and inputs are always welcome.
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Robust Design: Macro & Meta Contradictions

I'm speaking at a Robust Design conference this month and I think my job is to shake things up a bit. It shouldn't be too difficult. The Robust Design world is still thinking it's a good idea to be talking about Robust Design. Robust sounds good until things go wrong. When they do, a robust system goes really wrong. Never mind. One day the community will work out that Resilient Design would be a better target. Or, better yet, the real target ought to be AntiFragile Design. Systems that get stronger the more they are stressed. Some industries are heading there. Most have a way to go. This is for them.

Like everything else in life, a desire to improve the robustness – or reliability, availability, etc – of a system is bound by the universal law of the S-Curve. This is the law that tells us we can improve the robustness of a system and at first our attempts bear a lot of fruit, then, as time progresses, it gets tougher to make the improvements we seek, then, later still, a law of diminishing returns kicks in until eventually no matter how much more effort we put in, no increases in robustness are achieved. Something like this:

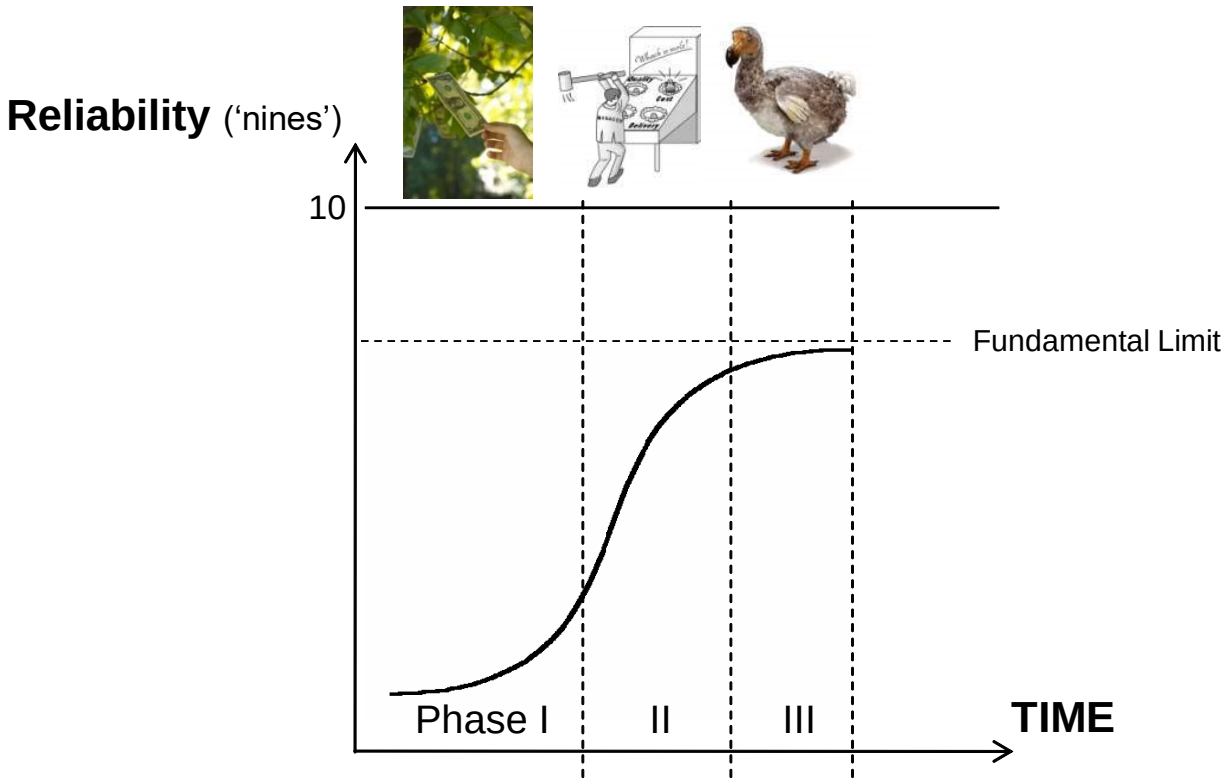

Figure 1: Three Phases Of Robust Design

In crude terms, also universal, we can observe three distinct phases of Robust Design. The first one is the low-hanging-fruit stage. This stage is found early in the evolution of the system we're designing when, because we've only just started to understand what the reliability of the system is when we place it in the real world (as opposed to the FEA calculations in the office). This is the phase where lots of things can and do go wrong with the system, but when we attempt to put them right, for the most part our efforts pay off.

Then comes Phase II. This is the Phase I think of as 'Robust With Consequences'. Attempts to improve the reliability of a system will deliver results, but at the expense of

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something else. We'll improve reliability, but the cost of the system goes up. Or we'll improve the reliability and make the operating efficiency worse. This is the contradiction stage of the S-Curve. It's one thing to trade-off reliability for other design parameters, but no customer is particularly going to thank us.

Because the whole world of Robust Design is still relatively immature, I think a lot of designers are still of the view that these trade-offs are an inevitable part of their design challenge. Traditionally – if we all look back through our college notes – they'd be right. In a world in which TRIZ and tools like the Contradiction Matrix exist, of course, we know that the smart designer will recognize the existence of the trade-off and tap in to the conflict-resolving strategies of those that had successfully challenged the design conventions. Something like this…

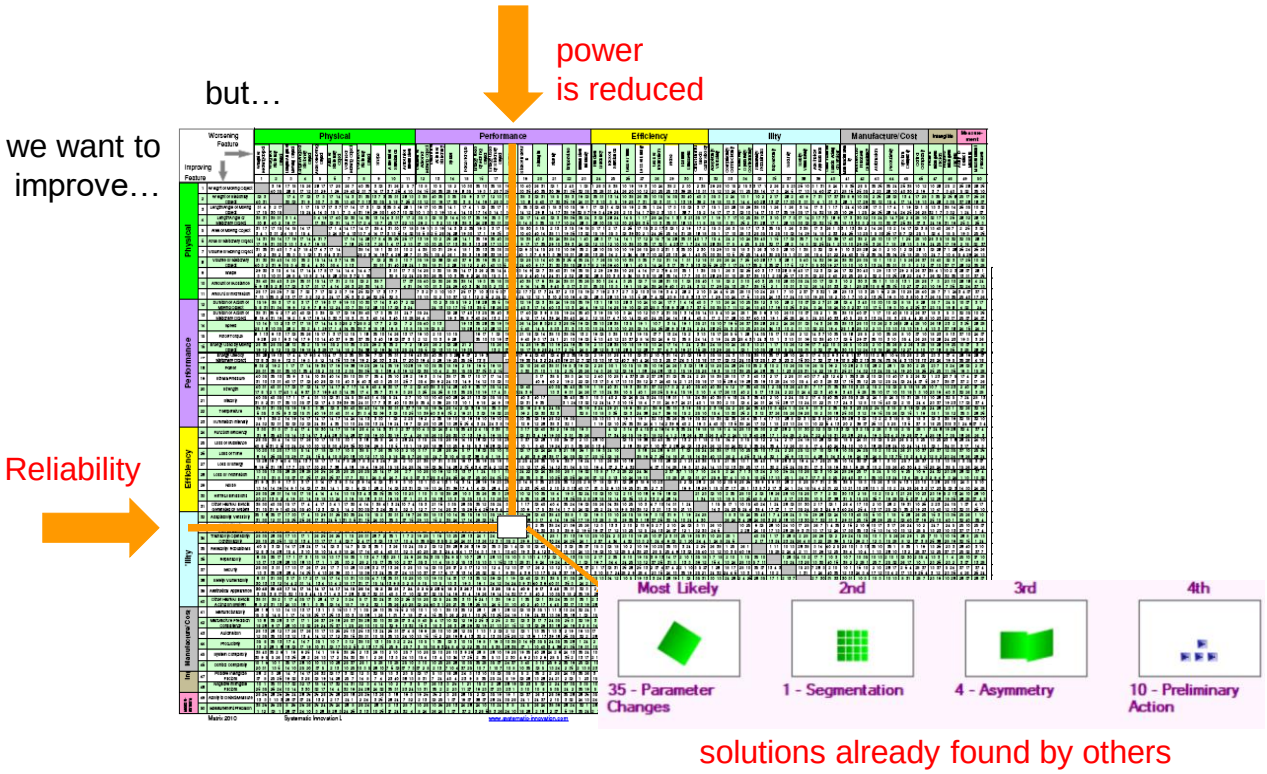

Figure 2: Phase Two Robust Design Contradiction-Solving

Some designers accidentally find their own solutions to these kinds of trade-off problem. The majority embark on a game of Robust Design Whack-A-Mole, occasionally getting rid of the mole for a while, but the game gets tougher and tougher until we enter the next Phase.

