Systematic Innovation

e-zine

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In this month's issue:

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Case Studies: Finding The Root Contradiction(s)

As is often the case, we gain some of our biggest insights when things aren't going to plan. I had such an instance during one of my less successful client workshops, an asset-sweating session to reduce the manufacture costs on a simple electrical assembly. In simple terms, we got ourselves three-quarters of the way through the session, and essentially going around in circles, when someone, completely peripheral to all of the contradiction and evolution potential analysis we'd been forcing ourselves to plough through, said the now fateful words, 'why don't we just make it smaller?'

It was a classic piece of psychological inertia breaking logic that broke the erroneous assumption everyone – especially me – had made at the start of the session. The context for the session was built around a product (Figure 1) that was made in the millions every year and sold for less than a dollar. Over the course of the years since the product was first conceived there had been a steady programme of cost reduction across and along the production line and, as always happens when we start hitting the top of an s-curve, it had become progressively more difficult to obtain further cost reductions. Our ideation session was taking place because the company felt they had hit the top of this curve. Our task was to step back from the production processes to look at the design in order to see how it could contribute to further cost reductions. The designers had also apparently been involved in the cost reduction process for several years. The evidence that they'd done their job well quickly became apparent when we found ourselves unable to trim any of the components that made up the final assembly: everything had a place and function, and everything had been optimized to the top if its own component-level s-curve. In short, everything seemed like it was at the top of every s-curve. And so – 'obviously' – the job at hand was to focus on the step-change s-curve jumps that would only come from solving contradictions and jumping from one trend stage to another. Pure psychological inertia.

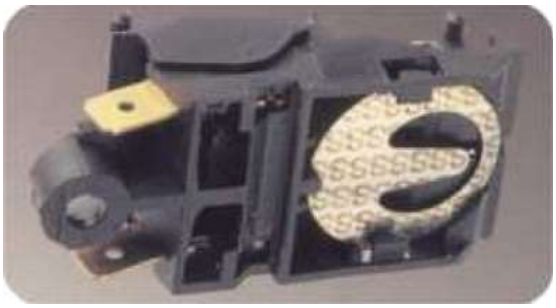


Figure 1: Kettle Switch Control

Because the previous optimization activities had focused within the boundaries defined by their component, inevitably when we started looking at how others had solved similar conflicts, the process was driving us towards super-system (i.e. the kettle into which our component was installed) solutions. But we didn't 'own' any of those solutions and moreover had no control or influence over the kettle manufacturers to get them to change the way they did things. More psychological inertia as it turns out.

The 'make it smaller' comment brought an immediate hush around the workshop room we were working in. On one level the comment was so obvious as to be not worth stating – the large proportion of the cost of the switch came from materials, so reduce cost by reducing the amount of material used. It was the solution to our problem…

…except – surely – making the switch smaller would have an inevitable adverse consequence somewhere else. If only that it would cause the kettle manufacturer the 'yes, but' challenge that they'd have to change the design of their kettle. But was that a real problem? No it turned out. There really was no reason why we couldn't make the switch smaller and accrue a significant cost saving by simply taking the same design and scaling it down so that less materials were needed during manufacture.

Stepping back from the psychological inertia driven woes of this specific asset-sweating session for a second, the problem we were facing was, of course, not a unique one. In general terms all we were doing was discovering that we thought we had hit a brick-wall contradiction when in actual fact we had not.

In a former life, I used to design gas turbine engines. The world of jet-engine design tends to see a lot less change an awful lot slower than the comparatively light-speed changes that can occur in the world of consumer electronics. In the gas-turbine world things make step changes only every couple of decades. One of the consequences of which is that the industry makes lots of incremental, component-level step changes over the years that periodically get bundled into what will become a new generation of engine. Another is that engineers and designers have a lot more time to think about the implications of their design decisions.

As in every industry, there are consistent desires on the part of customers in terms of what they want in future designs. In general, as we know from TRIZ, what motivates them at the highest level is the desire for 'free, perfect and now'. In specific terms, when it comes to gas turbine engines, that equates to four big design drivers:

1) Make it cheaper
2) Make it last longer
3) Make it burn fuel more efficiently
4) Make it smaller and lighter

Everyone in the design team knows these high level goals and everyone does what they can to contribute to achieving the overall most ideal solution. At the same time, some will discover that their ability to deliver benefit is more difficult than others. In essence what happens is that everyone takes the bit they're responsible for and looks to see what they can do to make it cheaper, more reliable, contribute more to efficiency, become smaller and use less materials. If you can imagine that the engine contains several thousand components and that each has someone responsible for them, when we ask all these individual responsibles to extrapolate their design in the desired directions until they hit a brick wall, we will quickly see that some will hit their brick wall before others. If we now get each person, when they hit their own brick wall to point at the other person or thing that causes them to get stuck, what will eventually happen is that everyone will be pointing at someone else. All except for one or two people. These poor unfortunates will find themselves in the very uncomfortable position of having several thousand people all pointing at them. The person everyone is pointing to is the owner of a root contradiction.

In an ideal world, we would get a situation where everyone is pointing to just one person. That way we'd know we've found a genuine 'root contradiction'. Unfortunately, when we are working with a complicated design like a jet engine, where there are multiple often conflicting design goals, there may well be different root contradictions for different design parameters. For a typical helicopter engine – my main area of responsibility when I worked in the industry – for the four main design drivers described above, everyone in the design team that does the design parameter extrapolation job and points to the person that causes them to hit a brick wall, ends up in a situation where everyone is pointing at two

people in particular: first up the person responsible for the design of the turbine that experiences the highest temperatures in the engine. He or she knows that the higher the temperature they can live with, the more efficient the engine will be. And then that the hotter their component is, the more difficult they will find it to achieve the design that will last for a long time. Unfortunately, their brick wall is they can never get that temperature as high as they'd like it due to all sorts of material related constraints.

The second person being pointed at will be the person responsible for designing the power turbine shaft that passes up through the middle of the engine. All the people in the design team trying to make their components smaller and lighter will ultimately find themselves pointing at this person. Basically all of the useful power from the engine needs to be transferred from the hot, high pressure gases into the mechanical linkages that will ultimately make the helicopter rotor blades turn. The power turbine shaft is the thing that does the most difficult part of this job. It has to transmit several thousand horsepower worth of torque which in turn needs a certain minimum amount of material to do. The minimum required diameter of this shaft in turn comes to drive the size of the bearings needed to hold it. Which in turn drives the size of the support structure needed to hold those bearings… and so on until we get to the outermost casings and peripherals around the engine.

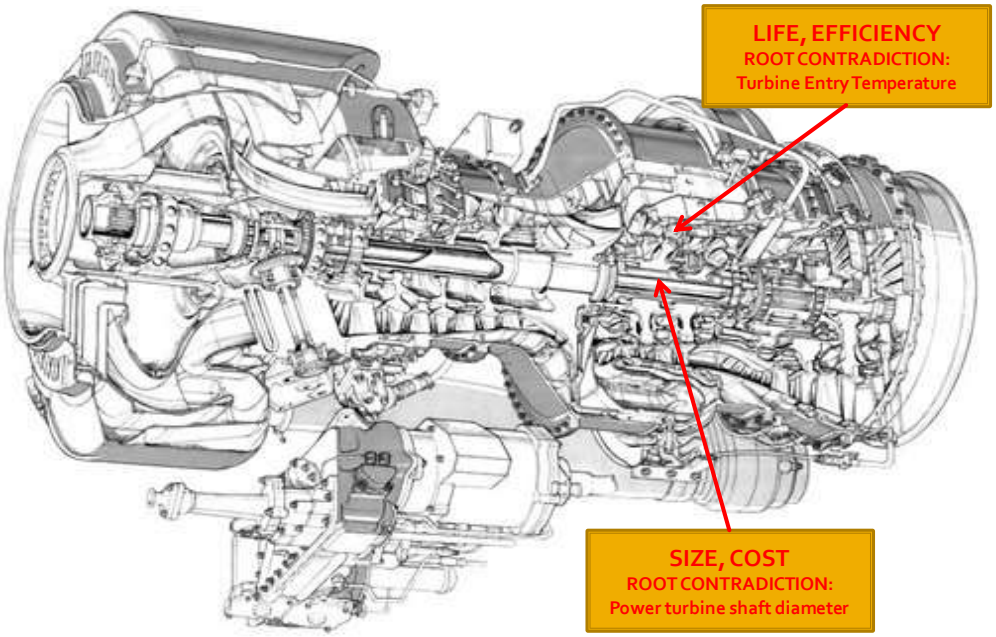


Figure 2: Current Generation Helicopter Engine & limiting Contradictions

Knowing these two root contradictions, the smart chief engineer will harness their R&D resources to tackle these two problems before and more than any of the others present in other parts of the engine. (The even smarter one, will go back to the team to ask them the brick-wall finding questions again every time a step change in capability is achieved by the turbine shaft or turbine blade temperature people to make sure that the root contradiction sources haven't changed. The even smarter one still, will open up the brick-wall questioning to also include the people who design the aircraft into which the engine will go (NB: from personal experience, the findings from such an exercise can often make you unpopular with many people!), and, even better, the customer.)

