Systematic Innovation

e-zine

Issue 101, August 2010

In this month's issue:

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

Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.

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

Requisite Agility

Q: What are the main differences between the instrument panel in your car and the one found in a fighter aircraft?
A: Because the fighter pilot is travelling a lot faster and survives primarily on the ability to out-maneouvre an enemy threat, the normal 'steady-state' information isn't anywhere near good enough so new and different instruments are needed.

In our cars, change happens relatively slowly. Slowly enough at least that when we look at our speedometer, it is absolute speed that matters rather than rate of change of speed. We use our experience to tell us when to brake rather than our instruments. Above around 160mph, though, and even the best reflexes aren't good enough to cope with an unexpected event up ahead. Above this speed and we need more information in order to be able to function. At Mach 2, the main additional information needed by a pilot is acceleration and more specifically 'how many g's am I pulling'. Fighter aircraft are fitted with g-meters precisely to give this information. The pilot needs to know 'g' level in order to evade threats on the one hand and to know when there is a danger of exceeding the physical limits of his or her body and those of the aircraft on the other.

Figure 1: Fighter Aircraft 'g' Meter

In the past, organizations have, like the typical car driver, been able to survive using steady-state measurements of key business metrics. Increasingly, however, companies in many industries are beginning realize that the rate of change in their world has exceeded some kind of limit whereby those traditional dashboard measures are no longer adequate. Change no longer happens in gentle, predictable ways, and so, just like the fighter pilot, the C-Suite dashboard demands the incorporation of new instruments. Businesses increasingly need their own 'g-meter'.

The business equivalent of 'g' is rate of disruption and discontinuity to the business. In terms of managing the business, it is about identifying rates of change of key business metrics in order that the organization is able to respond appropriately and, crucially, faster than the competition. The key management metric is agility. And the key business requirement is requisite agility – is there sufficient ability to change inside my organization so that I can react faster than my competitors?

We've been thinking about 'requisite agility' for a number of years now. The problem with designing and implementing a solution that enables it to be measured is that it demands a lot of data in order to be able to sensibly identify where and what the right disruptions and

discontinuities to look for are. Fortunately, three million data-points turns out to be sufficient to do a meaningful job. And so, for the first time, we are able to detail the bones of a 'requisite agility' sensing methodology.

Measuring Discontinuity

Any sensible organizational agility measurement needs to begin by examining the non-linearities in and around the business. Fortunately in this respect, the trends and Evolution Potential aspects of the SI toolkit have provided a comprehensive map of possible technical and business 'step-changes'. In effect when taken together, the SI discontinuous evolution trends define all (so far!) known successful discontinuities. When we map the step changes that take place in a given industry as a function of time – Figure 1 shows an example – we are able to calculate a 'jumps per year' for that industry.

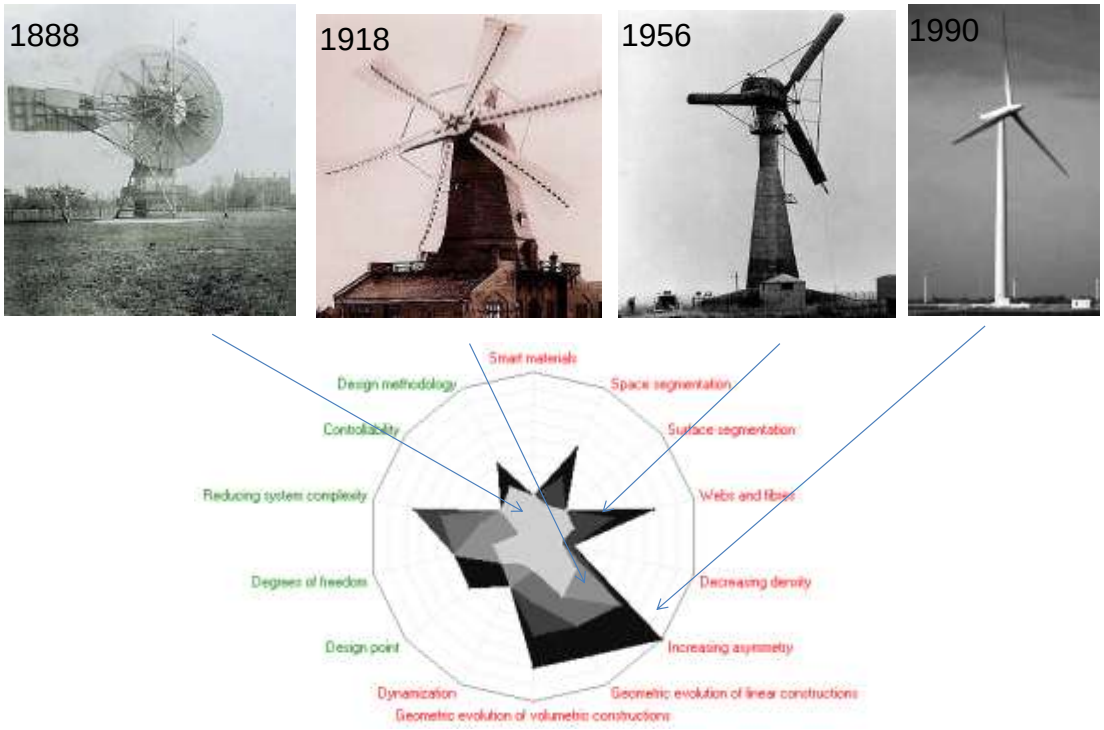


Figure 2: Technology Step-Change Rate In Wind Turbine Industry

Given the fact that we construct thousands of these radar plots for every new solution we add to our database, it is relatively easy for us to calculate the step-change-rate for any industry, or portion of industry. The only real problem with this kind of picture is it fails to take full account of disruptions from 'other industries'. As is now well known from the TRIZ/SI research, most innovations come from outsiders and new players to a domain. A meaningful 'agility' measurement needs to take such possibilities into account. The way to ensure this happens is to re-frame the Evolution Potential lens away from a specific industry ('wind-turbines') and towards the functions delivered by that industry ('produce power' in the case of the wind-turbine sector). Agility measurement, in other words, starts from discontinuity rate of any players delivering the same functions as you.

Now we really get into some heavy-duty processing work. In effect all of the thousands of radar plots for any system delivering a given function need to be constructed and then overlayed on top of each other. Fortunately, there turn out to be not that many different functions. As discussed in last month's article, there are in fact less than fifty functions that need to be considered. And even there, the world divides into a smaller number of

'primary' and 'secondary' functions. Figure 3, compiling masses of step-change data, plots the current step-change rate for the world's primary functions:

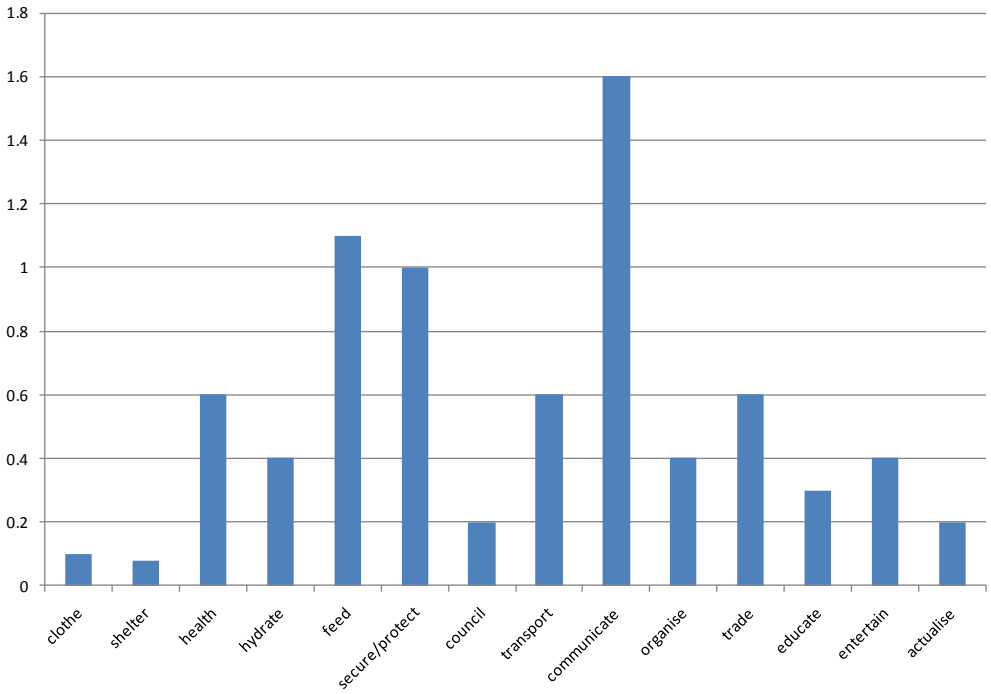


Figure 3: Step-Change Rates For Global Primary (Technical) Functions
(don't try this at home… unless you have a few million datapoints laying around)