Phase III is what I call the Dodo Phase. It's the time when we think we're being really smart continuing to make best use of our resources to improve reliability, but in so doing we've unwittingly begun to make fatal compromises to the overall efficacy of the design. As with the Dodo, we've made really reliable leg muscles, but forgotten that wings might be useful if hungry sailors start shooting at us.

In an ideal world, we recognize we're about to enter Phase III before we actually reach its threshold. Sadly, few organisations seem to have in place the mechanisms that allow them to recognize the fundamental-ness of the approaching fundamental limits. It usually takes months of beating one's head against a wall before people get an inkling that something is amiss. Maybe that's the sign. The sign that tells us that solving the Phase II contradictions can only help so far.

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True enough, the Contradiction Matrix will offer certain clues that more fundamental jumps are required in order to fix the prevailing conflict. Principle 28, Mechanics Substitution is a pretty good clue that a mechanical system needs to stop being mechanical. Principle 36, Phase Transition, a more subtle but no less profound signal that a bigger discontinuity is in order.

Fortunately, as we plot out how Robust (or should that now be Resilient or AntiFragile?) system design mechanisms evolve through these bigger paradigm-shifting jumps we get to observe a very clear pattern.

We're talking now about meta-contradictions. Solving Phase II reliability-with-consequences contradictions will climb us up the current design paradigm s-curve (while enabling macro-scale s-curve jumps), but when we hit its limits, we need to change the way we think about the design processes we deploy if we're to jump to a new paradigm.

Typically, it seems, each one of these meta-design S-curves will offer designers one or sometimes two orders of magnitude increase in the levels of (compromise-free) reliability. Hence, if we think about reliability in terms of the number of 'nines' we're able to achieve (Table 3 offers a way of calibrating where we are and where we need to be), and we have a desire to achieve a certain number of 'nines' that will ultimately tell us how many design-method paradigm jumps we are likely to have to make.

Availability %	Downtime per year[2]
55.5555555% ("nine fives")	**162.33 days**
90% ("one nine")	36.53 days
95% ("one and a half nines")	18.26 days
97%	10.96 days
98%	7.31 days
99% ("two nines")	**3.65 days**
99.5% ("two and a half nines")	1.83 days
99.8%	17.53 hours
99.9% ("three nines")	**8.77 hours**
99.95% ("three and a half nines")	4.38 hours
99.99% ("four nines")	**52.60 minutes**
99.995% ("four and a half nines")	26.30 minutes
99.999% ("five nines")	**5.26 minutes**
99.9999% ("six nines")	**31.56 seconds**
99.99999% ("seven nines")	**3.16 seconds**
99.999999% ("eight nines")	**315.58 milliseconds**
99.9999999% ("nine nines")	**31.56 milliseconds**

Table 1: Mapping 'Nines' To Availability And Downtime

To those familiar with our Trends Of Evolution, it shouldn't surprise you too much to learn that this design-paradigm trend is one of the thirty-eight step-change trends we've uncovered over the years. The pattern – reproduced in Figure 3 – has been established for some time. It has, in light of the emergence of the 'antifragile' word, also evolved. What

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is less well known is how the various evolution jumps correspond to the number of nines they are likely to deliver to the designer of a given system. Figure 3 contains an attempt to calibrate the trend, but it is still very visible that there's a lot of uncertainty. Achieving nine-nines in a jet engine is not the same as achieving the same level of reliability in an epi-pen, for example.

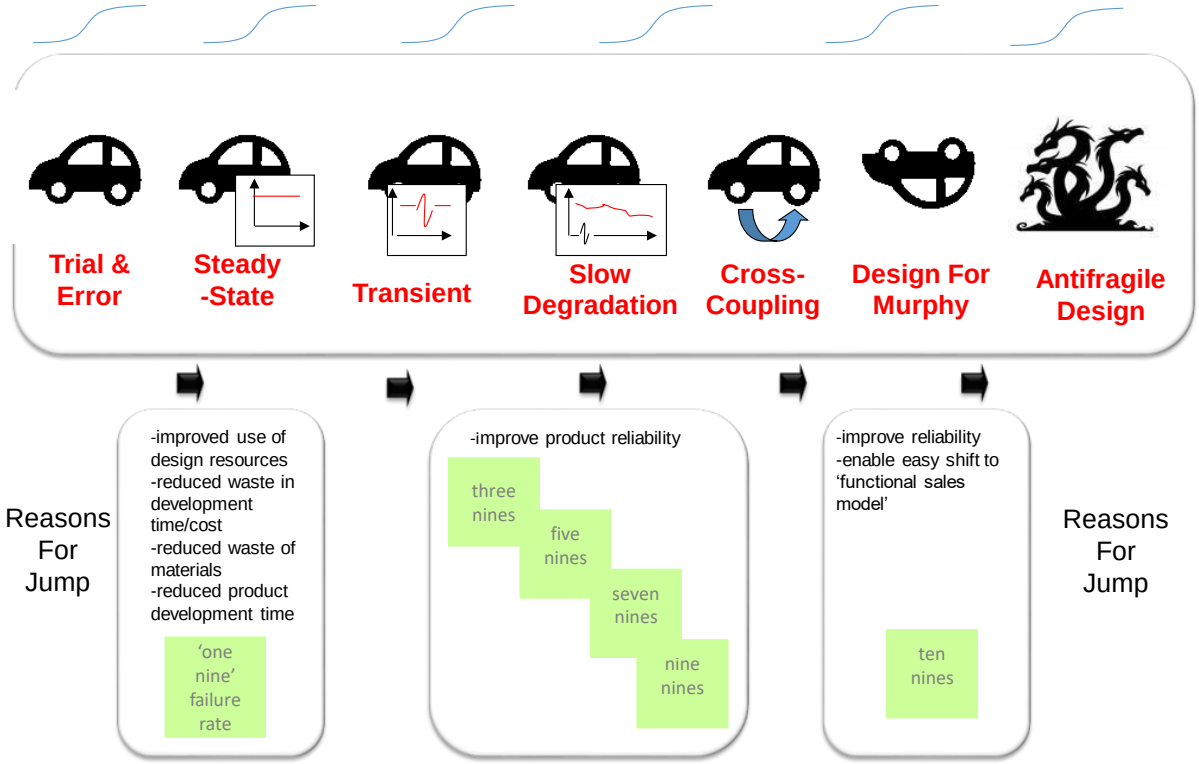

Figure 3: AntiFragile Design Evolution Trend

Best at this stage in the evolution of the Trend to see it as a relative rather than an absolute tool. Which means that, to stick with the epi-pen thought for a few more seconds, if we're currently achieving three-nines reliability and are currently using design methods that are 'steady state', and we have a desire to achieve six-nines, then we're likely to have to make two design paradigm jumps: we need to think about and do something about transients and we need to think about and do something about slow degradation effects. Each jump, as stated earlier, likely to give us an increase in our number-of-nines of one or two.

For the jet engine example, where the current state of the art on modern engines is ten-nines or higher, we know that the next evolution jump in terms of design method is to go beyond the 'design for Murphy' idea that the engine should survive no matter how badly the customer tries to treat it, to the idea that when the customer does something dumb, the engine learns to make itself stronger.

What happens beyond the 'AntiFragile Design' paradigm remains to be seen. Keeping an eye out for that new jump is a job for the SI research team. In true 'think of someone with a more extreme version of your problem because they've probably solved it' and given that the aerospace industry currently defines the highest capability, it will very likely be them that we will need to look first. Meanwhile, the good news for all the other industries is that because aerospace has already made all the paradigm shifts along the Trend, the wheel doesn't have to be re-invented. If you're designing to include transient effects, in other words, you know where you need to look for your next big meta-level S-Curve shift.

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Breakthrough Game Design

Since the launch of TRIZmeta last month, we've been embarked on a tour of the game industry. Main conclusion: there are a lot of games. And the industry is a lot like every other one in that most attempts to create something new end in failure. Most new games don't turn into all-time classics. If I had to place a bet, I'd say the success ratio was significantly lower than in analogous entertainment sectors like film or literature. Lots of game-players seem to accumulate enormous collections of games, the large majority of which, if I can believe what people say about their collections on social media, are destined to spend their life on a shelf. Maybe this fact helps explain the connected fact – based on what I see in the Twittersphere – that there seem to be as many 'game designers' as there are 'game-players'.

From where I sit, I'd say there are two overwhelming reasons for the poor track record of the games industry:

1) No-one appears to have connected to the Hero's Journey findings of Joseph Campbell. Games, like films and literature, are only successful if they follow certain 'meta-'principles.
2) Perhaps building on 1), few if any of the game designers I've encountered seem to have any kind of appreciation of the importance of contradiction-solving. Look at almost any new game and there's been a massive emphasis on features rather than benefits, on rules to enforce trade-offs rather than try and challenge them. As a result, everyone seems stuck in largely the same paradigms.