This type of 'brick-wall' finding search for root contradictions has become pretty much a standard practice within design teams involved in the design of complicated systems. Back to my kettle control workshop, part of my psychological inertia was assuming that if it

was possible to do the exercise for really complicated things like jet engines, it must have been much easier to do it for relatively simple things, and therefore, everybody ‘must’ be aware of the practice all the time.

Alas, not true.

As became very obvious when no-one could say ‘yes, but’ when the ‘why not make it smaller?’ question was asked.

This blinding flash of the obvious that the contradictions we thought we were looking for were the wrong ones, allowed us to get very quickly to where I’d wrongly assumed we were at the start of the day. Now we could follow the protocol found in jet engine design: everyone in the workshop could be given responsibility for each of the components in the switch and each asked to make their component smaller and smaller until such times as they found the brick wall that prevented them from going any smaller.

As it turned out, very quickly using this strategy we were able to take 20% of the material out of the design before anyone hit any kind of brick wall. The first real ‘yes, but’ wall found the team all pointing to the kettle manufacturer and a specific design feature of the kettle.

When we picked up the phone and started talking to the kettle designer about this problem we quickly discovered that, while the wall was very easy to break down technically, there were multiple business reasons why it could not be.

Which is to say that – as is more and more often the case – technical teams embarked upon root contradiction finding extrapolation exercises find themselves pointing at the business parts of the organization. In our workshop, it turned out to be a contradiction too far. A pity from my side, but for the team, a 20% reduction in material costs with no downside was already looking like a big tick in their annual KPI box.

Funny, in summary, how we sometimes fail to see how our own previous ‘obvious’ solutions haven’t been deployed elsewhere. Funny too how I failed to live by my oft used statement ‘go think of someone with a more complicated version of your problem, because they’ve already had to find a solution’: in this case, the strategy of identifying the main design drivers (‘reduce size’ in this case) and then doing a component-by-component extrapolation exercise until everyone is pointing at the person with the real root contradiction. A strategy, in case you haven’t already done it, you might like to try in your own teams and designs.

Pulse I : The Singularity Is Not Near

More and more these days, we find ourselves talking about the importance of understanding ‘pulse rates’ when it comes to determining the right innovation strategy and implementation activities for a company. Frequently the discussions are prefaced by the ‘two men being chased by bear’ story and its message that success comes through outrunning the other runner and not the bear. Innovation success follows from doing the right things at the right time in the right way. A bit like opening a safe, we only get to the money inside, if we know the combination numbers and apply the numbers in the right sequence. A good part of the ‘right numbers’ story in the innovation world comes from understanding the rates at which the various parts of the system are able to make step changes. This article is the first in what we anticipate will be a whole series looking at the pulse-rate question. The aim of this first one is to set the scene with a 30,000 foot view of what we mean when we talk about ‘systems’ and the way in which pulse rates come in to play within such systems. Subsequent articles will then zoom-in and focus on each of the individual parts.

The ultimate reason for wanting to explore this, we expect, quite difficult topic is that it is increasingly being seen as the most important dependency in the whole of the innovation world. The organization that best understands the pulse rate of their world is the one that has the best chance of being the winner within it. Quite literally, the future success of an organization depends on its ability to understand the prevailing rates of change within their market. In this respect, the world is changing. A hundred years ago, the pulse rate of every industry was pretty slow – things didn’t change very much at all so that, for example, whatever job a person found themselves doing, they would expect to be doing the exact same job in the exact same way for their whole (short) life. My father had three careers during his life. I will probably have double that number. My descendants probably double again. We inhabit a world in which change provokes more change to the point where – per Ray Kurzweil’s suggestion (Reference 1) we face the possibility of some kind of exponential surge towards an infinite rate of change singularity – Figure 1.

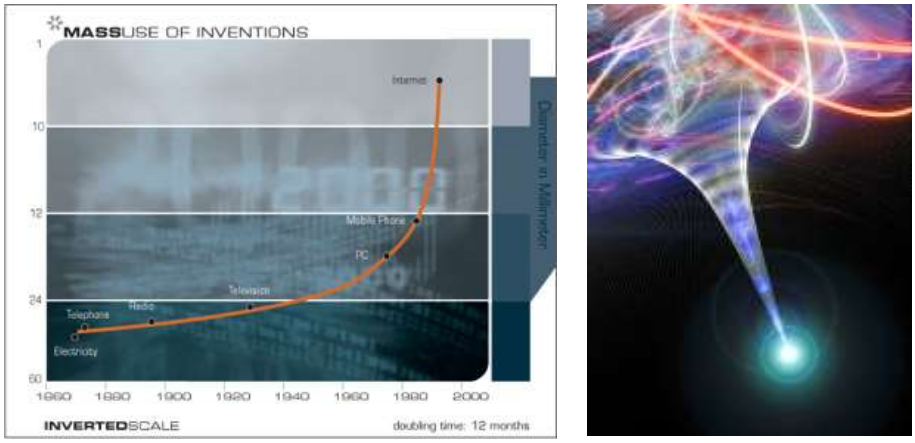


Figure 2: Kurzweil’s Singularity

We start our journey to understand pulse rates and the likelihood of Kurzweil’s so-called singularity here by thinking about innovation as a system. A system, as defined within TRIZ is a critical mass of elements that come together to deliver a useful outcome. In the case of an innovation, that useful outcome is ‘an innovation’ – a successful step-change solution to a meaningful problem. No sooner have we made this connection to an entity as

a system then we are able to connect ourselves to the Law Of System Completeness. When we do this for as big and as general a system as something like 'innovation', we find it is more appropriate to use the most comprehensive version of the Law. Which, right now, means the 6-element version reproduced in Figure 2.

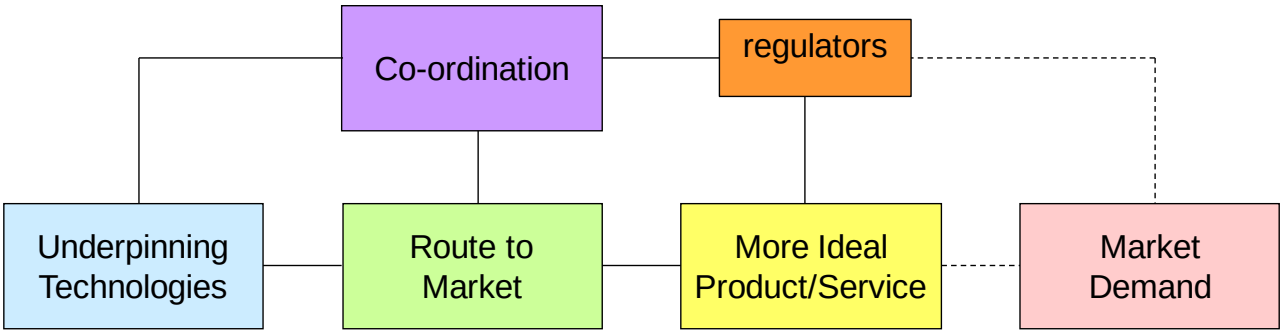


Figure 1: Six Essential Elements Of An 'Innovation' System

In the same way that the strength of a chain is determined by the strength of the weakest link, the overall pulse of an industry is determined by the pulse of the slowest and/or most significant element in the system. Each of the six elements in the Figure 1 model has associated with it, at any moment in time, a certain pulse rate. By 'pulse rate' here, we mean some kind of combination of the rates at which any of the elements is required to and able to make successful step changes. As in any complex system any element within the system has the potential to influence and be influenced by any other part of the system. Thus it is not possible in any kind of valid manner to completely isolate each element, work out its pulse rate and then assume that the slowest gives us the pulse rate for the overall system. Changes in capability in one part of a system can and frequently will have positive or negative influences on others.

By way of a simple example, think about the patent system. The granting of a monopoly to an inventor that lasts for nominally twenty years, should in theory set a pulse rate for the 'regulator' part of the complete system of 1-per-20-years. In industries like pharmaceuticals, where the extraordinarily high cost of developing a new drug molecule makes patents the main (only?) means of protection that lets a research team have enough revenue generation exclusivity to recoup their investment. Prevailing pulse rate in the pharma sector is largely still dictated by this regulator (patent) pulse-rate. By contrast, the telecom and semiconductor sectors, while they still play the patent game, have found themselves in a world in which matching the customer pulse rate has become a much more important success driver. The typical telecom customer has come to expect 'new' stuff on the phone-shop shelf every three or four months. Overall telecom innovation pulse rates are heading towards an astonishing 'four-per-year' rate, and the patent system has become a major source of 'drag' to the point where this and other industries are calling for wholesale changes to the way in which the patent system operates. A change in one part of the system, thus has the potential to affect another – if the patent system, for example, is destroyed by one set of players, those, like the pharma industry, that rely upon will find themselves in a new world where the prevailing pulse rate might well end up being very different to the one they've been used to.