In addition to this mapping of the technical world, our agility measurement also needs to take into account the equivalent rate of step-change in the 'business' domain. The picture here has traditionally been somewhat more 'fuzzy'. Mapping technology flux is possible because we are able to tap into a pool of patents measurable in the tens of millions. There has been no business equivalent of this database. Until recently, when we finally collated a critical mass of analyses across the innovation spectrum. Figure 4 illustrates the main idea:

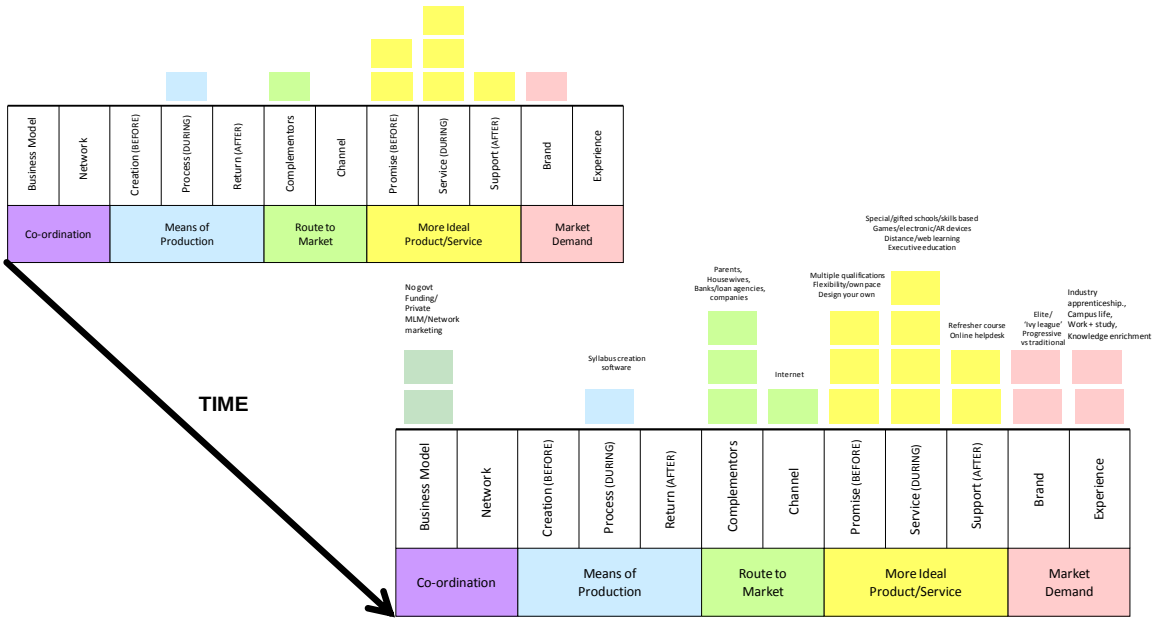


Figure 4: Step-Change (Business & Technical) Rates For Example 'Educate' Function

The figure shows the 'where to innovate' template and the idea of mapping the innovations across each of the twelve main innovation opportunity areas as a function of time. Clearly, the twelve areas cover both technical and non-technical territories. As far as our agility measure is concerned, our primary interest here are the business-related categories. As with the technical Evolution Potential, it is important to construct these pictures at the primary and secondary function levels in order to capture the full disruption potential.

Connecting Global To Local

Having uncovered a means of calculating global step-change rates, the job of creating an agility measure for a given organization becomes relatively simple. We have been dividing the measure into two categories in our recent analyses; the first looking at a measure of technical agility; the second looking at business agility. We define the two as follows:

$$\text{Technical Agility } (A_T) = \frac{\text{current technical Evolution Potential change rate for company}}{\text{global step change rate for functions delivered by company}}$$

$$\text{Business Agility } (A_B) = \frac{\text{current business step-change rate for company}}{\text{global business function step change rate}}$$

Having calculated these two numbers, it is possible to map them as points on a simple map as shown in Figure 5.

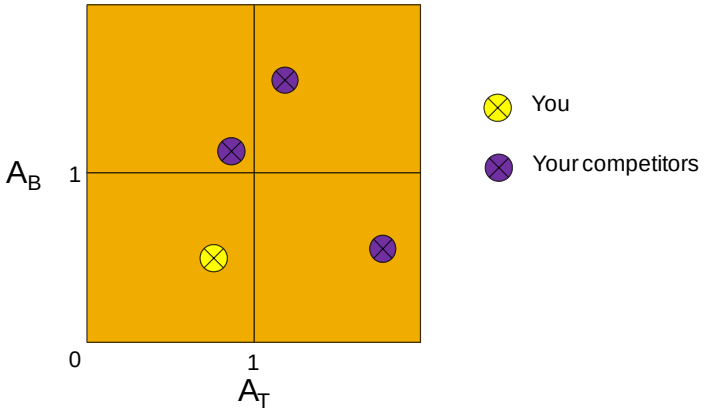


Figure 5: Agility Map

As shown on the map, as soon as there is a means of calculating something, it becomes possible to benchmark different organizations against a common set of metrics. When the map is drawn as a 2x2 Matrix like this, it is usual to give a label to each of the quadrants. Figure 6 illustrates the suggested meanings of each in the case of the Agility story:

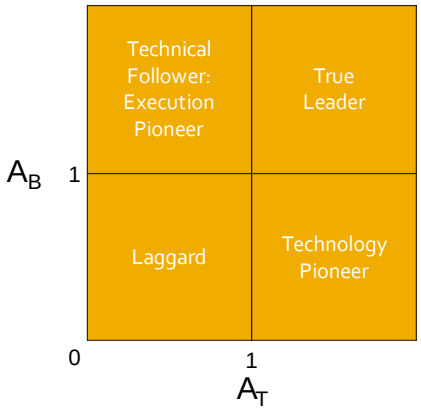


Figure 6: Agility Map Quadrants

As per convention, the bottom left box is the one not to be in – this is the box which says the company lags the domain step change rate in both business and technical terms. Anyone in this box is a laggard, becoming progressively further and further behind others in the domain in terms of both business and technology step-change.

The bottom-right box represents the classic technical innovator territory. Companies finding themselves in this box are out-innovating their competitors technically, but are lagging in terms of their ability to commercially exploit their technical success.

The converse of this situation is the top-left box. Organizations finding themselves in this territory are the ones typically viewed as 'fast followers': they let someone else take the lead technically, and then earn a place in the market by executing brilliantly and making sure they stay ahead of the game in terms of the manner in which they innovate their business processes.

Finally, and again consistent with usual convention, the top-right hand box represents the territory occupied by those that successfully resolve the either/or contradiction and manage to beat their competition in both technical and business step-change agility. In agility terms, an organization scored in this box is what we might think of as the 'true leader'.

Requisite Agility

Alas, being a 'true leader' in agility terms is not the end of the story. For a start, nothing we have talked about so far as explicitly brought the customer and more specifically the rate of change of the customers' behavior into the story. We'll talk more about this in next month's follow-on to this article. The danger in not considering the customer relates to the classic John Naisbitt quote, 'don't get so far ahead of the parade, no-one knows you're in the parade anymore'. Finding yourself in the true-leader territory means you are highly agile (good!), but possibly looking to make jumps faster than the future market demands.