We designed TRIZmeta first and foremost to help designers successfully break trade-offs in real-world projects and challenges. We chose games as the focus largely *because* they possess the characteristic of fixed rules that the TRIZmeta rule-breaking provocations could be applied to. We didn't think that game designers might be part of our target audience. Call that lack of forethought. Game designers are ultimately classic rule-makers. Rule-makers I now see that are caught in the middle of an enormous chicken-and-egg challenge in which everyone is designing the same basic games because everyone is using the same basic rules. Do that long enough and everyone converges on the same basic solution, where the only differences between one game and the next is the shape of the pieces and the number of sides on the dice.

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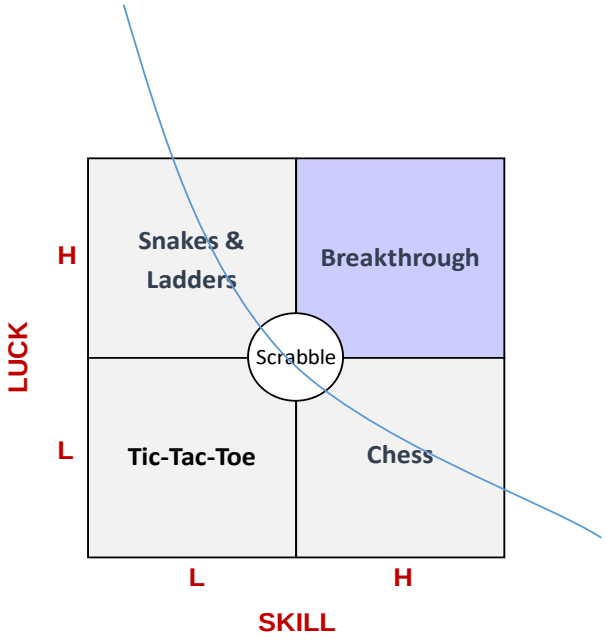
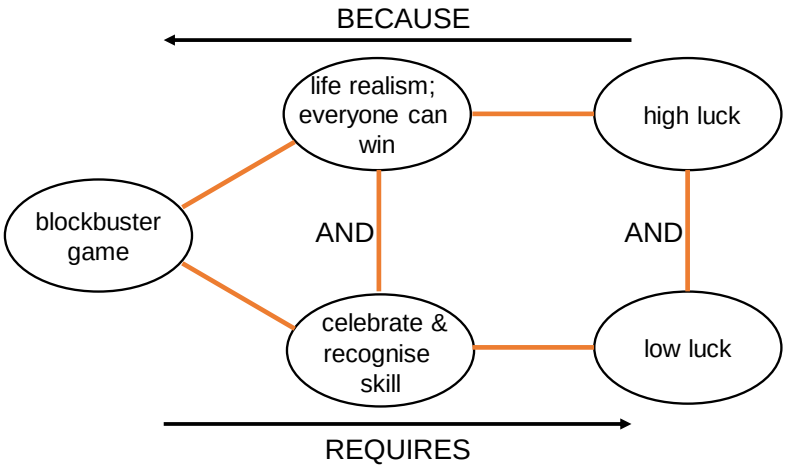
Breakthrough anything requires the identification and resolution of at least one contradiction. Some of the biggest breakthrough opportunities happen when we uncover contradictions that are so pervasive they've become invisible to everyone involved.

Therein lies one of my advantages as an outsider. Aside from a very short spell in the school chess club when I was eleven, I'm borderline game-allergic. On the other hand, one of my favourite life games is one I call 'Contradiction Radar'. My innovation senses are highly tuned to hunt out interesting contradictions. When I started to apply this radar to the games industry, one particular contradiction (opportunity) struck me very early. It's a contradiction centred around luck. Look at just about any game and players are forced into a trade-off choice between luck and skill. Something like this:



When selecting a game to play, the players effectively have to make a choice somewhere along the skill-luck spectrum. If I'm feeling particularly smart today, I might choose something like chess, which is nearly all about skill and contains almost no element of luck. If on the other hand, I've had a tough day, I might opt for something more like Snakes and Ladders. Or Solitaire. Something that I can blame on Lady Luck rather than my lack of competence should I somehow manage to lose.

It's a contradiction we might map like this:



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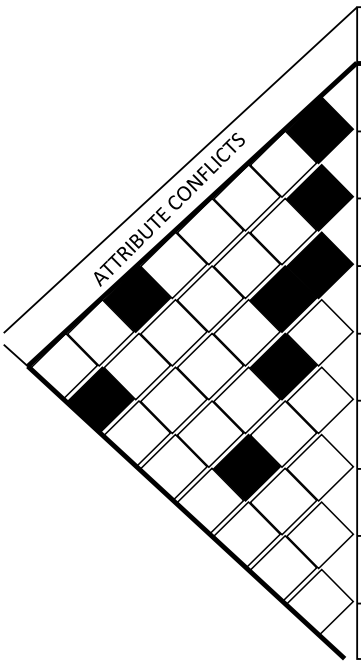
If I was a game designer looking to design a breakthrough game, I'd be far better off trying to create a solution that gave players the best of both worlds, rather than playing on the luck-or-skill spectrum that every other game sits.

Achieving such both/and solutions is what TRIZ is all about. Once I've found a good contradiction like this one, TRIZ tells us there are only 40 possible ways to design our way to a breakthrough. Make that fifty-two ways if you're using TRIZmeta. Plus, because it's a meta-game, you could use the cards in conjunction with any existing game and re-design that game to solve the contradiction. In TRIZmeta world there's no reason why players couldn't re-configure chess to incorporate an element of luck, or to re-think Snakes & Ladders to mean that it acquired the need to apply some actual thinking if a player is to win.

In many ways, finding the solution, thanks to TRIZmeta and the TRIZ Principles is the easy bit. The more difficult part is identifying the hidden contradictions. Here's a starter for ten via my radar and the TRIZ Ideal Final Attribute template:



ATTRIBUTE	CUSTOMER A IFR	CUSTOMER B IFR	PROVIDER IFR
Duration	seconds	infinite	longer
Learning Curve	nil	nil	acceptable
Skill	none	high	don't care
Luck	none	high	don't care
Players	1	infinite	higher
Jeopardy	none	white-knuckle	don't care
Action	passive	adrenaline	don't care
Teamwork	none	all	team
Outcomes	infinite	single	simplest

A few that appear to me to be potentially important ones:

- Some people want to play alone, others want a social experience
- The more people the game requires, the more difficult it is to recruit, but the better the social experience potentially becomes.
- Some people are more skilled than others. Finding a player with a similar skill level can be hard, so how to even up the odds of winning or losing?
- People want to be able to play as quickly as possible without a protracted (or any) learning curve, but the more instant the game is, the less likely it is to be one that delivers a wide range of outcomes and is therefore unlikely to be one that people come back to.
- Sometimes I want action; sometimes I want something more passive.
- Sometimes during the game I want to dynamically vary the level of luck or skill ratio.
- Sometimes I want to be part of a team; sometimes I want to be by myself.
- Some players like the adrenaline rush that accompanies high amounts of jeopardy; others will not.
- A game with a high number of possible outcomes (Carcassonne for example) is good for future play desirability, but some times it is nice to know that we got the

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‘right answer’, which in turn demands few or maybe only one possible outcome (Mousetrap, Kerplunk, etc).

One thing I am certain about is that anyone that successfully resolves any of these contradictions (or any other ones I haven’t had the patience to list), stands a fair chance they’ve just created some kind of breakthrough game. Call that a call to arms. Or challenge.

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Not So Funny – (WD-) 40 Inventive Principles

All hail the mighty WD-40. If there is ever going to be a 41st Principle, WD-40 will very likely point the way. Or it might actually be Principle 41. Meanwhile, it is already *all* of the 40 we currently know. Kind of. That's how it got its name. Kind of.

1. **Segmentation**
   Remove chewing gum from hair

2. **Taking Out/Separate**
   Lipstick-on-collar remover

3. **Local Quality**
   Ahem…

4. **Asymmetry**
   Waterproof shoes
   (but still allow them to breathe)

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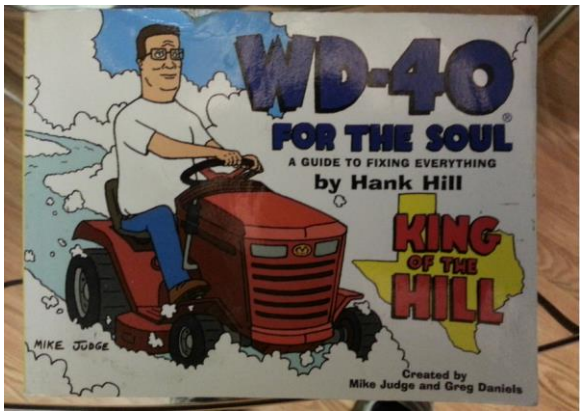
5. **Merging**

WD-40 attracts fish. Spray a LITTLE on live bait or lures (like the emphasis on little!)