No doubt we'll talk more about some of these kinds of interaction effect in the more detailed level articles that will follow this one. As far as our discussion right now is concerned, there are two things we need to concern ourselves with: firstly to take a closer look at each of the six essential elements in a little more detail, and then second to see

how they might all come to work together at the meta level to deliver the 'singularity' discussed by Kurzweil. Let's start with the conceptually easier of those two parts:

Market Demand
This 'interface' element of an innovation system concerns itself with the 'customer'. In terms of pulse rates, the market Demand pulse rate – let's call it ΔM for convenience – is determined for a given industry or market by the amenability or otherwise of the customer to make step changes. One only needs to spend a few moments reviewing one's own personal purchasing habits to recognize that we operate with some quite different pulse rates across different aspects of our life. In my own case, for example, I haven't changed my phone for two years now, and still don't find myself interested in entering the world of touch-screen smart phones; my laptop is three years old and my car is ten years old. My step-change pulse rate for these products is pretty darn slow in comparison with the majority of people I encounter in the innovation world (I'm sure many of them wonder when they see my communication technology possessions whether I'm in the wrong profession – surely, they must think, an innovator, should be the ultimate early-adopting techno-geek). Put me in a guitar shop, on the other hand, and given half a chance, I'll buy a new guitar once a fortnight. I love guitars and somehow can't release myself from the habit of purchasing more of them. My guitar step-change pulse rate is frighteningly close to coronary inducing levels. Integrating all of the various step-changes that occur in my life, I think the fair conclusion I can generalize to cover everyone is that whatever the limit is, it is finite. The overall market step-change rate then is also finite – there is only so much change that any one of us can live with before we become paralysed into inaction. The trick for innovators in a given market domain is to know what the prevailing range of pulse rates is for different types of customer. As we'll see in the future article focusing on this aspect of the overall pulse rate story, this element is perhaps the most difficult to calculate meaningfully out of the six different elements.

Regulator
The regulation ('sensor' or 'measurement') aspect of the overall innovation system, by contrast, is often the easiest of the six to assess. In many ways, governments have traditionally used standards and regulations as the primary means of controlling the pace of change in society. The aforementioned pharma industry is not only governed by the lifetime of a patent – one type of regulation – but also by the need for a new drug to go through a host of clinical trials and approvals to ensure the public is not exposed to something dangerous. The rate at which regulations change – the pulse of the regulator (ΔR) – is the easiest of the six to calculate because changes in regulations are by definition very visible within any given industry and across society as a whole.

More Ideal Product/Service
The 'tool' part of the overall system and thus, in the innovation context, the output of the innovation process. Within the Systematic Innovation world, this is where we have spent a large proportion of our research time, certainly through the 1990s and into the first five years of this century. The TRIZ/SI trends of evolution and the Evolution Potential concept are the tools we've built over the years to enable us to calculate what we've thus far tended to simplistically label the pulse rate of an industry. Our very first 'innovation timing' algorithm (Reference 2) used rate of change of Evolution Potential (ΔP) as the 'first order' approximation that would help organizations to determine when was the right time to start deploying a new step-change product. Calculating ΔP is easy if you have enough data. We've found that once we got over the 2.5 million mark, the ΔP-calculation process became very easy indeed. Constructing a sequence of Evolution Potential radar plots for

several thousand design solutions and then putting them in date order – Figure 2 – has now become a largely automated process for us these days.

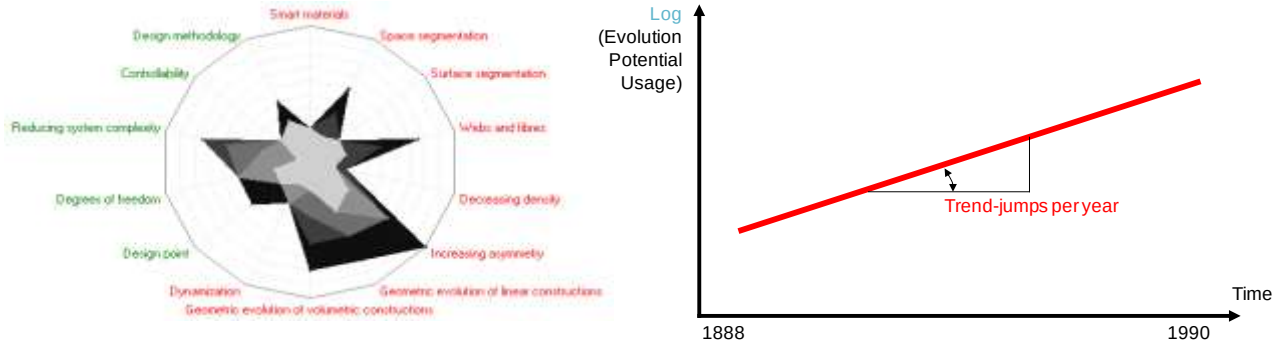


Figure 2: Rate Of Change Of Evolution Potential Gives ΔP

Route To Market

The 'transmission' part of the complete system and thus, in the innovation context, the manufacture processes, logistics and supply-chain activities that all need to come together to allow the transition of ideas and core technologies (the 'engine') to create the products and services that become the physical manifestation of an innovation. If we think of having a Voice of Customer and Voice of Product, what we have here is what we might think of as the 'Voice of the Operations'. The pulse rate associated with this part of the system (ΔO) is calculable primarily through examining how well able a business is to create and implement step changes into its internal operations. The step changes we need to focus on in this regard come through examination of the business version of the Trends of Evolution part of Systematic Innovation. In the same way we can draw – as in Figure 2 – a sequence of radar plots to show how products and services have evolved over time, we can draw the equivalent operations time sequence by constructing a series of business Evolution Potential radar plots to show how quickly the operations aspects of an organisation are or are not making step changes. Again, easy enough to calculate once you have a critical mass of data available to work with.

Coordination

Sitting at the top of the Complete System hierarchy, the 'coordination' element is all about the overall ability or otherwise of an innovating company to coordinate each of the other five elements – and to make sure the right things really do happen at the right places and times. There is a tendency to confuse this element with the Operations part of the system since it is – surely – the management and leadership within an organization that determines the coordination of when, how and why to create and implement a given step change. The best way to discriminate between the Voice of the Operations and this coordination element is to clearly place the coordination task in the hands of the CEO of an organization. Making this distinction is important since the CEO is literally the only person within an organization that has the responsibility to balance the internal and external needs and capabilities and to make the decisions about the necessary balance between innovation and day-to-day 'business as usual'. As to measuring the 'pulse rate' of the coordination capability of an organization, we find ourselves very firmly back in 'difficult to measure' territory. Very simply because we need to get ourselves into the heads of an individual CEO, to assess their personal goals and motivations (good ones as well as real ones!) if we are to make a meaningful assessment of the Coordination-change pulse rate (ΔC). Somewhat depressingly, for most organizations, the tenure of a typical CEO is now so short that the ΔC value is often distorted by what we have come to think of as the 'not on my watch' criterion. This is where a new CEO comes into position and very quickly

learns to ask the question, ‘is something bad likely to happen in the next three years?’ If the answer to that question is ‘no’, the smart CEO is very likely to say to themselves, ‘why, then, should I go through all the hassle associated with disrupting the smooth running of the business by innovating?’ For the organizations with this kind of CEO at the helm, the ΔC pulse rate may well dip to zero for the duration of the tenure. More optimistically, whenever a new CEO comes into position, almost by definition, they have an agenda to make some kind of step-change statement (alas, whether it is called for or not). Taking the two pieces of data together suggests that the overall global ΔC value tends to approximate to the average tenure of all CEOs. Whether that crude average is relevant at all to a given specific situation is difficult to judge. The only reliable way we’ve found to get a meaningful assessment of the actual prevailing ΔC of an organization is to make some kind of psychological profiling of the individual CEO. Not easy on a whole series of levels… but also, because this element sits at the top of the hierarchy, one of the most important to get right.

Underpinning Technologies

Last of the six in our description sequence comes the ‘engine’ part of the overall system. The ‘engine’ in our innovation context are the technologies and science that come to underpin the ability of an organization to create new products and services. We’ve left this one until last since this is the element of the overall innovation system that most closely equates to what Kurzweil was looking at in making his assertion that ‘the singularity is near’. From a measurement perspective, we can pretty much use the same Evolution Potential process found in the product/service element of the system. The only real difference is that we have to be able to interpret the trends in a more abstract fashion if we’re to predict, for example, likely future advances in physics and the other sciences. Kurzweil’s great contribution to the art is to devote a large part of his life (and now that of all the academics affiliated to the ‘Singularity University’) to thinking about the evolution of technologies. Its thanks to the work of his team that we can step back and admire pictures like those reproduced in Figure 3.