Which leads us to the main message of this article, and the idea of requisite agility. Figure 7 indicates what 'requisite variety' means in the context of the agility map:

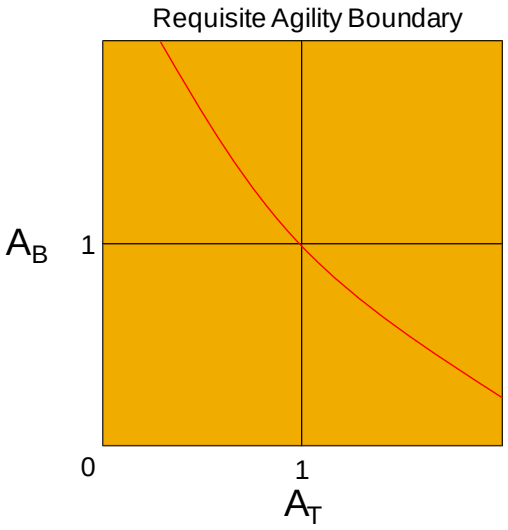


Figure 7: Requisite Agility

In line with the classic cliché involving the two men being chased by a bear, 'requisite agility' is about not being the person the bear catches. In terms of the Figure 7 map, this means being above the red line.

Most notably, the red line passes through the centre of the map. This point denotes the position whereby the organization is exactly matching the domain agility in both technical and business step-change terms. On either side of this point, 'requisite' is taken to mean that it is possible to earn our way in life with a below industry technical change rate provided that we have a business step-change agility some way above the average. And vice-versa.

Measuring The Agility Of My Company

As discussed earlier, making a meaningful calculation of Agility demands a lot of data. Few if any organizations are in possession of the information necessary to do the job. Partly because the world has historically changed at a slow enough pace that it wasn't necessary to collect the relevant information, and partly because it demands going outside one's own domain in order to adequately capture disruption potential.

Having been accumulating the relevant data for every industry for the last 16 years, we're now in a position to offer the capability to our client organizations.

We can all see that agility is becoming the new business driver. Now, for the first time, we can measure precisely what it means. And, therefore, what we need to do to make sure we're not the one caught by the bear.

ApolloSigma:
Evolving IP Robustness Measurement Capability

Back in April (SI e-zine Issue 97), we first introduced the new ApolloSigma IP robustness evaluation tool. The basic motivation for developing the capability was to provide organizations with a tool that could be used pro-actively to help write new invention disclosures as well as analyzing already published IP. Since April, we have been running the software across a variety of different scenarios in order to assess its basic value and, more importantly, to see how and where it needs to evolve in the future. The purpose of this article is to report and review some of the first of those evolution steps.

Figure 1 illustrates a typical output obtained from the multi-point plotting version of the tool. The picture shows an analysis of the patent portfolio of a company business unit. In this case, the company patent portfolio comprises close to 250 granted patents

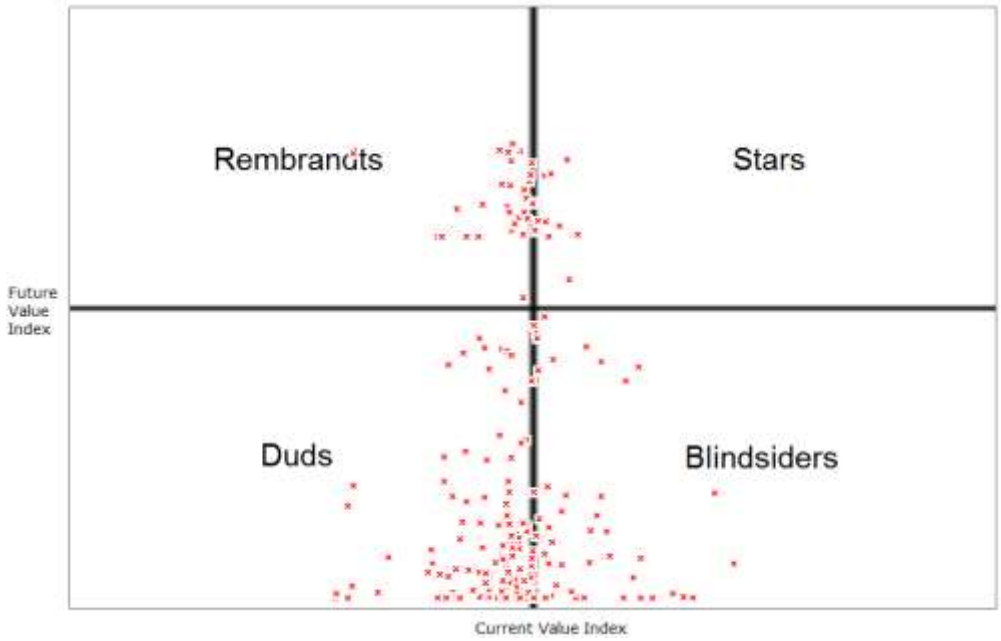


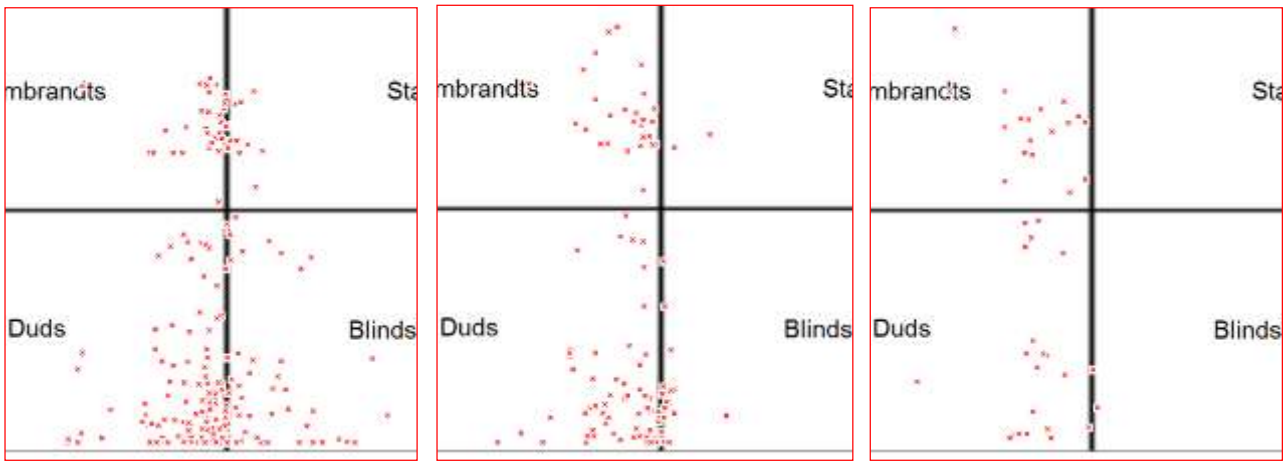
Figure 1: Typical ApolloSigma Analysis For A Single Company Patent Portfolio

The ApolloSigma tool is aimed at three main target audiences; strategic management, IP managers and inventors. The Figure 1 plot is primarily of use to the second of these three groups. Annual renewal fees on patents represent a not inconsiderable level of investment for a company, and with even just 250 patents on the books, it becomes difficult to work out which patents are delivering value and which are not. Although ApolloSigma is a completely automated tool and therefore at best what we think of as a 'gist'ing tool, it does give an immediate means of at least beginning the task of prioritizing where to consider renewing and where not. The Figure 1 picture is designed to be the sort of thing IP Managers would benefit from when looking at their patent portfolios from the 'should I renew or not?' perspective.

Benchmarking

From a strategic point of view, assessing our own IP portfolio needs to be complemented by a corresponding look at the IP of our competitors. In the case of the company who's

patents are mapped in Figure 1, they live in a market with two other main competitors. Figure 2 shows what happens when we place the analyses for the three different companies next to one another:



Company A Company B Company C

Figure 2: Comparing IP Portfolios For Three Competing Organisations

This picture comes from a real analysis. The details of the industry and companies concerned aren't desperately relevant to our discussion here. What is interesting, however, are some of the conclusions we can begin to draw from the analysis. First up, none of the three organizations has a portfolio full of 'stars'. This by itself shouldn't be too surprising since the ApolloSigma calculation algorithms are scaled to recognize that 97% of all patents fail to deliver any real value to their owners.