6. **Universality**

Hey, it does everything, dummy. Read the rest of the list…



7. **'Nested Doll'**

Secret stash-can safe

8. **Counterweight**

Fly repellent (especially for cows, apparently)

9. **Prior Counter-Action**

Lighting the barbeque

10. **Prior Action**

Spray on wood to prevent splinters

11. **Prior Cushioning**

Wipe onto glass and mirrors to prevent fogging

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12. Remove Tension

Relieve arthritis and tendonitis pain (not much clinical evidence on this one, but plenty of anecdotal)

13. 'The Other Way Round'

Separate stuck glassware ('make fixed things movable')

14. Curvature

Ring-remover (phew, thought I was going to struggle with Principle 14!)

15. Dynamics

Loosen stuck zipper

16. Slightly Less/Slightly More

The slightly less effective younger brother

17. Another Dimension

Jewelry (here's Christmas sorted…)

18. Vibration

(modesty prevents me from explaining this one in too much detail. Thankfully, a picture speaks a thousand words sometimes…)

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19. Periodic Action

Soften leather ('Spray a baseball glove with WD-40, put a baseball in the palm, and fold the glove sideways. Take a rubber band or belt and tie it around the folded glove. The WD-40 will help soften the leather and help it form around the baseball. Keep the glove tied up overnight, and then wear it for a while, flexing the glove so it will begin to fit the shape of your hand.')

20. Continuity of Useful Action

Deter wasps from making nests (spray into nooks and crannies)

21. Hurrying

Keep pesky squirrels off bird-feeder by creating no-friction surface

22. 'Blessing in Disguise'

Refreshing party drink (I love Poland!)

23. Feedback

Aftershave… let's your loved ones know what a 'go to' guy you are

24. Intermediary

Spray onto shovel to prevent snow/dirt from sticking

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25. Self-Service

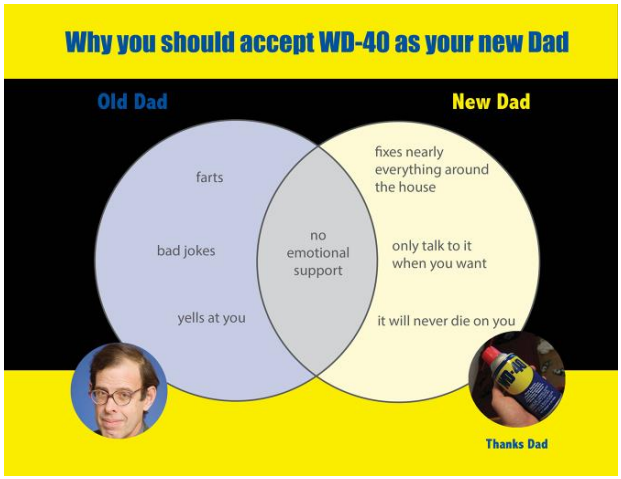
Remove car paintwork scratches

26. Copying

Fancy dress – go as the most versatile person in the room

27. Cheap/Short Living

Substitute parent



28. Mechanics Substitution/Fields

eliminate static on volume and tuning control knobs

29. Fluidity

Improve guitar playing prowess (I wish!)

30. Thin & Flexible

Untangle jewelry

31. Porous Materials

Spray onto air filters to improve dust collection efficiency

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32. Colour Changes

De-tarnish silver

33. Homogeneity

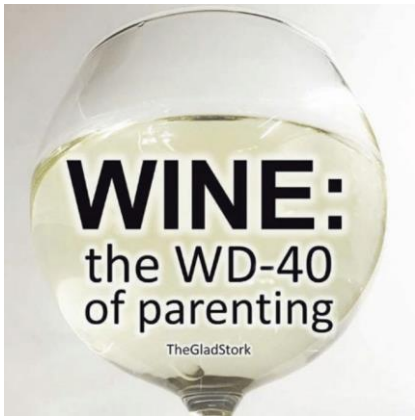
"Can you move your elbow? Knees? Toes? Lips? *Everything's* froze up? OK, hang on. The athletic trainer's coming with the WD-40."

34. Discarding and Recovering

Clean dried glue ('Simply spray WD-40 onto the spot, wait at least 30 seconds, and wipe clean with a damp cloth')

35. Parameter Changes

Turns into wine to then solve all emotional problems :)



36. Phase Transitions

Prevent car doors freezing shut in cold weather (by spraying on to rubber seals)

37. Relative Change

Free rusted locks

38. Enriched Atmosphere

Re-inflate tyres (totally safe(ish)):

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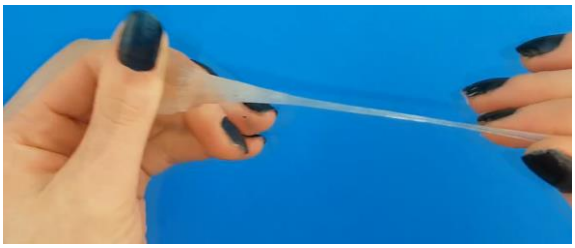
39. Calmed Atmosphere

Spray onto oven burns or any other type of burn. It takes the burned feeling away and heals with NO scarring. Ditto ant bites. Apparently.

40. Composite Structures

Mix with polymeric glue to make slime



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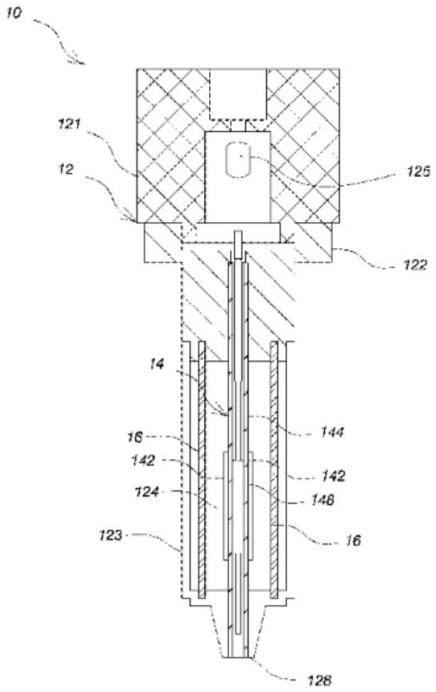
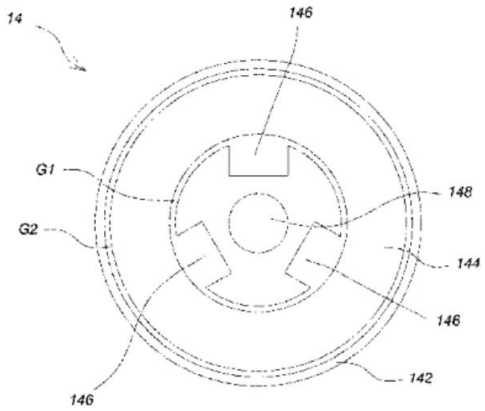
Patent of the Month – Atmospheric-Pressure Plasma





Our Patent of the Month this month takes us to Taiwan, and a quartet of inventors at the National Chiao Tung University. US 10,121,638 was granted on November 6. In a wonderfully succinct write-up (5 pages of narrative), here's what the team has to say about the problem addressed by the invention:

In general, plasma is generated via applying an electromagnetic field to neutral gases. The gas temperature and electron density of plasma ranges widely. Therefore, plasma has numerous applications such as plasma spray coating, semiconductor etching, metal cutting, metal welding, vehicle exhaust purification, and fluorescent lamps.

At present, non-thermal (near the room temperature) atmospheric-pressure plasma is normally generated using inert gases. In fewer studies, a higher breakdown voltage is applied to ionize nitrogen, air, or even oxygen. However, the electron affinity of oxygen at atmospheric pressure is so strong that oxygen is easy to capture the electrons from plasma. Thus, it is very difficult to maintain the plasma in a steady state. Besides, under such operating condition, excessive voltage may result in high temperature or generating an unintended high concentration of ozone. Therefore, this kind of plasma thereby is unsuitable to be used in biomedical therapies and temperature-sensitive materials.

Nowadays, there are few researches generating plasma activated water in high volume at atmospheric pressure. Using air as the working gas to generate plasma activated water for water purification, some poisonous substance such as nitrite ions are generated in the meantime, causing the death of aquatic animals, furthermore causing the damage to ecology.

Owing to the above mentioned problems, the present invention proposes an atmospheric-pressure plasma jet generating device to provide non-thermal atmospheric-pressure plasma, which may be applied to temperature-sensitive materials or generate plasma activated water…
…The primary objective of the present invention is to provide an atmospheric-pressure plasma jet generating device, which can generate a non-thermal (near the room temperature) plasma jet under atmospheric pressure with low energy consumption.