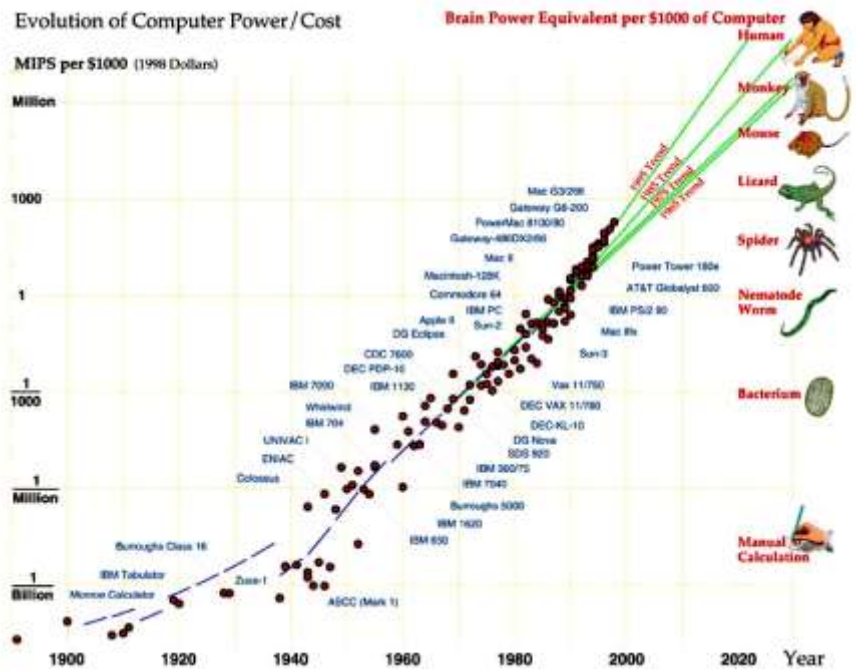


Figure 3: Rate Of Change Of Evolution Potential Gives ΔP

According to Kurzweil, the voice of the underpinning technology and the technology pulse rate (ΔT) is fast approaching the infinite.

And So To The Singularity

The rate of technology change observed by Kurzweil provides the basis for the assertion that pretty soon computers will be more intelligent than humans and that the world will make a jump to a period where computers will be able to invent solutions to problems faster than humans do. When this happens, Kurzweil speculates, innovation rates will inevitably tend to infinity. Paradoxically, even though Kurzweil has published many s-curve models, he continues to also draw pictures, like Figure 3, where logarithmic curves remain free to fly off exponentially to infinity. The dynamics of s-curves tell us that sooner or later when we try and head off into the sunset like this, something comes along and stops us. That something being a contradiction of course. So either Kurzweil assumes that the singularity happens before this contradiction emerges, or he's somehow forgotten to take the possibility into account. I suspect it's the latter. To believe that somehow the technology change pulse rate is the one that will set the pulse rate for everything else ignores the other five essential elements of our innovation system. Just because one is tending toward infinity, doesn't mean that the others will follow. Or even acquiesce.

Overall pulse rate of an industry or, when integrated together, the overall dynamic of society at large, is determined at any point in time by the interplay between the six elements. One might be tending to infinity in Kurzweil's singularity scenario, but at least four of the others certainly are not. While it might well be completely true that computers will be 'more intelligent' than humans by 2030, that doesn't mean the Voice of the Customer will say, 'yes please, that's exactly what we want'. Ditto for the regulators in the world. And the organizations that will have to harness the underpinning technologies. And the CEOs that will authorize such activities. At least four of the six elements very clearly appear to contradict the technology singularity driving force.

The singularity, in this interplay-of-multiple-elements world, is very definitely *not* near.

Here's how the dynamic is much more likely to play out:

Firstly a few new (admittedly crude) parameters we might like to define to integrate the individual pieces together:

The change capability pulse rate of an individual company:
$\Delta_{company} = f\{\Delta C, \Delta O, \Delta P, \Delta R, (\Delta T)\}$

The change pulse rate of a given market:
$\Delta_{market} = f\{\Delta M, \Delta_{company1}, \Delta_{company2}, \Delta_{company3}....\}$

The overall change pulse rate of society at large:
$\Delta_{society} = f\{ \Delta_{market1}, \Delta_{market2}, \Delta_{market3}....\}$

The only way for the singularity to really occur is if $\Delta_{society}$ pulse rate hits zero. The only way this can happen is if the interplay of individual Δ_{market} values also tends to zero. And, since the Δ_{market} values are determined by pulse rate of customers (ΔM) and the interplay with the various different $\Delta_{company}$ values, where $\Delta_{company}$ is fundamentally not zero, the only way for the singularity to occur is if customers are suddenly willing to accept infinite rates of change. Now I know how adept at change Gen Yers seem to be, but good as they are, I suspect infinity is some way away from any kind of practical reality.

The singularity, in other words, can only happen if the customer lets it happen. The technology might be there, but our desire or ability to do anything with it very quickly starts to emerge as the other side of the contradiction that will prevent the exponential trajectory to infinity and beyond.

Kurzweil is purportedly a health freak. He believes that if he can live another twenty years, the technology available at that time will allow him to live forever. Personally, I think I'll keep eating junk food, drinking too much, not exercising enough and listening to too much loud music (i.e. enjoying the present) because I strongly suspect the voice and change pulse rate capabilities of the clinicians, regulators, and CEOs of the world will have rather more to say about my future healthcare service opportunities than the mere technology. And with the best will in the world, no matter how much broccoli I chose to eat, I don't think I could survive for the rather longer period of time likely to pass before infinite life becomes a practical possibility.

References

1) Kurzweil, R., 'The Singularity Is Near', Gerald Duckworth & Co Ltd, 2006.
2) Mann, D.L., 'More On Innovation Timing: Discontinuity Rate', TRIZ Journal, March 2006.

Humour – Principle 35 Redux

Number 35 continues to be one of the least well understood of the TRIZ Inventive Principles. Many still think that 'Parameter Changes' is about optimizing one or more of the parameters in a system, rather like twisting a volume dial on a radio. But optimization is fundamentally the opposite thing to solving a contradiction. Solving a Contradiction using Principle 35 needs a sufficiently large change of parameter that it forces a step-change response. This is relatively easy to see with some of the Principle 35 instructions – like 'change physical state' – but far less obvious with things like 'change pressure'.

Here's the sort of Parameter Change we should be looking for to create a step change. In this case changing the height of the handlebars of the bike to an extent that transforms 'biker' into a person better known by an expression ending with the word …head.

I've got a similar soft spot for this next 'extreme', this time turning up the parameter 'laziness' to the point where the packing delivers the function. Genius.

'Extreme laziness' turns out to deliver some pretty rich pickings when it comes to gaining insight into the ways in which people think. Product designers intent on delivering 'convenience' in the artifacts they design might perhaps wish to re-calibrate how this might be interpreted by some consumers. For some reason laziness in the restroom department seems to be particularly important. Here's a winning pair of images from the home of convenience (no pun intended), the good old US of A:

SYSTEM ·ATIC INNOVAT· ION

Putting out the trash doesn't fare much better either:

Not to mention boiling water for a cuppa:

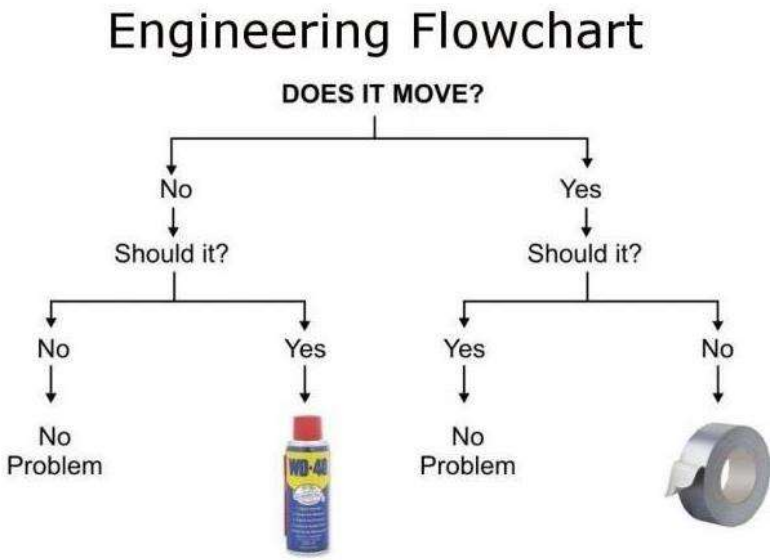
(Thinking about it, maybe this is more of an example of Principle 28 than 35 – replacing one field with another. Whichever is the better start point, no doubting that a 'change of state' has occurred. In both kettle and IQ level of the thirsty drink maker.)

Here's one that I have to say I've got a sneaking admiration for. Sure there's some Principle 35 in play, but perhaps even better as a Principle 25B illustration par excellence:

Docked one credibility point for not using a real budgie.