Company A in this analysis certainly has the biggest portfolio. They seem, however, to also have a proportionately higher number of weak patents. That's 'weak' in the sense of vulnerability to future disruption – i.e. they have a low Future Value Index (FVI).

Both Company's B and C have a large number of patents in the 'Rembrandt's category, many with higher FVI scores than the Rembrandt's in Company A's portfolio. Company C, although it has the smallest portfolio in terms of total number of patents (which shouldn't be too surprising since they are the smallest of the three companies overall), has the highest proportion of high FVI patents. As such, in terms of their future disruption ability, they are quite probably the strongest of the three players. Coupled with the fact that they have a lower Current Value Index (CVI) on average than the other two players largely because they are a smaller organization, and the emerging message to Company A is that they might need to do something to redress the balance…

Time Effects

…again, ApolloSigma is very much a fully automated tool aimed at providing users with 'gist'ing information. Averaged out over lots of data, however, and it will provide a host of patterns useful in the formulation of strategy and strategic options. Changes in IP performance as a function of time is the next important dimension we have been exploring. Figure 3 shows the sort of output possible from the ApolloSigma software. This sequence of plots shows the patents for Company A drawn as a function of time. Each plot in the sequence shows the patents granted in a given calendar year.

The main message observable from this sequence of plots is that Company A doesn't appear to have evolved the strength of its IP (or their ability to draft patents) over the

course of the last decade: patents granted in 2001 show a similar split between high and low FVI as was achieved in 2009.

Figure 3: Company A's IP Portfolio As A Function Of Time

This pattern turns out to be fairly typical. And unsurprising – unless people within an organization become familiar with the SI trends – the primary basis upon which the Future Value Index is calculated – then there is no reason to believe that more robust IP will be generated.

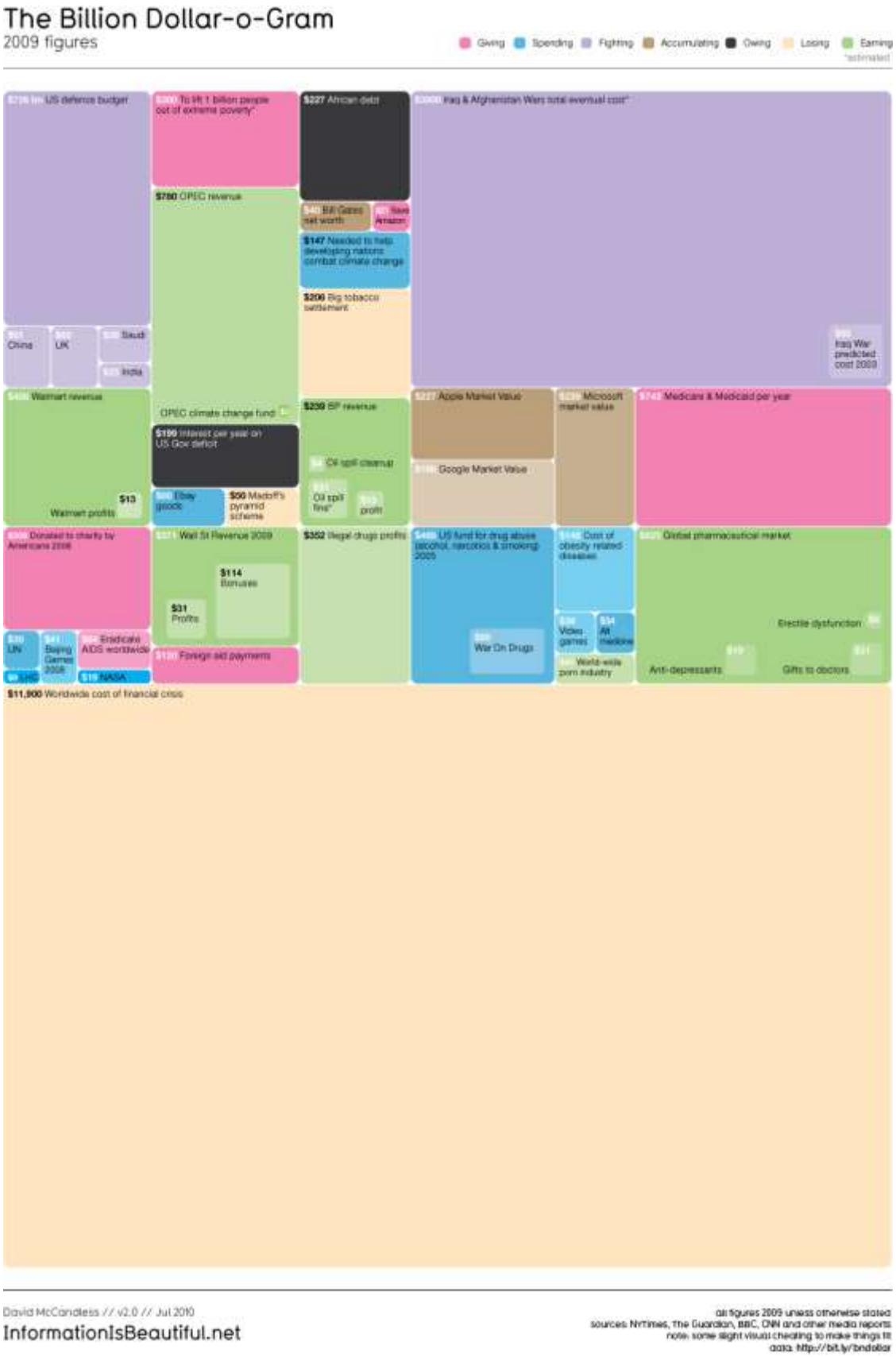
It is still early days for everyone when it comes to the creation of more 'future-proof' patents. Step 1 in any improvement initiative is the ability to measure capability. It is hoped that ApolloSigma is making such measurements not just possible, but practically achievable for large numbers of patents.

By way of a simple example, the SI research team collectively spent several hours each month trying to decide the candidates for our 'Patent Of The Month' e-zine spot. Of course, the decision is driven by other factors above and beyond the future-proofness of the solution (like, for example, 'does it make for an interesting story?'), but even so, running all of the month's patents through the software has reduced the search time by close to an order of magnitude.