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From a contradiction perspective, the basic fight described here is between the desire to achieve a stable plasma, and to not to have to use high temperature or inert gases to achieve it. Mapped on to the Contradiction Matrix, the problem thus looks like this:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Stability (21)

WORSENING PARAMETERS YOU HAVE SELECTED:

Amount of Substance (10) and Temperature (22)

SUGGESTED INVENTIVE PRINCIPLES:

40, 35, 24, 5, 31, 3, 1, 15, 18, 39, 13

And here's how the inventors achieved their solution:

In order to achieve the above mentioned objectives, the present invention proposes an atmospheric-pressure plasma jet generating device, which comprises a hollow housing [Principle 31, Holes]*, a discharge tube arranged inside the housing, an air inlet, and an outlet disposed in the bottom of the housing. The air inlet interconnects with the outlet and the discharge tube. The discharge tube includes an internal electrode, a first dielectric material, and an external electrode. The first dielectric material is placed between the external electrode and the internal electrode and surrounds the internal electrode. The internal electrode provides channels inside the discharge tube (…'has a cross section with a shape multiple V notches, or multiple grooves)* [Principle 3, Local Quality]*. An external power source is electrically connected to the internal electrode and the external electrode through cables to generate a high electric field within the discharge tube. When an external gas flows into the discharge tube via the air inlet, the external gas is dissociated* [Principle 1, Segmentation] *by the high electric field to generate plasma. Then, the plasma flows out of the discharge through the outlet.*

…as with many things in (mechanical design) life, it's all about holes and grooves and doing more with less.

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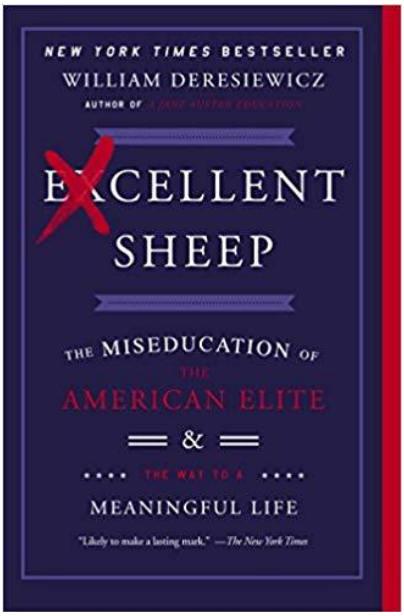
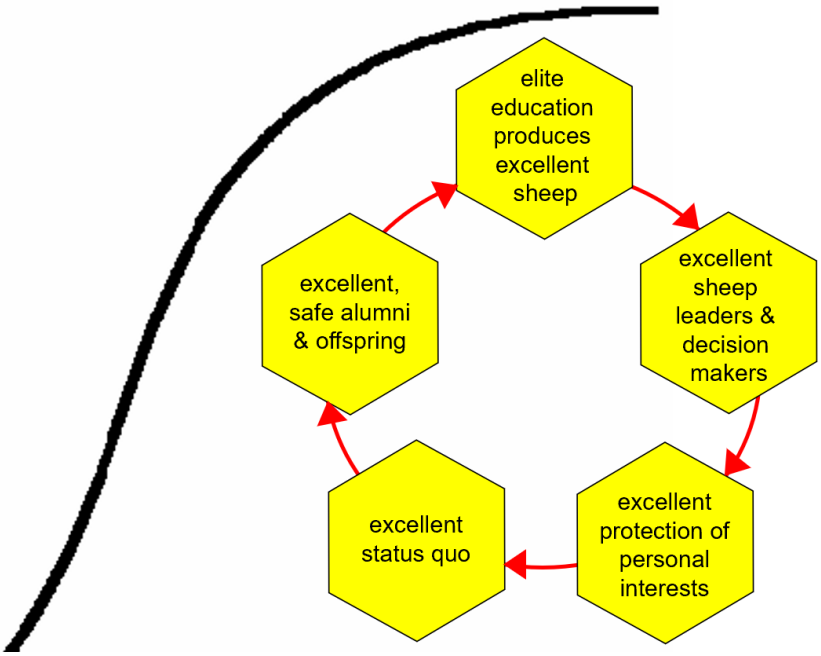
Best of the Month – Excellent Sheep



There's no such thing as a root cause in a complex system. I know that. But I also know there can be a root contradiction. Provided we understand the system at a first-principle level. In the same way that the CEO conveys the first principle 'DNA' of the culture of an enterprise, it is the leaders in our society that set out (often unwittingly) the behaviours we collectively accept and come to live by.

With that in mind, if I was forced to speculate on why large parts of the Western corporate world are delivering so little innovation these days, I think I'd be looking to William Deresiewicz's book 'Excellent Sheep' to help me understand, at a first principle level, what's going on in the parliaments of boardrooms of the world right now. If I was forced to turn the speculation into a root-contradiction vicious-cycle map of first principles, I think I'd end up with a picture that looks something like this:



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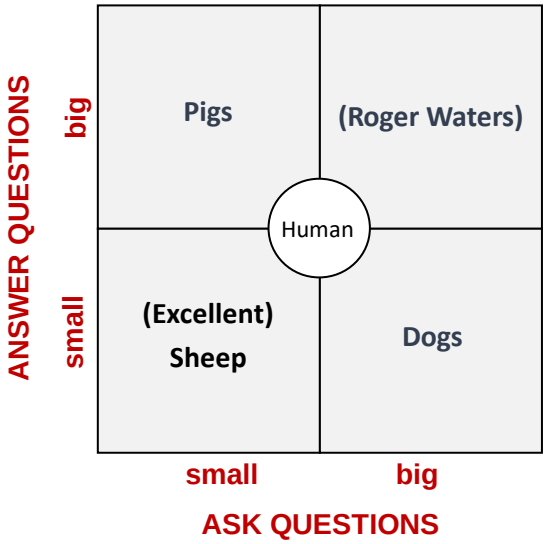
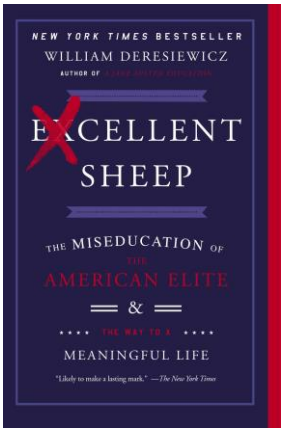
Which, expressed as succinctly as possible, says that large enterprises can't innovate because they're lead by armies of excellent sheep. Make that 'excellent selfish sheep'.

Or how about 'HYPSter'? That's William Deresiewicz's term, in his new book, for Harvard, Yale, Princeton and Stanford, though it seems more idiomatic to apply that acronym to these schools' graduates. With HYPSters, and with the recent graduates of the tier of elite American colleges a rung or two below them, he is unimpressed. I think he would have had the exact same reaction if he'd expanded his study to also include the 'elite' universities in other nations.

Far too many are going into the same professions, notably finance or consulting. He detects a lack of curiosity, of interesting rebellion, of moral courage, of passionate weirdness. We've spawned a generation of polite, striving, praise-addicted, grade-grubbing nonentities — a legion of, as his title puts it, "Excellent Sheep." A cohort that, to make a fairly big leap into another domain, are rather like the sheep described in the Pink Floyd tour-de-force album, Animals:





Excellent sheep take care to never ask or answer life's big questions. Excellent sheep graze on trivial grass.

Books like this one, volumes that probe the sick soul of American higher education, come and go, more than a few of them hitting the long tail of the best-seller lists. As a class of books, they're almost permanently interesting, at least if you work in or around education.

"Excellent Sheep" is likely to make more of a lasting mark than many of these books, for three reasons. One, Mr. Deresiewicz spent 24 years in the Ivy League, graduating from Columbia and teaching for a decade at Yale. (Yale denied him tenure, leading some to shrug this book off as sour grapes.) He brings the gory details.

Two, the author is a striker, to put it in football terms. He's a vivid writer, a literary critic whose headers tend to land in the back corner of the net. Three, his indictment arrives on wheels: He takes aim at just about the entirety of upper-middle-class life in America (and beyond).

When I say that Mr. Deresiewicz brings the gory details, I mean that he delivers tidy scenes like an account of sitting on Yale's admissions committee in 2008. The particulars of this experience will make parents break out in a prickly rash.

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Only five or six extracurricular activities? Those are slacker numbers. Does the applicant have “good rig” (academic rigor)? What about “top checks” (highest check marks in every conceivable category)? Is he or she “pointy” (insanely great at one thing)? How are his or her “PQs” (personal qualities)? Or is your child, as one committee member said of an applicant, “pretty much in the middle of the fairway”?