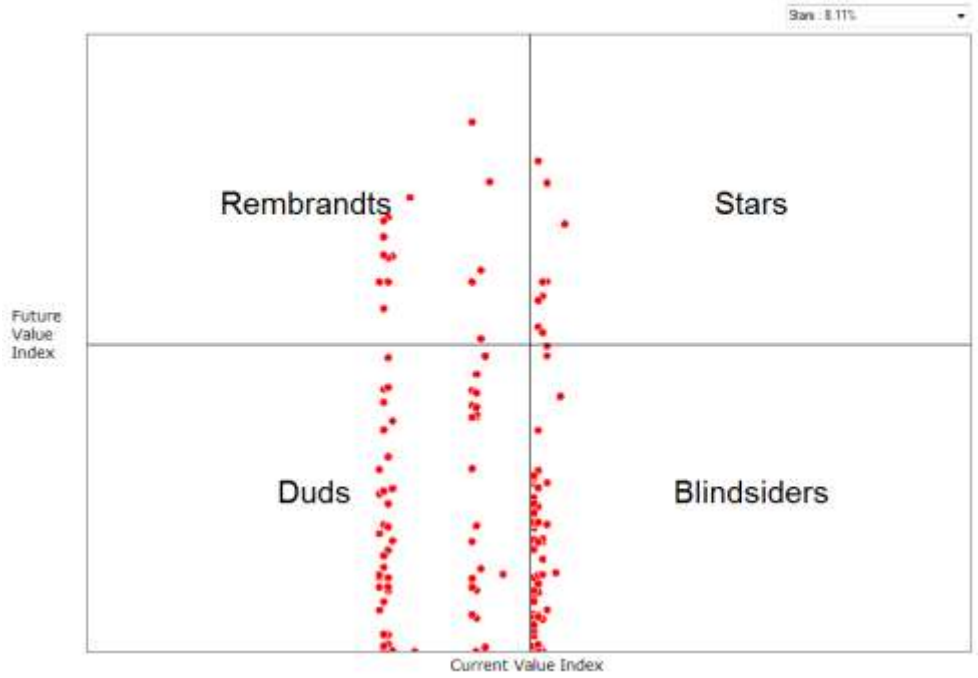
No budgies here either, but definitely my favourite example of not just a Principle 35 change of state, but also strong flavours of Principle 15, 1 and 20 (24hour opening) in play as well. I love the thought of those escalators still in operation when someone turns up for gym class at 4am.

And finally, one for the engineers, just in case you're not sure which extremes you should be heading towards:



Patent of the Month – Ocular Imaging System

Now that we have our ApolloSigma IP valuation tool validated across pretty much every industry domain, it has become a great labour saving tool during the process of trying to uncover our 'Patent of the Month' winner. On one level, we can simply instruct the software to analyse all of the patents granted on a certain date or range of dates and leave it to do its job. On another, we can specifically target known areas of high quality IP generation and point the engine at them. One such area is academia. The search reproduced here concerns itself with all patents granted to University assignees on 3 July:



A first indication of the general quality of patents here is that the proportion that find themselves in the 'star' category is over double the global average – 8% versus 3%. The second is that the 'stars', when we go and look at them, are all genuine candidates for our award. Take a look at any of US8,212,110, US8,211,837, US8,211,441 or US8,211,035 and we think you'll be quietly impressed. The only problem with these inventions is that, while they represent great star-making solutions to really interesting problems, they don't always have a story worth telling in the context of what we're trying to achieve in this section of the e-zine – i.e. to look at patents that carry some kind of generally applicable learning point.

Fortunately, one of the top 5 'stars' from the analysis manages to achieve all three of the things we're looking for – great solution; great problem and meaningful story. And so, Patent of the month this month is US8,210,680, granted to inventors at the University of Southern California. Actually, even better, the University plus industry/practitioner partners, Doheny Eye Institute.

The abstract is succinct to the point of starvation: "An imaging system for examining the interior structure of the eye at high-resolution under ambient light without the need for chemical dilation of the pupil." We get rather more from the 'background' section of the disclosure:

Detailed images of internal structures of the retina allow detection of ocular pathology at an earlier, more treatable stage. Examinations to obtain such images are often not performed because the

pupil naturally restricts the field of view, thereby limiting in turn the eye regions and structural detail apparent to the physician. Dilation of the pupil allows more light into the eye from either the ambient environment or an external light source, and also allows more light to be reflected from the eye through the enlarged aperture of the pupil.

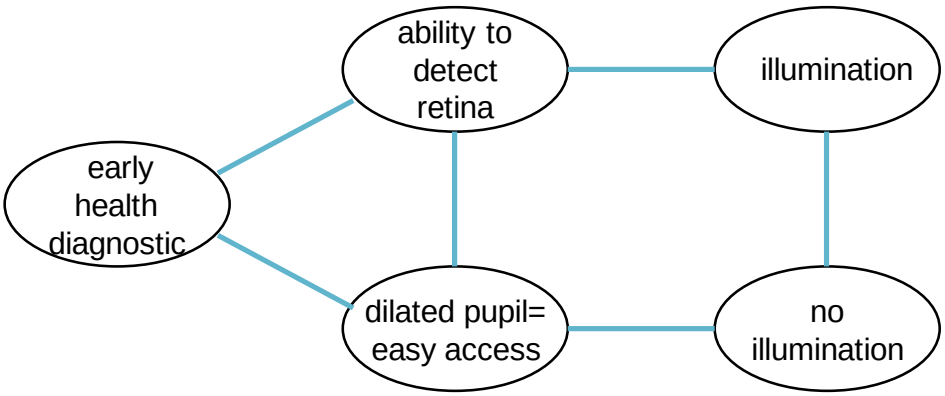
Attempts to address this problem have taken several forms, many of which are cited in U.S. Pat. No. 7,311,401, which is hereby incorporated by reference in its entirety. Mydriasis, the drug-induced dilation of the pupil, allows sufficient light into the eye to permit detailed colored imaging of the retina, but necessitates extra time to induce dilation, and furthermore makes the patient's eyes painfully sensitive to light for hours afterward.

An alternative way of getting enough light into the eye is to use flashlamps, which emit high-intensity light. Flashlamps, however, cause patients discomfort, and according to recent studies, can damage retinal cells. In addition, flashlamp-based cameras are not amenable to extended observation, but are essentially "one shot" devices as pupil contraction occurs immediately following the flash, obviating further study.

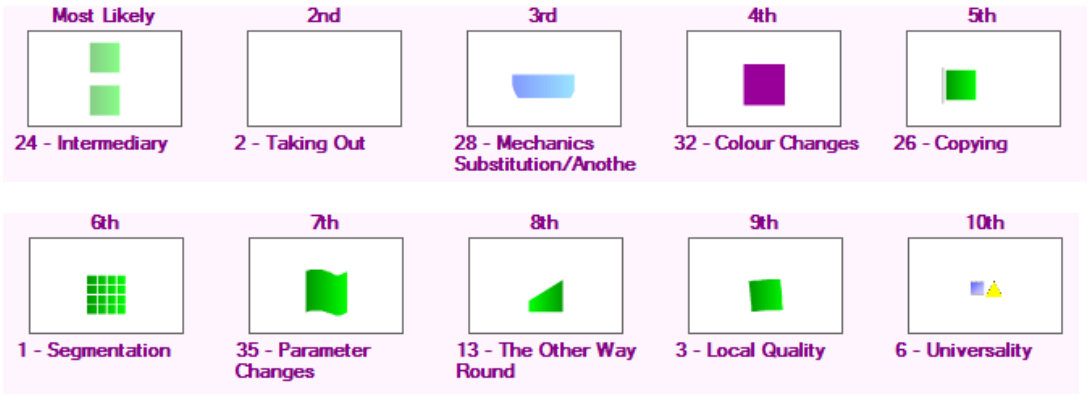
A third approach is to use image intensifiers to make more efficient use of pupil-limited light fluxes. Image intensifiers, however, result in relatively low resolution monochrome images, thereby making detection of pathology difficult.

Thus a need exists for a way to obtain detailed, high-resolution color images of a patient's retina without use of mydriasis or light sources apart from ambient room light.

All of which, particularly when we take the illumination solution direction (the current alternative of pouring chemicals into someone's eye feels just plain wrong) strikes us as a very clear physical contradiction. Here's how we might map it onto the Conflict mapping template:



When we map this conflict system onto the Matrix using the Matrix+ software wizard tool, we obtain the following ranked list of Inventive Principles used by others in equivalent situations elsewhere:

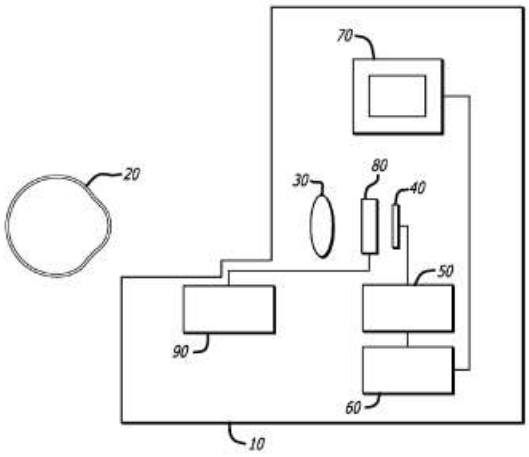


And here's what the inventors have actually done to resolve the problem:

Low-light monochrome viewing devices recently developed for military and law enforcement applications, as described for example in U.S. Pat. No. 7,420,153, which is hereby incorporated by reference in its entirety, have been adapted by the applicants to yield an ocular imaging system that provides high-resolution eye structure and retinal images under ambient light conditions that dilate the pupil physiologically, without the use of mydriasis or flashlamps. Furthermore, when used in conjunction with a tunable color filter (being configured to allow the central wavelength of its optical bandpass and its dwell time to be controllably set), the system can provide images with veridical (true) or pseudocolor, as desired, thereby facilitating the detection of ocular pathology by the examining physician.