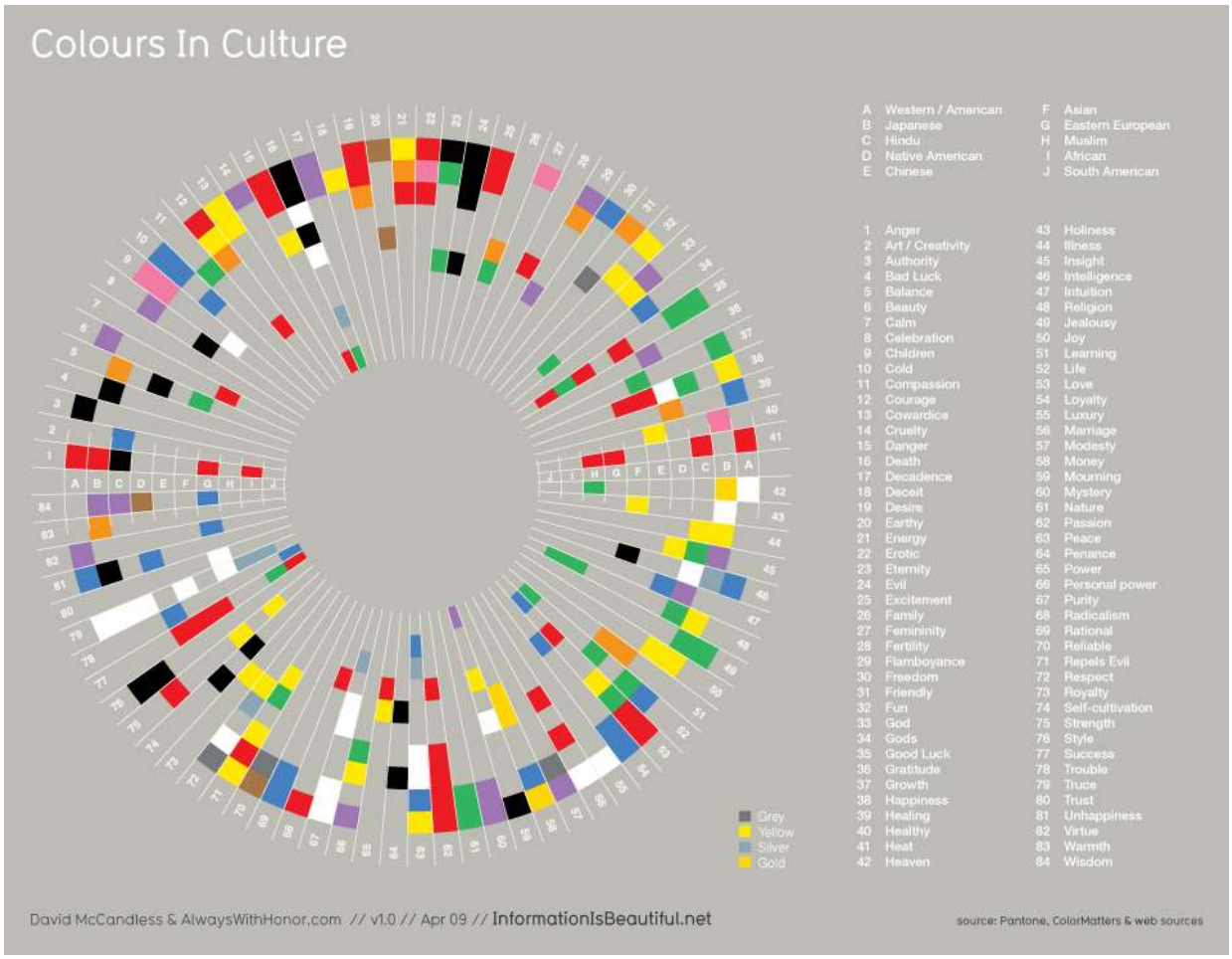
Anyone interested can try ApolloSigma out by visiting:
www.systematic-innovation.com/ApolloSigma

Not So Funny – The 'Billion Dollar-O-Gram'

From the utterly brilliant David McCandless, a sobering thought about the GFC:



Nobody presents information as elegantly. We also have something of a soft spot for this one too:

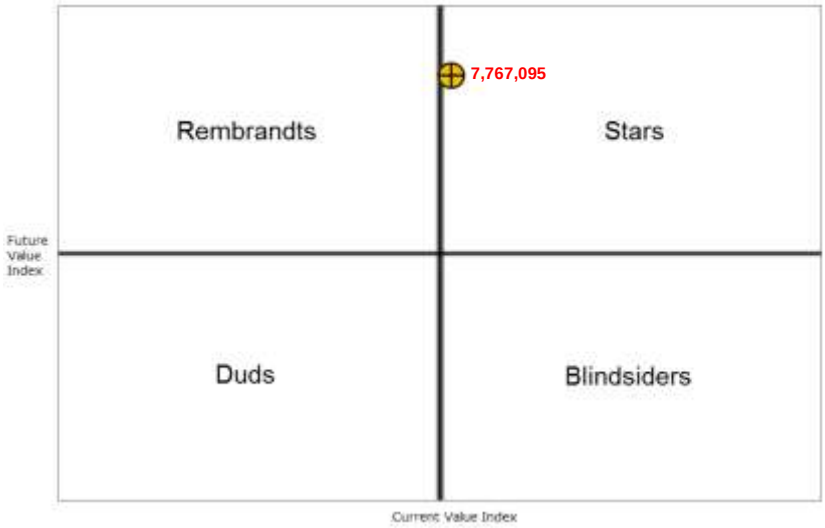


Seems like clothing colour schemes that make sense in one culture can easily have a very different impact in another. You won't catch me wearing my blue shirts in Brazil any more that's for sure.

To get the full effect of the hard work each picture requires, take a look at www.informationisbeautiful.net. There, that should keep you busy for a few hours.

Patent of the Month - Pathogen Reduction Using Chloramines

Our patent of the month this month takes us on a rare journey to the world of chicken farming and specifically ‘processes which allow for the safe and economic recovery, treatment and reuse of certain poultry processing water, specifically including the "carcass final rinse," "inside/outside carcass rinse," "water rails", water sprays used in the inspection process, scalders, instruments, flume transport of various animal parts, water from the communal chiller bath and other smaller streams with respect to poultry processing operations and other food processing applications, like red meat washing, fruit and vegetable washing, retort cookers and pasteurizers’. Sounds fairly gruesome. We wouldn’t normally have spent much time looking at IP in this area (shame on us!), but when we ran this month’s patents through ApolloSigma, this is what we saw for our invention from inventors at the Zentox Corporation:



Truth be told, it is unusual for a new patent to immediately reveal itself as a ‘Star’. The reason being that part of the Current Value Index score comes from looking at forward citations and, almost by definition, a newly granted patent – 3 August – is highly unlikely to have had time being cited by other inventors.

So what made our software pick out this solution? Alas, the inventors get into quite some detail in their problem description, and so unraveling the story wasn’t that easy. The essence of the invention, however revolves around the need to simultaneously conserve and sterilize water, primarily in the poultry processing industry, but ultimately in any ‘foodstuff’ domain (as described in some of the Claims).

Here’s what the background description tells us:

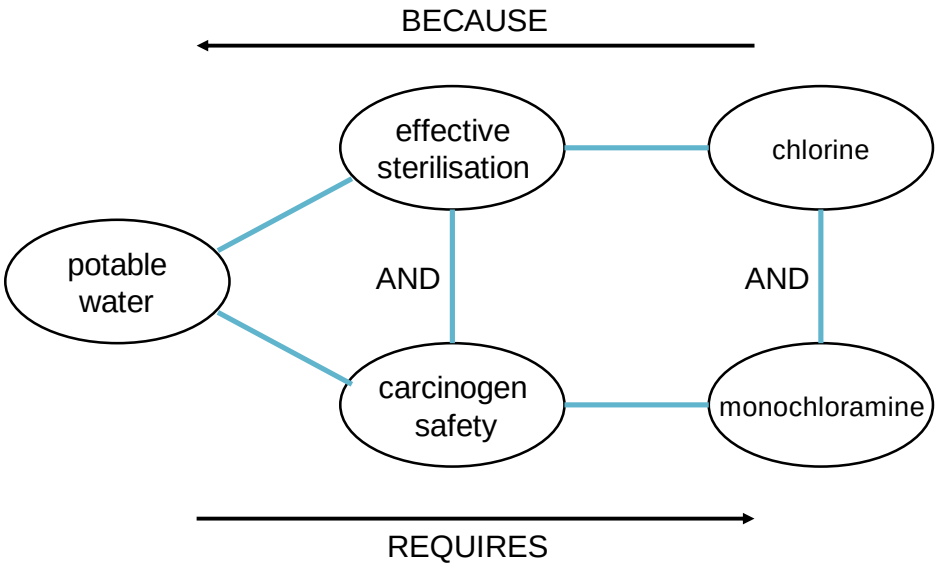
Because of its efficacy in inactivating a wide range of microbes, chlorination became the standard method for disinfecting potable water in both the water treatment plant and in the distribution system.

However, the reaction of chlorine with naturally occurring organic matter (NOM) in the water can result in the formation of suspected carcinogens such as chloroform, which is in the group of potentially dangerous disinfection byproducts called trihalomethanes. Growing public health concerns gave rise to the Safe Drinking Water Act Amendments of 1996, which required the U.S. Environmental Protection Agency (EPA) to develop new drinking water regulations, including rules to address simultaneous compliance of microbial disinfection and disinfection by product generation.

And then:

Because of its chemical characteristics, monochloramine, a slow-reacting and persistent anti-microbial agent that is not prone to react with organic matter, gained widespread use in programs designed to meet the new rules. This chlorine species is generated by the controlled mixing of chlorine and ammonia in water. Currently monochloramine is used primarily to provide a residual biocide in potable water distribution systems. Because of its relatively low antimicrobial efficacy, monochloramine is not generally used as a primary disinfectant in potable water treatment.