Mr. Deresiewicz spends a long time considering college admissions because a vast number of crimes, he suggests, are committed in its name. We’ve created kids who throughout their high school years are unable to do anything they can’t put on a résumé. They’re blinkered overachievers.

Once they’re in college, they don’t know what to do with themselves, so they jump through the only hoop that’s bathed in a spotlight: finance. He argues that many miss truer and more satisfying callings.

He notes that at many of the Top 10 liberal arts colleges — “places that are supposed to be about a different sort of education” — economics is the most popular major. In 2010, he writes, about half of all Harvard graduates had jobs lined up in finance or consulting.

Colleges conspire in this funneling. They are working, he writes, “to line up the major gifts a generation hence. As for the smattering of future artists and do-gooders, they’re there to balance the moral books (as well as furnish a few alumni to brag about).”

Little of what Mr. Deresiewicz has to say is entirely new. Ezra Pound got there first, 80 years ago, with the metaphor that supplies this book with its title. Real education must be limited to those who insist on knowing, Pound said in his book “ABC of Reading.” “The rest is merely sheepherding.”

But the author consistently peels off in interesting directions. He speaks directly to students, giving this advice, for example, about cracking the mold while at college: “Don’t talk to your parents more than once a week, or even better, once a month. Don’t tell them about your grades on papers or tests, or anything else about how you’re doing during the term.” He concludes this litany this way: “Make it clear to them that this is your experience, not theirs.”

He observes how Jewish kids like Norman Mailer, Saul Bellow, Susan Sontag, Woody Allen and Philip Roth were socialized academically and otherwise into American culture and “went on to take possession of it.” He has similar hopes for Asian and Latino kids. “Telling them to stick to medicine or finance is just another way,” he says, “of keeping those communities down.”

As ever in our TRIZ-blind world, I had problems with “Excellent Sheep.” Even at 245 pages, it feels padded, especially with quotations from a thousand sources. I didn’t skim pages, but I sometimes wanted to. It gets self-helpy. (“The only real grade is this: how well you’ve lived your life.”) Mr. Deresiewicz is a hammering writer, one who could have taken advice from, say, Robert Hughes in his “Culture of Complaint” about nailing your points with saving wit. That said, Excellent Sheep was, by several furlongs, the best thing we read this month, and therefore, there wasn’t going to be a doubt it would feature here in the ezine. Whether you’re a parent, teacher or part of an enterprise leadership team, you need to read this book before the Excellent Sheep vicious cycle takes us all down.

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Wow In Music – Here, My Dear/Let's Get It On

I have another theory. One I've had for a long time, but have never had the chance to really explore. Mainly because, outside the world of art, music and literature I wouldn't know where to go find the data, and within those worlds, I don't know that it would ever be possible to compile enough empirical evidence to be convincing. Anyway, in true, 'all theories are wrong, but some are useful' fashion, here goes…

…people are at their most creative, and most likely to create great works of art when they are in one of two states:

1) They are in the depths of a crisis and are determined to come-out-fighting and stick it through in order to avoid falling off 'the cliff'
2) They are in the first throes of trying to attract a mate and are in 'the chase'

The two can be seen as polar opposites in many ways, and as such it's rare to see both present in the work of a single artist. We tend, if we're going to be good at either, to be better at one than the other. A rare exception, I believe, is Marvin Gaye. Two of his albums – 1973s Let's Get It On and 1978s Here My Dear – are regularly featured in 'best album of all time' listings. I've played my copies consistently for the last forty years and never tire of them. I rarely use the word 'genius', but I think both qualify for the honour.

Here My Dear was the 'cliff' album. Gaye was terrible with money, often investing in bogus schemes and blowing untold sums on Class A drugs, so when his first wife, Anna asked for $1 million to settle their divorce, he simply didn't have the funds. In a bizarre piece of creative thinking, his lawyer proposed a novel solution: Gaye would pay $600,000, half of which would come from the advance for his next album, with the other half coming from that album's royalties. It was an insane idea. So, of course Gaye agreed to it. That's what being on the edge of the cliff does to you sometimes.

Recorded in 1977, around the time Gaye's divorce became final, the singer originally planned to produce something quick and mediocre, but the subject matter and the crisis proved to be too rich. The result was a 73-minute epic and the only double-LP he would ever make. Though birthed from contentious circumstances, the album still retains its power because it's not just a heated diatribe, a peeved he-said to infinity. Unlike some of Gaye's real-life actions, the album is nuanced, thoughtful, progressive.

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After a scene-setting intro - “I guess I’ll have to say this album is dedicated to you” - the story begins in earnest with, fittingly, a doo-wop song. “I Met a Little Girl” boasts all the longing and vocal stacking of Gaye’s beloved ’50s music, but with the perspective flipped—he’s singing not as a green teen but as a man in his late 30s who has tried and failed at love (Principle 37), and is no closer to figuring it out. Gaye exquisitely sings all of the parts himself, creating an echo chamber of hurt. Though the singer spoke out against the women’s liberation movement of the era, there’s a generousness to his voice and sentiments, and a shared blame. “Then time would change you,” he squeals, “as time would really change me.” The song is nearly zen in its wistfulness, with a sumptuous arrangement and languid pace. Later, on a track called “Anger,” Gaye still takes the long-view, condemning the soul-destroying properties of rage rather than giving into them.

Like much of Gaye’s ’70s work, Here, My Dear is a groove album. Voices, instruments, and hooks don’t jump out as much as they lay in the cut waiting to be discovered. Though it can sound redundant at first, its (Principle 20) unvaried instrumentation and tempo strengthen the thematic bonds within. Three tracks called “When Did You Stop Loving Me, When Did I Stop Loving You,” are worked into the suite, all with the same easy sax funk, as if Gaye keeps returning to the question in hopes of a definitive answer. Spacious jazz backgrounds make tracks like “Sparrow” and “Anna’s Song” luxuriate in memories and idylls gone by—even when Gaye breaks character by screaming “An-na!” the vamp barely breaks its stride, acting as something of a calming agent.

Let’s Get It On, on the other hand sees Gaye at the peak of his ‘chase’ period. Especially the title track. And especially the vocal performance.

Nine days after the initial session to cut the instrumental parts of the track, Gaye was back in the studio to record his final lead vocal and, according to Ben Edmonds, author of Marvin Gaye and the Last Days of Motown Sound, that day Gaye had extra inspiration in the studio: One of Townsend's friends, Barbara Hunter, brought along her lovely 16-year-old daughter, Janis, and as Edmonds writes, “The presence of this young girl compelled him to perform the song to her, and in so doing, it was transformed into the masterpiece of raw emotion we know so well.” (The Chase!) Indeed, Marvin and Janis fell in love, almost on the spot, and were married a few years later (after his messy, acrimonious divorce from wife number one, the one who was the inspiration behind Here, My Dear… a complicated crisis indeed!). So, some of the urgency and exhilaration in Gaye's vocals came from his new muse, but some of the other vocal ad libs that Gaye tacked on came from conversations he had with Townsend. “They were Ed's ideas really,” notes Harry Weinger, who produced the Deluxe Edition set and helped mix some of the bonus tracks. “Marvin was saying, ‘What should I do here? What kind of vibe do you want?’ And Ed said, ‘You know, something like “sanctify”…’ So Marvin then sang ‘something like sanctify,’” he laughs. “What Marvin did was find something that appealed to him and he went with it. It was not just a casual ad lib. Marvin overdubbed background vocals on that line several times. He added to it and augmented that phrase.”

The amazing vocal shouldn’t detract from the song’s music. Some of L.A.'s finest jazz and R&B players were assembled for the March '73 sessions at Motown's new Hitsville-West studios. Ernie Watts and Buddy Collette on reeds; Joe Sample and Wilton Felder of The Crusaders on piano and bass, respectively; drummer Paul Humphrey; Victor Feldman on vibes, and various other local luminaries. There were also extra percussionists and a small string section on hand on March 13, 1973, when the song was cut live in the studio by Motown engineer William McMeekin. What we end up with is another great illustration of the meaning of a band playing ‘in the pocket’. The rich, interweaving tapestry of different

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parts (Principle 40) belies the feeling when listening to the song that there's as much empty space as there is music (Principle 31). It's a masterclass in how to be both rich-and-sparse.

But then, if we look at Gaye's mature career as a whole, we should expect nothing less. He left behind one of the world's greatest music portfolios by the time of his too-early death. He was a man who oozed musicality. These two high points, I'd say get to be a cut above the rest of his work because of Inventive Principle 38, 'Enriched Atmosphere'. Whether it be the Cliff or the Chase, Let's Get It On and Here, My Dear are living testament to the idea of occasionally turning the emotion up to eleven.