Specifically, this disclosure describes an ocular imaging system for imaging an eye, comprising a high-sensitivity, high-resolution image sensor array, with a sensitivity of at least about 0.1 lux, and preferably of at least about 0.01 lux, and more preferably of at least about 0.001 lux.

The system comprises a sensor array selected from the group consisting of CCD and CMOS devices, wherein the sensor array is preferably constructed of a material selected from the group consisting of silicon and silicon-germanium, and further comprises imaging optics disposed between the eye and the sensor array and adapted to form an image of the eye on the sensor array.



At the risk of being trite, on one level we might say this is an invention that has simply 'copied' (Principle 26 ☺) the technology found in night-vision goggles (NVG) and applied it to the optometrist world. While there is nothing whatsoever wrong with this ('someone, somewhere already solved… etc), by rights it would not have been grantable as a new patent since the transfer would probably have to be classed as obvious.

The patent, however, does get granted because the inventors have solved the next problem in the sequence. NVG is good but not calibrated and does not provide colour images. The 'tunable colour filter' that lies at the heart of this part of the invention represents a nice illustration of several of the recommended principles – 2 especially, but also 32 (!) and 35.

All in all, a very elegant solution to the problem at hand. One now has to wonder how long it takes for the colour and calibration capabilities to find their way back into the military world of night-vision. Start the clock…. now.

Best of the Month – Thoughts From A Grumpy Innovator

Ah, the sweet smell of nails being hit squarely on the head. Our book of the month choice this month won't carry too many surprises since not only is author Costas Papaikonomou a friend of the SI family and one of the people we like working with more than anyone, but he's really pulled the rabbit out of the hat with his first book. Followers of his grumpyinnovator Twitter feed will know exactly what's in store - a torrent of pithy, to the point, barbs aimed at the bloated army of innovation killers found in most large organizations. The 140 character limit imposed by Twitter makes for a great discipline when it comes to encapsulating big thoughts into the most efficient and effective aphorisms, and Costas is a rare master of the art.

Only now, with 132 pages to play with, there's also an opportunity to fit each aphorism into a coherent bigger picture. And so we get four big themes topped and tailed by what will hopefully be something serious for the aforementioned innovation killers to take home and think about. The four main themes take eloquent swipes at creativity facilitators ('the art of beanbags and funny hats'), incremental thinking ('the evil twin of operational excellence'), Marketers ('market research and modeling madness'), and, perhaps best of all, people that don't understand the dynamics of S-Curves. Favourite tweets from this section:

"There's no stopping an idea whose time has gone."

"Somewhere out there, someone is making a living out of doing the exact opposite of what you are doing."

I've got a friend who is probably the worst cook in the world. She kind of gets it, but sometimes needs a gentle reminder that general inedibility is one thing, but food poisoning is something else entirely. The time after we had such a near miss, I turned up at the sacrificial dinner table wearing a homemade bandolier filled with rolls of Bisodol tablets. I mention the scene because, in my mind, what Costas has achieved here is an equivalent message to the mass of poisoning Marketing managers out there in FMCG-land. At the very least, you need to get yourself signed up for the individual tablets dispensed daily at grumpyinnovator. But, really, you need to be ordering a few copies of the book to be judiciously handed out to a choice few in your own Marketing department. You know it makes sense.

Conference Report – ICSI, Seoul

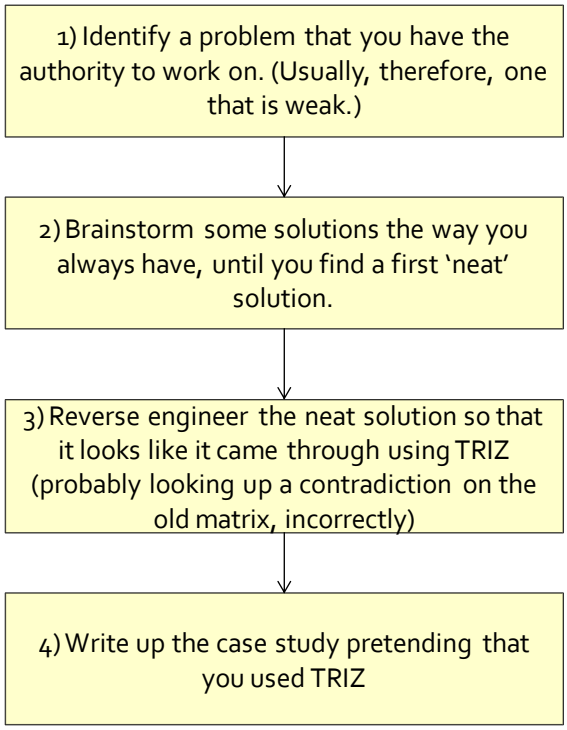
I think I might have to stop going to TRIZ conferences. There was a time they at least served the purpose of making me angry (good for focusing the mind and writing response papers). Now they just make me sad. How can so many people – close on 200 attended this event at Yonsei University in Seoul – take on such a powerful methodology and yet deliver such pitifully meager outputs? It quite simply beggars belief. Over two days and often four simultaneous tracks, well over a hundred papers were presented during what looks set to be the biggest event of its kind on the planet. The majority were from Korean or Taiwanese origins – perhaps not surprisingly given the fact that the conference was held in the former, and the large majority of all the hard work to make the event a success was done in the latter (thank, as ever, have to go to Professor Sheu, who it has to be said put on a marvelous show despite the seemingly frequent attempts on the part of his Korean co-organisers to stymie his fine work).

Several of the big Korean companies had papers on show, but if anyone had their fingers-crossed hoping that we were in for a barrage of exciting new case studies, they were in for something of a disappointment. To the best of my reckoning there were approximately zero new case studies on show. What we got instead were at least half-a-dozen comments to the effect that 'we're not allowed to prevent the important work', each of which was usually followed by a trite and already familiar, 'these are the sorts of exercises we do in workshops'. When the Samsung presenter put out a request that no one in the audience take photos during his presentation, it was difficult to keep a straight face when it quickly transpired the closest we were going to get to hearing anything worth the risks of being arrested for industrial espionage was the description of the 'make a bridge from just wooden sticks' exercise inflicted on Samsung employees that had the misfortune to find themselves in an internally run workshop.

This from a 'MATRIZ Level 4' presenter. We also had several others from Level 2 and 3s and even one from a newly created (Korean national) Level 5 Master. The correlation is becoming quite clear: evidence of creativity is inversely proportional to Matriz Certification level. The higher the Certification level, the more abysmal the material presented. Good if the covert purpose of MATRIZ is to create an army of very, very uncreative people, not so good from the perspective of gaining any credence for TRIZ in whatever form. That there was a big onstage agreement signing ceremony between MATRIZ and KATA, the Korean Academic TRIZ Association, should give us a hint that TRIZ in Korea has now begun the slippery slope down into irrelevance. Very sad. Although not as sad as the sight of MATRIZ President Sergei Ikovenko (the good one!) ploughing his way through a small mountain of MATRIZ certification multiple choice exam papers during the conference – frequently at the same time as one of the already certified people was up on stage presenting. I suspect he cries himself to sleep some nights.

Also present during the conference was the second 'international' SI competition. I was roped in to do some of the judging of the 24 'finalists'. I'd hate to have been the person that had to work their way through the ones that didn't make it to the final, if the standard of the 24 I had to go through was typical of 'best'. In fairness, there were a couple of very good (Professor Sheu) case studies that quite rightly found their way to gold medal winning positions, but very appropriately, I think, the competition committee decided, based on the marks delivered by the judges that none of the 24 entries were worthy of the two top prizes on offer. One hopes that this kind of honesty will prompt potential entrants to next year's competition to try a little harder. In case I might have some minor

contribution to the story, people will stand a far higher chance of succeeding if they avoid following the protocol that I would say 20 of the 24 entrants from this year had adopted during their projects. Here is what I perceive that protocol to be:



Some of the cases were so shockingly inauthentic it was difficult to avoid the temptation to confront the project owner and ask if they'd even heard of TRIZ prior to submitting their entry. Shocking to the point of tears.