Which all comes together to say:



Which in turn tells us that this invention cannot simply be about replacing chlorine with monochloramine; the monochloramine is simply not up to the job because it is not reactive enough. However:

…undesirably, any free chlorine added to high-demand waters rapidly reacts with the organic constituents and is consumed in seconds, becoming unavailable for disinfection. Monochloramine, which is less reactive and more persistent, remains available to inactivate the microbial population and therefore, under these conditions can be a more effective disinfectant than free chlorine. It has been found that monochloramine treated process waters produce a nominal one log (10 fold) reduction in pathogen levels over those treated with equivalent concentrations of sodium hypochlorite (free chlorine). In organically laden water, chloramine disinfection is a more effective disinfecting agent than free chlorine.

So, step one, the inventors have tapped into a previously untapped resource: monochloramine becomes more effective in ‘organically laden water’… such as, hey, a poultry processing plant. But that’s not all either, because in another inventive step the inventors also uncovered the fact that:

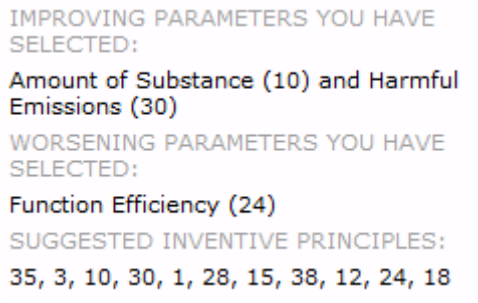
…additional food safety benefits are offered by the invention due to the fact that advantageously dosed chloraminated water is being returned to a number of "upstream operations" such as scalding, picking, stunning and flume type operations. The treated reuse water being directed to these reuse points is treated with chloramines at an advantageous dosage. It was surprisingly discovered that such advantageously dosed chloraminated reuse water is beneficial to the reduction in microorganisms on the carcasses being processed using said reuse water.

Which again in layman’s terms says that because the chloramines are more persistent than chlorine, they can be ‘recycled’ and returned to earlier processing steps:

…the device of the present invention allows for maximum removal of solid matter, floatable fats, oils, and grease, animal parts including skin, small body parts and detritus. The early removal of these constituents at or close to the source of the water from wash or rinse cabinets provides far greater efficiency and reduces significantly the complexity of treatment components in the later treatment stages of the integrated water recovery process. It was surprisingly discovered that by removing a greater mass of constituents at, or close to the recovery source, a greater impact on downstream water treatment economics was obtained.

i.e. they now also save a lot of water that would otherwise be sent to the drains.

Here's what the problem looks like when mapped onto the Contradiction Matrix:



Interesting to note that the two main strategies deployed by the inventors: firstly a shift from one agent to another (Principle 35) and the re-introduction of the monochloramines to upstream process stages (Principle 10) are both contained in the list of recommendations. This doesn't explain the high ApolloSigma score. What does that is the fact that the Claims are well written, a contradiction has been challenged and, overall, the inventors have made very effective use of existing resources. Amen to that as an innovation strategy.

Best of the Month – Making Breakthrough Innovation Happen

Many thanks to Prashant Joglekar for passing us a copy of this sly gem of a book during my last trip to India, back in May. And shame on me for taking this long before the book found its way to the top of my reading pile.

The book is also pretty difficult to come by outside of India. Probably because if any company executive in the West got a hold of it there'd be an outbreak of mass panic. The eleven extended case studies which make up the vast majority of the book all make for an amazing testament to what people are capable of when they set their minds to something:

- Western vaccines sell for an unaffordable 750Rs, so we'll develop one that will sell for 15
- I want my newspaper to have the number one circulation figures on the first day of launch
- I want to eliminate *all* cataract-caused blindness in the world
- Normal convention says that I will need 7000 officers to police my city, I will do it with my existing 260
- The (Western) company HQ is about to kill off my main product, I will transform it into the company's best product?
- I want my agricultural products to overtake Western MNCs even though currently they are 100 times bigger than me

Every story in the book is source of at least one wow moment. And an absolute testament to the triumph of stretch-goals and determination over whatever hurdle turns up. My main learning from reading the book as a whole was that none of the stories in the book described the use of any kind of method. If someone is determined enough, they may go and find the relevant tools, but whether they do or not, they will get to where they want to be anyway. And given an environment in which there are millions of people hungry to be successful, hungry to show the world what they can do, hungry to make a difference, the rise of India begins to look like a foregone conclusion.

Although no tools are mentioned, never mind TRIZ, the next amazing thing is how, once the big goals were set, the innovation teams successfully solved a string of technical and business conflicts and contradictions. The watchmaker Titan Edge were told by Swiss manufacturers that it was 'impossible' to make a watch 3.5mm thick, so, rather than listening to the masters, engineers at the company took it upon themselves to show the Swiss how to do it. And they did it. They did it by solving one contradiction after another

(the glass needs to be 0.3mm thick and that means it won't be strong enough; the casing will be too thin so the watch won't be waterproof; the battery will be so thin it will have insufficient life; opening the back of the watch to put in another battery more often will destroy the waterproofing; and so on).

You don't need tools to solve contradictions, the message seems to be, you just need sufficient will and determination to overcome them. (Imagine what adding tools to the mix might do!)

Author, Porus Munshi, talks throughout the book about the idea of 'orbit-shifting' innovation. If his company hadn't trademarked the name, I'd have said that it was a great way of describing what all innovation is ultimately about. Within SI, we define innovation as 'successful step-change'. An orbit-shift is a far more evocative and meaningful term for step change. It's better because it conveys an image of moving further and further into the unknown, and everyone recognizes that there needs to be an input of energy in order to rise from one orbit to another. The metaphor also allows the introduction of other elegant metaphors like 'escape velocity' and 'gravity'.

As we know from our globally connected statistics, well over 90% of innovation attempts fail. After reading this book, we're rapidly coming to the conclusion that the predominant reason for this level failure is that most organizations simply fail to set the necessary emotional goals within their teams. Emotional engagement beats the profit and loss account every time.

Conference Report – (Almost At The) India TRIZ Conference

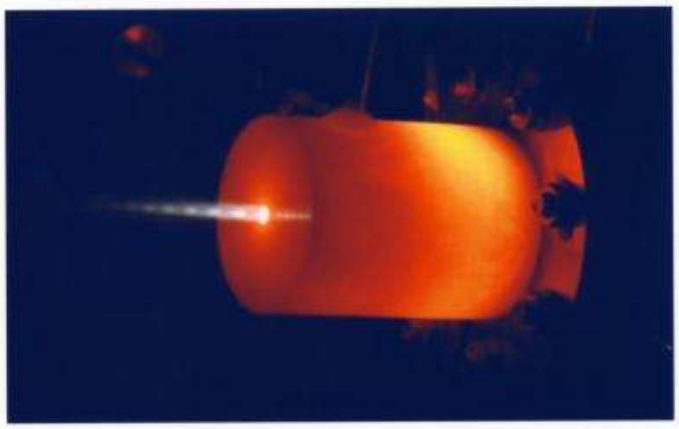
In theory I was supposed to be providing an in-person footnote presentation to the first Indian TRIZ conference. In practice it turned out that I couldn't get to Bangalore in time. And then we couldn't even make Skype work either. All in all, a bit of a disaster.

A real pity as it turns out since the event was attended by close to a hundred delegates. Interested readers should check out good friend, Ellen Domb's running commentary at TRIZ Journal. Anyone interested in our meager offering – 'TRIZ Evolution For Innovation Revolution' – can download the slides from the Free Downloads page on our website.

Hopefully we'll get to make full amends at next year's event. Hopefully.

Investments – Sustainable Wastewater Treatment

Within the sludge of wastewater treatment plants is an invisible world teeming with microbes. Here, diverse species of bacteria convert solid and liquid wastes into gases, some of which contribute to global warming.



Two Stanford University engineers recently announced they are developing a new sewage treatment process that would actually increase the production of two greenhouse gases - nitrous oxide (aka, "laughing gas") and methane - and use the gases to power the treatment plant.

"Normally, we want to discourage these gases from forming," said Craig Criddle, a professor of civil and environmental engineering and senior fellow at the Woods Institute for the Environment at Stanford. "But by encouraging the formation of nitrous oxide, we can remove harmful nitrogen from the water and simultaneously increase methane production for use as fuel."