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Investments – Reforestation

Bruno Rutman Pagnoncelli grew up among the trees in Brazil's Atlantic rainforest, learning how to kayak its whitewater rapids and soaring high above the treetops in paragliders. On one of these paragliding trips, Bruno looked down and saw, first-hand, just how much deforestation was affecting the land he loved.

"One day, flying high, I saw a really big area with no forest, just grass. I realized that we need to make an innovation to solve this problem," said Bruno, an industrial designer.

There are 17 million hectares of land – approximately the size of Florida – that have potential for reforestation in Brazil. Bruno discovered that planting and maintaining trees in these remote lands was slow-moving, dangerous, and inefficient work. He began to create a design that could ensure that tree seedlings survive without requiring hands-on maintenance, mimicking the natural forest succession process. He enlisted his brother Pedro's help and teamed up with forester Bruno Ferrari to create what would become Nucleário – a new way to restore the rainforest, inspired by nature.

Six years later, after winning the Biomimicry Institute's Global Design Challenge and being invited to take part in the Biomimicry Launchpad accelerator program, the Nucleário team has won the 2018 Ray of Hope Prize®, a $100,000 prize sponsored by the Ray C. Anderson Foundation.

Nucleário is an all-in-one reforestation solution, designed to be used in remote areas of the Atlantic rainforest. The device was created to function like leaf litter, preventing soil leaching and increasing soil moisture levels, and protecting seedlings from leafcutter ants and invasive grasses. It also mimics how bromeliads collect water from rain and dew to provide a microclimate that attracts biodiversity. All of this means that seedlings can thrive without needing extensive maintenance.

"The main bottleneck in forest restoration is seedling maintenance. If you just plant seedlings and go away, more than 90% will die. Every three months, you have to cut

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grass, water, apply fertilizer to avoid this," said Bruno. "With Nucleário, we can plant more forest in less time."

Forest restoration plays a large role in limiting a global temperature rise of 1.5 degrees Celsius or lower. Forests currently absorb just over a quarter of our CO2 emissions. Reforesting degraded areas can, in concert with improved forestry practices, soak up over 7 billion metric tons of carbon each year.

By reducing maintenance costs and helping improve seedling survival rates, Nucleário can get more trees in the ground in less time, helping make it possible to achieve environmental agreement goals like the Bonn Challenge and the Paris Agreement.

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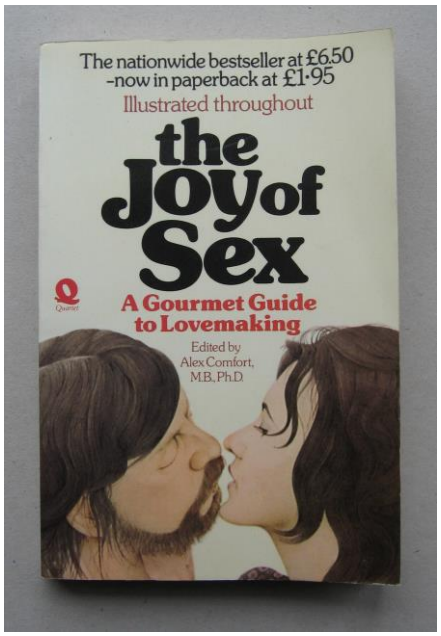
Generational Cycles – Joy

Baby Boomer (Prophets)	-	The Joy Of Sex
Generation X (Nomads)	-	The Joy Of Sucks
Generation Y (Heroes)	-	The Joy Of Shots
Generation Z (Artists)	-	The Joy Of Socks

Baby Boomers – grew up in a great age of permissiveness. Sex, in the heady days before AIDS and in the wake of the arrival of the birth-control pill, was something to be shared freely. Enter the 1972 book, 'The Joy Of Sex', a must read for any young Boomer couple who wanted to get the most out of jiggy-time. No longer was it necessary to be embarrassed about a previously taboo topic. Now it was something to be given pride of place on the bookshelf. For the Boomers at least…



Generation X – as with most Nomad generations Gen X'ers found themselves looked down on by the surrounding generations. All the free-love optimism of the Boomers gets revealed as a sham, and the X'ers find themselves caught in a whole bunch of conflicts and contradictions. Life sucks…

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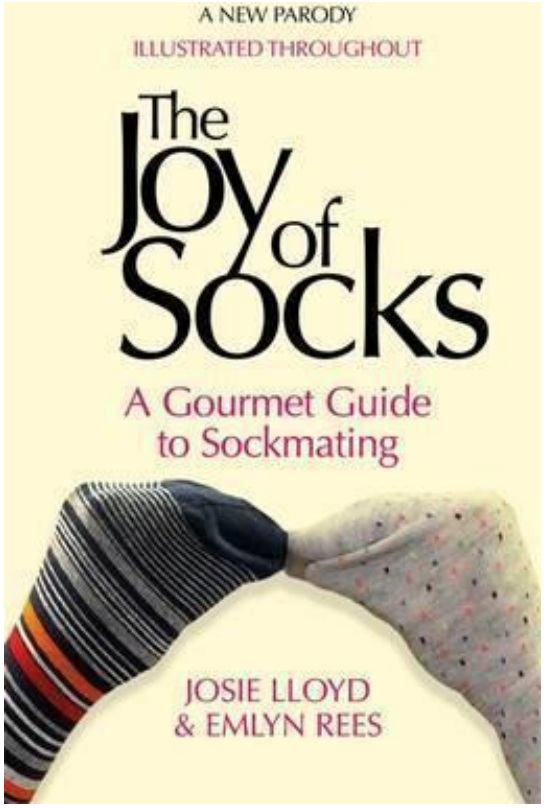
Generation Y/Millennials – when you're a hero, everything in life gets turned up to eleven. And concentrated. No time to waste. The 'shot' came to symbolize what happens when life gets distilled down to its very essence.

And now, along come Generation Z, a generation of Artists. Suffocated kids with all the sense of adventure sucked out of them by helicopter parents and a society that demands a cotton-wool wrapper on everything. 2018 saw the publication of what looks set to be the aspiring Z'er life bible…



Teenage rebellion: now defined by wearing non-matching socks.

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Biology – Polka Dot Tree Frog (Hypsiboas punctatus)

Under normal light, the South American polka dot tree frog (Hypsiboas punctatus) sports a muted palette of greens, yellows and reds. But dim the lights and switch on ultraviolet illumination, and this little amphibian gives off a bright blue and green glow.

The ability to absorb light at short wavelengths and re-emit it at longer wavelengths is called fluorescence and is rare in terrestrial animals. Until now, it was unheard of in amphibians. Researchers also report that the polka dot tree frog uses fluorescent molecules totally unlike those found in other animals.

Because fluorescence requires the absorption of light, it doesn't happen in total darkness. That makes it distinct from bioluminescence, in which organisms give off their own light generated through chemical reactions. Many ocean creatures fluoresce, including corals, fish, sharks and one species of sea turtle (the hawksbill turtle, Eretmochelys imbricata).

On land, fluorescence was previously known only in parrots and some scorpions. It is unclear why animals have this ability, although explanations include communication and mate attraction. The associated conflict-to-be-solved, assuming these hypotheses turn out to be true, is the desire to communicate would otherwise be hampered by the amount of energy required to do so. From a Contradiction Matrix perspective, that conflict would map something like this:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Compatibility/Connectivity (33)

WORSENING PARAMETERS YOU HAVE SELECTED:

Energy used by Moving Object (16)

SUGGESTED INVENTIVE PRINCIPLES:

28, 29, 12, 3, 25, 2, 13

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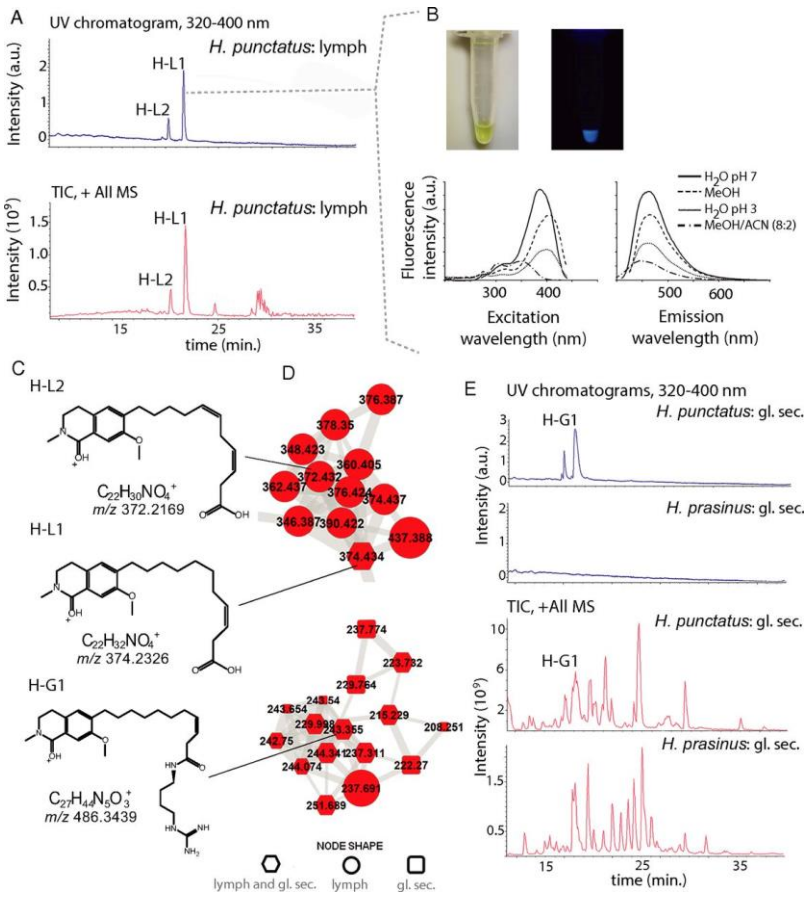
Which, all in all, looks pretty good as far as the polka-dot tree frog is concerned, fluorescence being a good example of Principle 28, Mechanics Substitution (i.e. ‘use a field’) in action. Not to mention a touch of Principle 25, Self-Service, thrown in for good measure. Then, zooming in to look at the frog’s fluorescence solution at the micro-scale, how about Principle 3, Local Quality…