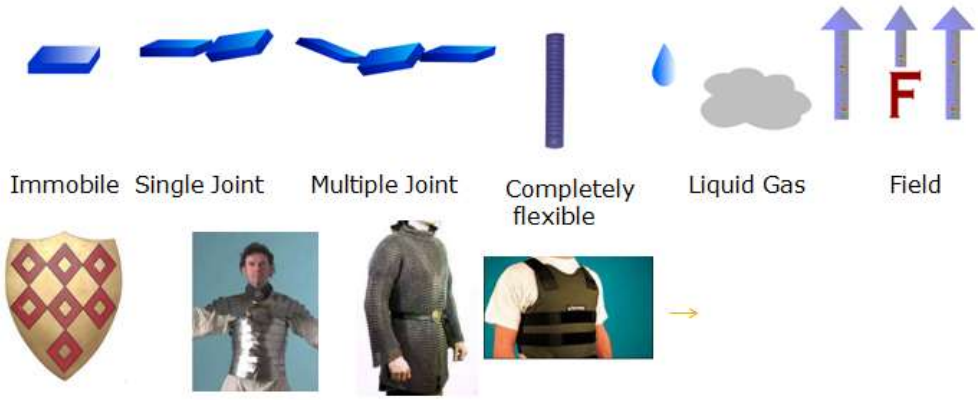
If there's a way out of this conference-wide downward spiral (short of making Matriz illegal), I really can't see from where I am what it might be. Several at the conference were making the case for academic accreditation of TRIZ publications and papers as a means to improve the standing of the subject. I'm not convinced this will have any effect at all, other than discouraging people. Which, thinking about it, is probably a good thing – the idiot-quotient is now at record high levels. If there was someone out there with a desire to kill TRIZ, right now I don't think they could be doing a better job:

Step 1: spread a certification process that is 40 years out of touch with reality
Step 2: insist that people with high Certification Levels present the worst papers
Step 3: distract the academic community with irrelevant accreditation wild-goose chases
Step 4: forbid papers containing any semblance of being actual case studied delivering actual benefit to anyone.

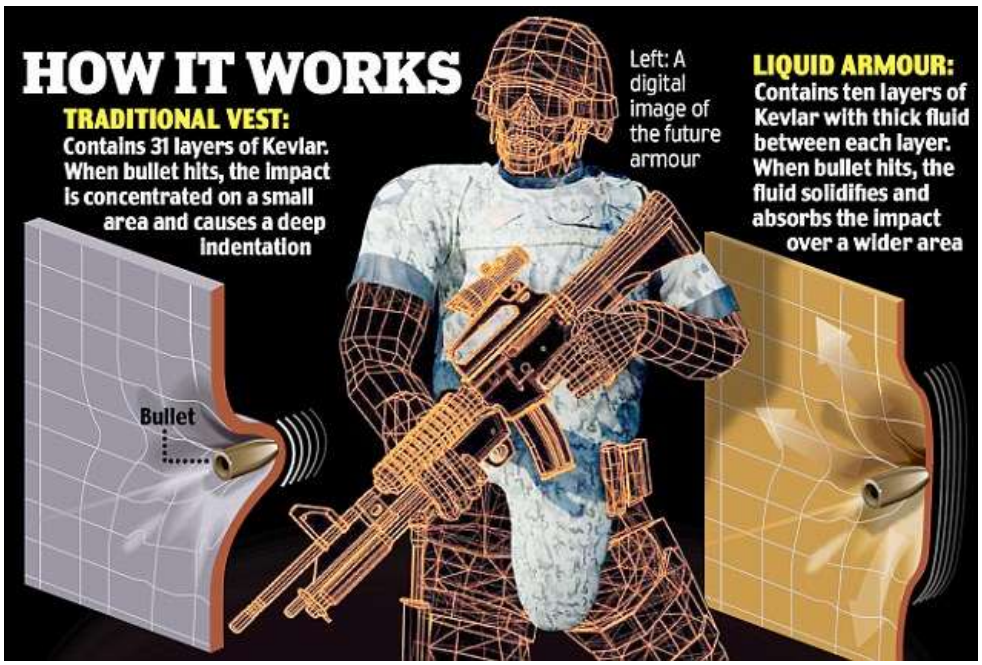
It's more devious than a devious thing. There were good points of course. Despite the language difficulties, there were some good 'off-the-record' conversations to be had. And the simultaneous translation was exceedingly good throughout all the main hall sessions. I'd have to say overall though that things don't bode well for the 4th ICSI event in Taiwan in 2013: good translation and good off-line networking does not a conference make. 'Why isn't TRIZ spreading further/faster?' was another frequent conversation topic (as seems to be compulsory at all TRIZ events) at ICSI3 and will no doubt still be being discussed next year. No need to wait til then, the answer seems very clear to me already: 'because we're a bunch of clowns who don't practice what our method preaches'. Has anyone ever heard the expression 'mercy killing'? No jury would convict.

Investments – Liquid Armour

One of the most frequently used illustrations of the ‘Dynamization’ trend, armour, recently took a highly predictable latest step…



BAE Systems engineers recently announced they are developing radical new 'Liquid Armour' that combines with more traditional protective materials such as Kevlar to give soldiers high levels of protection but much greater freedom of movement.



This innovative engineering technique takes advantage of the distinctive properties of ‘shear-thickening’ fluids, whose particles collide when disturbed, and can even lock together to form a solid barrier.

Kevlar armour is stiff, uncomfortable and can impede movement. Used to cover the torso it can be hot and heavy to wear, contributing to fatigue, particularly in extreme operating environments such as Afghanistan. But Kevlar combined with a counter-intuitive liquid can produce body armour that is 45% thinner, without any safety compromise.

The liquid armour technology is part of a project to create future body armour that gives soldiers greater ballistic protection and ease of movement in combat situations.

Stewart Penney, Head of Business Development for Design and Materials Technologies at BAE Systems, said:

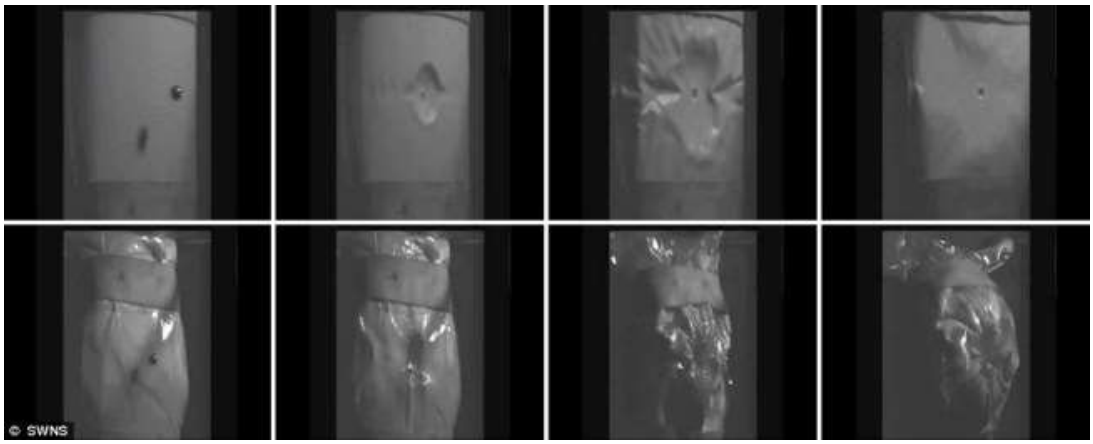
SYSTEM·ATIC INNOVAT·ION

“The technology is best explained by the example of stirring water with a spoon. In water you feel little resistance to the spoon, whereas with ‘liquid armour’, you would feel significant resistance as the elements in the fluid lock together. The faster you stir, the harder it gets, so when a projectile impacts the material at speed, it hardens very quickly and absorbs the impact energy.”

When traditional Kevlar is struck by a bullet, the impact area is small and shows a significant ‘dent’. It can save a soldier from death, but still causes considerable pain. When liquid armour is struck by a bullet the force is spread over a wider area and the depth of penetration is less because the reduced flow of the fluids restricts the motion of the fabric, dispersing the energy over a wider area. As a result, the material is less likely to distort than standard body armour – and after impact the liquid armour returns to a flexible form.

Trials conducted at BAE Systems’ Advanced Technology Centre have demonstrated the liquid armour’s properties. There are plans to further develop the liquid armour to create a lightweight version of the material and incorporate it into body armour systems.

And the team is looking at how the technology could be used in other sectors - there is business potential for a version that could be of interest to police forces and ambulance crews.



Test: High-speed video shows a bullet hitting ten layers of Kevlar treated with liquid armour 'custard' (top photos). The bottom row shows a bullet fired at 31 layers of untreated Kevlar

Final stop, ‘field’-based armour, here we come. In the meantime, this looks like a no-brainer addition to the Level 1 TRIZ/SI workshop curricula of the world. Unless you have anything to do with MATRIZ ☺.