Criddle, an expert in wastewater management, has joined forces with Brian Cantwell, a professor of aeronautics and astronautics, who has spent the last five years designing rocket thrusters that run on nitrous oxide. With support from a Woods Institute Environmental Venture Projects grant, Cantwell and Criddle are applying that rocket technology to sewage treatment, with the goal of making the process energy neutral and emissions free. "We want to reduce the cost of wastewater treatment, increase energy generation and eliminate greenhouse gas emissions," Cantwell said, "for too long we've thought of treatment plants as places where we remove organic matter and waste nitrogen," Criddle added. "We need to view these wastes as resources, not simply something to dispose of."

Microbial zoo

For Criddle and Cantwell, the first step in building a green treatment plant is raising the right kind of bacteria. "We're really managing a zoo," Criddle said. "To get the right microbes, we need to encourage the growth of bacteria that produce nitrous oxide gas." One way to accomplish that is by reducing the bacteria's oxygen supply, he said. Conventional treatment plants pump air into wastewater sludge -- a process called aeration. The idea is to convert nitrogen waste into harmless nitrogen gas by promoting oxygen-loving bacteria that thrive on sugars and other organic matter in the sludge. But aeration is a costly and energy-intensive process. As an alternative, the Stanford team wants to create a low-oxygen environment in the treatment plant, where nitrous oxide-producing bacteria are favored, while aerobic species die off.

These nitrous oxide producers consume relatively small amounts of organic matter. That's good news for other anaerobic microbes that produce methane gas by feasting on organic compounds. "When bacteria make nitrous oxide, less organic matter is oxidized, so more can be converted into methane -- potentially two or three times more than is possible in a typical treatment plant," Criddle said. "That extra methane can be used as fuel to run the plant independent of outside power sources." Using less oxygen also could reduce costs, Cantwell added. "In a typical treatment plant, aeration is responsible for about half of the operating expenses," he said. "So pumping less oxygen could save a lot of money."

Rocket science

In recent experiments, the researchers demonstrated that under laboratory conditions nitrous oxide gas could be produced from wastewater using a low-oxygen technique. But there's a downside to the process. Nitrous oxide is a significant greenhouse gas that's more than 300 times more potent than carbon dioxide. That's where Cantwell's rocket thruster comes in. Designed for use in spacecraft, the thruster runs on nitrous oxide -- a surprisingly clean-burning propellant.

"When it decomposes, nitrous oxide breaks down into pure nitrogen and oxygen gas," Cantwell explained. "At the same time, it releases enough energy to heat an engine to almost 3,000 degrees Fahrenheit, making it red hot, and it shoots out of the engine at almost 5,000 feet per second, producing enough thrust to propel a rocket."

In 2008, Yaniv Scherson, one of Cantwell's graduate students, was looking for a suitable topic for a doctoral thesis that would incorporate the thruster research. "We wondered whether nitrous oxide could be exploited as an emissions-free source of energy," Cantwell said. "Since the product of the decomposition reaction is simply oxygen-enriched air, energy is generated with zero production of greenhouse gas. But first we needed to find a cheap, plentiful source of nitrous oxide."

Scherson eventually turned to Criddle, who had spent years studying microbial communities in wastewater treatment plants. Criddle explained that wastewater sludge contains bacteria that naturally convert nitrogen wastes into nitrous oxide, providing Scherson a cheap source of the gas. Soon, Scherson, Criddle and Cantwell joined forces in a unique experiment bridging two very different fields -- space propulsion and environmental biotechnology. "It took a couple of rocket scientists to make this happen," Criddle said.

The result was a novel design with the potential for treating the world's wastewater: First, reduce oxygen levels at the treatment plant to encourage the production of nitrous oxide and methane gas. Then use the extra methane to power the plant and a small rocket thruster to break down the nitrous oxide into clean, hot air. "A single thruster about the size of a basketball could potentially consume every ounce of nitrous oxide produced by a typical treatment plant," Cantwell said.

New generation

Most treatment plants in the United States are using technology developed in the 1970s and are in dire need of an overhaul, according to Criddle. "In the U.S., we haven't invested much in wastewater treatment in recent decades," he said. Cantwell envisions a new generation of plants that are energy self-sufficient. "You even have the prospect of installing a wastewater facility where there is no energy source," he said. "This could be especially important in the Third World, where millions of people live with contaminated water." Both researchers say that the technology could have other applications beyond wastewater treatment. For example, they also want to explore ways to recover energy

from nitrate-contaminated groundwater beneath fertilized agricultural fields. "We're thinking very broadly about all the ways nitrogen gets into the environment, and how we can exploit it," Cantwell said. "If successful, this technology could be a game changer, with the potential for worldwide impact on several fronts," Criddle said.

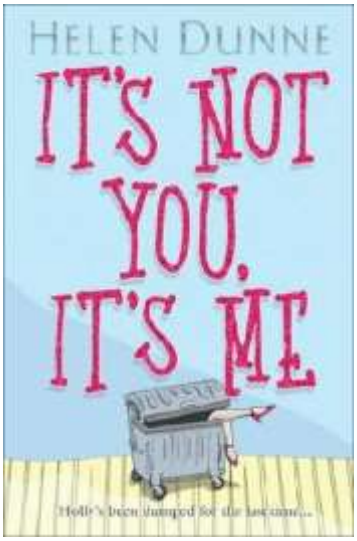
Restoring the Earth's nitrogen cycle

The world's supply of nitrogen exists in a never-ending loop, moving from the atmosphere to nitrogen-fixing bacteria to plants and animals, then back to bacteria and, eventually, to the air. But humans have broken this natural cycle, according to Criddle. "We now take more nitrogen from the air, mostly through the manufacture of agricultural fertilizers, than we give back," he said. Tons of excess nitrogen fertilizer also flow into groundwater, rivers and eventually out to sea, where it feeds massive algal blooms that can damage marine ecosystems. Nitrogen also impacts human health. Too much nitrate in drinking water can be harmful to infants and pregnant women, according to the Centers for Disease Control. "Slowly but surely the world is being contaminated with waste nitrogen," Cantwell added. "Restoring the balance is a critical thing to do for the future of the planet." Farmers lose money when nitrogen is wasted, Criddle added. "But with the right technology, the balance of the nitrogen cycle can be restored and value recovered from waste nitrogen," he said. And Criddle looks forward to a world where nitrogen once again runs in a sustainable loop - and at a profit. All achieved by making better use of existing resources. And, via a cunning use of Inventive Principle 13 (did you spot it?) cunningly solving a contradiction or two.

Generational Cycles – It's Not You, It's Not Me

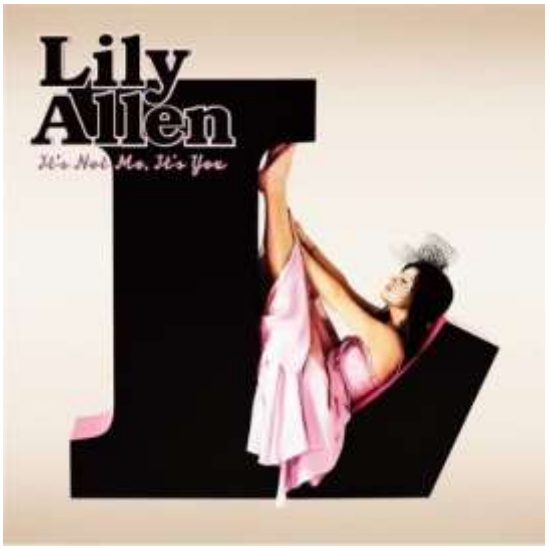
Of the sometimes enormous differences between Generation Y and Generations one of the more telling can be seen in the near-cliché couples break-up reasoning 'it's not you, it's me'.

The expression first appeared with mid-period Gen x'ers as a polite, non-confrontational way of explaining away why things were not going well. GenX author, Helen Dunne, even turned it into the title of one of her alienated-but-can-still-laugh-about-it chick-lit books (another very Generation X invention).