…Three molecules — hyloin-L1, hyloin-L2 and hyloin-G1 — in the animals’ lymph tissue, skin and glandular secretions were responsible for the green fluorescence. The molecules contain a ring structure and a chain of hydrocarbons, and are unique among known fluorescent molecules in animals. The closest similar molecules are found in plants, says study co-author Norberto Peporine Lopes, a chemist at the University of São Paulo in Brazil.

The newly described fluorescent molecules emit a surprising amount of light, providing about 18% as much visible light as a full Moon — enough for a related species of frog to see by. Almost nothing is known about the polka dot tree frog’s visual system or photoreceptors, so Taboada plans to study these to determine whether the frogs can see their own fluorescence.

“I think it’s exciting,” says marine biologist David Gruber of Baruch College, part of the City University of New York, who with his colleague discovered fluorescence in hawksbill sea turtles in 2015. “It opens up many more questions than are answered,” he says, including the ecological and behavioural function of fluorescence.



Read more:
Taboada, C. et al. Proc. Natl Acad. Sci. USA http://dx.doi.org/10.1073/pnas.1701053114 (2017).

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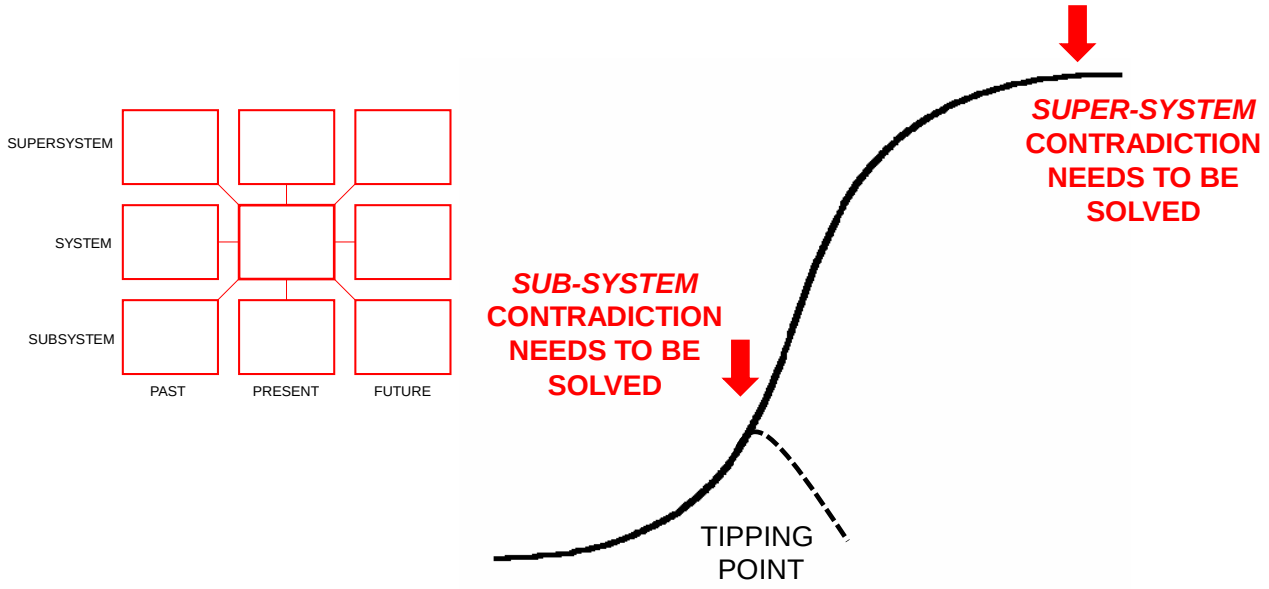
Short Thort

"What is the nature of the search? you ask. The search is what anyone would undertake if he were not sunk in the everydayness of his own life. To become aware of the search is to be onto something. Not to be onto something is to be in despair."
Walker Percy



News

Cardiff University
Darrell will be lecturing to the EMBA students on the topic, 'Complexity, Industry 4.0 and Understanding Customers Better Than They Understand Themselves', on Thursday 6 December. Not sure how open the event will be, but the slide-deck will be made available on the SI website after the event if any ezine readers are interested.

Brazil
It looks like SI will be giving workshops in Brazil again next year, following a gap of probably around five years. Lots of details still to be worked out, but we do know the trip will take place during the week 18-22 March and that there will be at least one '"1st Century TRIZ' workshop and at least on 'InnovationDNA for Managers' programme. More details on the website as the plans evolve.

University Of Buckingham
Darrell will be lecturing on the new cohort group of the MSc in Lean Enterprise. The first Module takes place during the second week of January at the University. Darrell will also be lecturing for three days during the last Module of the current cohort, which will happen in the rather lovely city of Zurich, towards the end of January.

TRIZmeta
Following the announcement of a second volume of the TRIZ Games book, it already looks like we'll be offering up the next evolution stage of TRIZmeta. The book is not due for publication until the middle of 2020. We expect TRIZmeta Oblique StrateTRIZ to be ready for Beta test by April 2019. Existing TRIZmeta players that want to get ahead of the game might want to let us know if they want to become beta test pioneers.

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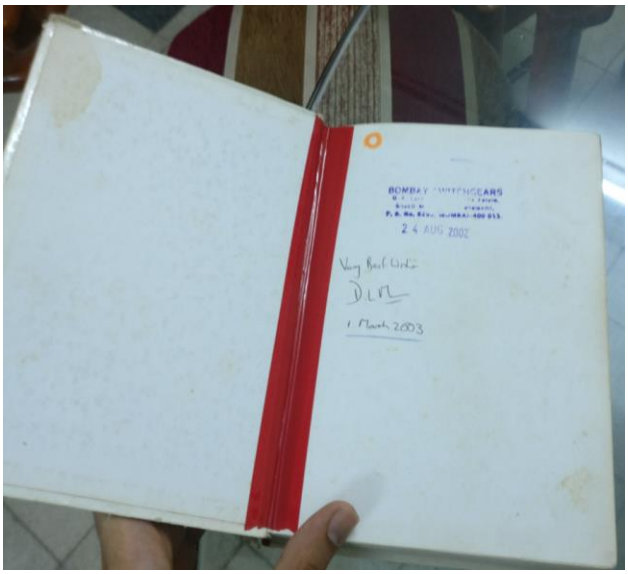
New Projects
This month's new projects from around the Network:

- Automotive – Concept Design Study
- Agriculture – Concept Design Study
- Retail – SI Certification Workshops
- Mining – SI Certification Workshops
- Education – SI Workshops
- Logistics – SI Workshops
- FMCG – Manufacture 'Cost Down' Project

Competition
Thanks to all the entries to our HOSI book-cover competition. The moment Pankaj Vora sent in his entry, it was always going to be tough for anyone to beat him. Short of placing their book onto the runway at Heathrow for a fortnight at least. For those that haven't seen it, here's Pankaj's copy of an actual first edition copy of the book, bought in 2002:



Thanks for your support, Pankaj. Your prize will join me on my next trip to India.
All the other entries will find their way into the frontispiece of the upcoming Third Edition.

Issue 200
Finally, it almost goes without saying, to all of the ezine readers, an enormous thankyou for all your support over the course of the last 17 years. We're now the world's longest standing, continuously produced TRIZ publication. Just shy of 2 million words so far. Here's to the next two hundred issues, somewhere around Darrell's 71st birthday. Retirement? Who said anything about retirement? We enjoy this stuff too much.

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