It also took on a slightly more edgy version of alienated in certain quarters. Like the Roy Lichtenstein spoof use of the slogan. It might be my fault, the upset superwoman character is saying, but you're still going to be eating hot lead for dinner.

But then, in February 2009, events took a step change in a different direction when iconic Generation Y superstar, Lily Allen and self-appointed spokesperson for her heroic cohort, released her sophomore album:



And so the generational shift turns the world on its head. Now the break-up is very definitely your fault. And if you don't believe her, she'll set her dad on you. So there.

SYSTEM·ATIC INNOVAT·ION

Biology – Spiny Lobsters (Do The Conga)

From the shallow waters to the depths in all the oceans of the world, and particularly in tropical regions, and in the seas a number of creatures migrate in various ways. Some creatures migrate from time to time, while others do so continuously. One of the most notable marine migrants is the lobster.

Towards the end of autumn, weather conditions in the region inhabited by the lobster are very changeable. Due to high air pressure, it becomes very windy. The sky darkens, rain falls, and the temperature drops. At the same time, the wind creates large waves in the shallows inhabited by lobsters, making the water turbid. This signals the start of the lobsters' migration season.

It is not known exactly why lobsters migrate in autumn or how they time it, but available information points to the influence of environmental factors. Sudden temperature changes and intense water movements may prompt lobsters to change their environment. The important point is that lobsters notice the climatic changes, understands that these conditions constitute a risk, and take precautions accordingly. But to take these precautions, they must know what the best habitat is, and how to get there easily. After making these decisions, they head off in a highly organised fashion.

Lobsters usually migrate to calmer waters, and their journey is a remarkable sight. As many as fifty lobsters come together to form a column, with each lobster positioning itself so as to touch the one in front. In this formation, they walk along the sea floor for a number of days and nights.

The convoy members maintain their respective positions by establishing continuous contact with the abdomen of the lobster in front, using their antennules and the tips of their foremost legs. Even if their antennae are removed, this contact is not disrupted. A lobster whose antennae have been removed will increase the frequency with which it touches the lobster in front with its foremost legtips. If these are also removed, the lobster will make use of the tips of its second legs. In this way, even if a lobster cannot see in murky water, the queue is preserved. When contact with the lobster in front is lost, water motion caused by the lobster ahead is probably used by the lobster behind to regain contact, while chemical stimuli show it that it is following a lobster.

When lobsters make a communal decision to migrate, a journey in single queue is advantageous in several ways. Primarily, group action saves the lobsters along the way from having to face potential dangers alone, because all available eyes and antennae are being used at the same time to perceive and avert possible enemies. On the migration route, when they encounter attacks from large fish, the leader starts to turn. Sensing this, the other members are alerted to the danger and also follow the leader around coiling into a circle and forming defensive pods or rosettes to repulse the predator. Under normal circumstances they would quickly become a meal, but this precaution protects them from the enemy. A lobster's most vulnerable part is its abdomen, and they sustain the most damage in this region. When they are lined up, the lobster behind covers and protects the abdominal region of the lobster in front.

While migrating, queuing also gives lobsters improved mobility. The drag a single lobster encounters as it advances through water is halved if it follows another lobster. Thanks to this efficiency, they can cover greater distances in a shorter time. Some species have been clocked at a speed of 1 kilometer per hour.

This use of a conga-line convoy ‘merging’ (Principle 5) is about overcoming a number of conflicts. They can be summarized as follows:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Length/Angle of Stationary Object (4) and Productivity (44)

WORSENING PARAMETERS YOU HAVE SELECTED:

Speed (14) and Safety/Vulnerability (38)

SUGGESTED INVENTIVE PRINCIPLES:

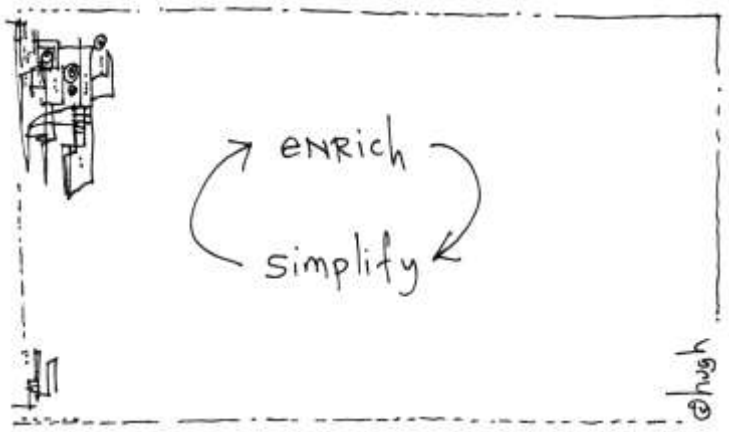
3, 14, 35, 31, 24, 4, 39, 18, 13, 17, 10, 30, 1, 5, 12, 9, 7, 19

What’s interesting about the list of Principles contained in the Matrix is what happens when the predator ‘safety’ problem emerges. What happens should the conga-line be threatened by a predator? Once a threat has appeared, the lobsters coil round into a defensive rosette, with all the pincers outwards, so that an enemy trying to attack is confronted with sharp weaponry at every angle.

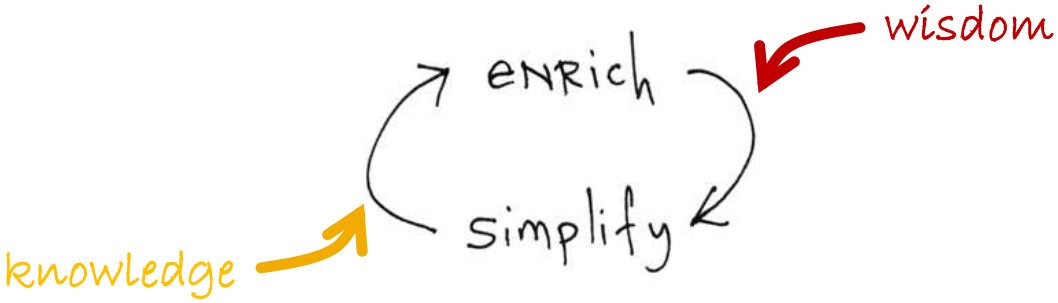
A pretty good example of a Principle 14, ‘form the wagons into a circle’ solution strategy.

Short Thort

Innovation summarized by the always-on-the-money,
Hugh McLeod:



And here's what makes the cycle work:



News

Creativity Circuit Challenge
How to get 200 of your employees exposed to and using SI tools in a single day, with a single facilitator. Sounds impossible? It probably was until we invented our 'circuit challenge' creativity boot-camp. The highly modular design of the circuit means we're able to tailor things to suit a whole spectrum of client needs. The first live challenge will take place with a client in SE Asia in September. We're hoping the concept will spread rapidly to other parts of the world.

TrenDNA B2B
Work on the B2B trend edition of the now best-selling TrenDNA book and cards is well underway, and we're expecting to see launch of the first deck of cards before the end of the year. Right now, we're looking for friendly Beta clients interested in having one of us come and run a workshop using the materials in their almost-finished form.

Japan TRIZCON
Alas, due to client commitments, Darrell won't be able to present at the big TRIZ event in Japan next month. Fortunately, co-author, Dr Paul Filmore is able to participate and so the Computer-Aided (Systematic) Innovation paper will be presented.

Innovation In Public Service Reform
Speaking of conference attendance by proxy, good friend, Eric Spain, will be presenting a TrenDNA-for-Public-Services paper at this scarily titled event to be held in Hong Kong in November. It is organized by the even more scarily titled 'Efficiency Unit' of the government. Oh to be a fly on the wall at that one. More details, as ever, on the website.

Matrix+2010
While in theory it should have been simpler to upgrade the Matrix+ software than to create the physical book, reality says that the book beat the software by several months. Which is another way of saying that the Matrix+ software has now been upgraded to full Matrix2010 status. In fairness to the software team, the new version of the software does include a host of other new features, not least of which is a new conflict mapping wizard.

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

Mining – Eyes on the World
Consumer electronics – innovation capability audit
Medical Devices – ApolloSigma IP strengthening study
Industrial – certification workshop series
Education – training workshops
Government – innovation strategy study
Medical devices – turnkey ideation-IP-design-make project