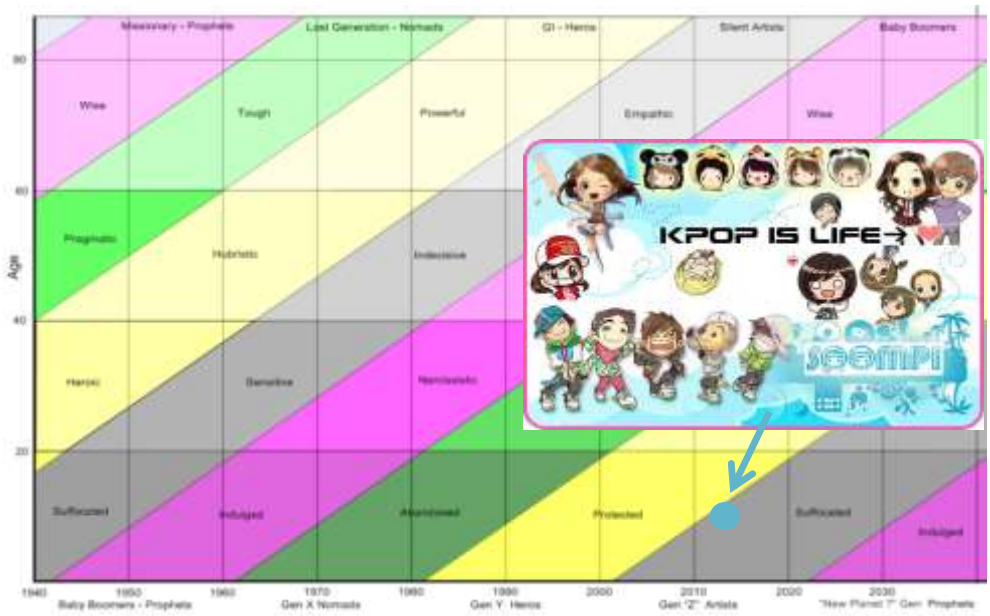
Generational Cycles – K-Pop

Okay, I was lying in my review of the TRIZ conference in Korea. It wasn't totally awful. I did, after all, get to meet ChiChi. Heart aflutter (dirty old man that I am), I even got to come away with a signed copy of their new single, 'Love Is An Energy'.

Just in case you've never heard of said girl group, they're one of the up and coming names in the mysterious world of K-Pop. One of the most enlightening – and funny – parts of the conference was when we had an hour long panel session of Korean TRIZ experts pontificating about the secret of the success behind the recent surge in interest in the K-Pop phenomenon in the West, and particularly the US. The enlightening part was discovering the degree to which the process innovation and optimization found across Korean industry has been applied to the identification, grooming, and production of the myriad girl and boy bands that form the K-Pop industry: it really is an industry. The funny part was listening to a bunch of middle age men trying to rationalize that success in TRIZ terms. The 2000 year 'S-curves of Korean music' journey was quite funny, but not ultimately in the same league as the presenter who managed to demonstrate that the challenge of growing the industry, during its inception when there was a hostile, no-resource market environment, was a contradiction solved through the use of Inventive Principle 24. Not, we were assured a situation in which a cash-starved industry lucked on a naïve sponsor, but a carefully mapped physical contradiction ('we want cash and we don't have cash') and use of TRIZ. Really, guys, you need to stop doing this kind of thing. It doesn't help TRIZ and it certainly doesn't help ChiChi and their ilk.

Now, I have no idea why K-Pop is so popular in Korea. Other than the fact that given the choice between squeaky-clean, highly polished American po(o)p (stand up and take a bow, Justin Bieber) and squeaky-clean, highly polished Korean pop, I suspect most people would go with the domestic alternative. Especially if, like most Koreans, they're extremely patriotic and on some kind of mission (Samsung, Kia, LG, etc) to take over the world.

I think I have a rather stronger idea why they're becoming so popular in the US though. One of our regular generation maps should help provide a fairly significant clue:



Targeting a new genre of music at young Glee-watching pre-teens would be a really smart move for anyone in the music industry right now. The first of the post-9/11, Artist generation is now starting to get interested in music and all the pre-pubescent things that pre-teens tend to do. K-Pop, in this sense has merely found itself in the right place at the right time.

Not that I think they've set out to deliberately open up the US market. Rather, I think, they've emulated the clean-cut image of America's rising pop stars and applied a manufacture-style optimization make-over to everything. This is music that can quite literally rot teeth from twenty yards it's so saccharine sweet. From the kids perspective, they don't know any better – they saw Justin and Katie and now K-Pop gives them more of the same, only with bells and whistles. Highly choreographed dance moves to learn and practice with your friends; lyrics that repeat the same inane message over and over again ('Love is an energy, you're my energy, love is energy in my heart, feel my heart', repeat for what feels like 'ever').

And if I sound dismissive, I absolutely am. But that's also the point: the key to any pop phenomenon is rebellion against what your parents like. For my – abandoned – generation it was the nihilism of punk. Basically, my parents were laissez-faire enough that they didn't really care that I was listening to songs about anarchy played by two-chord inepts. But today's parents – busy suffocating their precious offspring – have a somewhat different attitude to precisely how much and what kind of rebellion is permissible. If the kids want to bop along to ChiChi and sing about love being an energy, no problem. Meaningless rebellion is acceptable rebellion in our 'dangerous', crisis-ridden society.

And so, thanks to K-Pop, we get to help perpetuate the cycle. Our suffocated pre-teens will turn into the meaningless-rebellion-inspired 'sensitive' adults in a decade's time. Which, thinking about it, was maybe precisely what the Korean pop industry has been planning all along. Now there's something to think about: the decline and fall of the US will be triggered by my new friends ChiChi. You heard it here first.

Biology – African Reed Frog (*Hyperolius viridiflavus)*

Amphibians of all descriptions have a perennial water management problem. Which is why they tend to live life predominantly in or adjacent to a consistent and reliable source of water. The moment they are out of the water, they face the challenge of ensuring the right levels of internal hydration. The task is made most difficult by the sun, and especially the range of thermal loads presented by the differences between a bright sunny day and a cloudy day. The primary contradictions here centre around the simultaneous desire for both warmth and shade – warmth being good from an energy input perspective; shade being good from the perspective of hydration. One of the most pragmatic solutions to this variation problem is to live life dodging between exposed and shaded spaces. This strategy, however, can be somewhat limiting in terms of the other factors that come to play in the life equation: hiding from predators or finding a mate for example. The problem becomes more extreme when we take into account the bigger seasonal variations in climate – in a dry season, for example, the ability to access adequate water and shade becomes much more difficult.

The African reed frog (*Hyperolius viridiflavus)* has evolved a really elegant solution to the warmth/hydration problem: dynamic reflectance. In a dry season state, *H. viridiflavus* needs a much higher reflectance *to* cope with the problems of high solar radiation load during long periods with severe dehydration stress. During cooler, wetter seasons, the radiation load is smaller and so it is desirable to reflect less and absorb a greater proportion of the available solar energy.

Here's how the feat is achieved:

Hyperolius viridiflavus possesses one complete layer of iridophores in the stratum spongiosum of its skin at about 8 days after metamorphosis. The high reflectance of this thin layer is almost certainly the result of multilayer interference reflection. In order to reflect a mean of about 35% of the incident radiation across a spectrum of 300-2900 nm only 30 layers of well-arranged crystals are required, resulting in a layer 10.5 ~m thick. During experiments on reed frogs, iridescence colours typical of multilayer interference reflectors were seen after controlled dehydration conditions. The skin colour turned from white (0-10% weight loss) through a copper-like iridescence (10-25% weight loss) to green iridescence (25--42%).

Which, in crude terms means that the frog is able to change its reflectance (and colour) as a function of hydration level. This feels like a really wonderful closed loop control system: if

the primary requirement is to achieve a constant level of hydration, use hydration level as the primary sensory input to vary reflectance level. In using the multiple layers of iridophore cells, as the frog dehydrates, the distance between these layers changes and thus the level of ‘multilayer interference’ reflectance ‘automatically’ changes.

Here’s what the Contradiction Matrix has to say about the problem and how human engineers have tackled similar problems:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Temperature (22)

WORSENING PARAMETERS YOU HAVE SELECTED:

Illumination Intensity (23)

SUGGESTED INVENTIVE PRINCIPLES:

35, 19, 32, 5, 40, 4, 14, 3

All in all a pretty solid correlation between the reed frog solution and what we would expect from the built environment: Firstly the use of merging (Principle 5) and composite (layers) (Principle 40), but also the overall use of colour-change (Principle 32) to achieve the desired energy regulation and the use of (water) pressure difference (Principle 35) to drive the changing interlayer distance between the adjacent iridophore layers. Simple when you know how.

Short Thort

“It's not the "nice" guy who brings about real social change. "Nice" guys look nice because they're conforming. It's the "bad" guys, who only look nice a hundred years later, that are the real Dynamic force in social evolution.”
Robert M Pirsig, Lila. An inquiry into morals. p161

“Morality is not a simple set of rules. It's a very complex struggle of conflicting patterns of values. This conflict is the residue of evolution. As new patters evolve they come into conflict with old ones. Each stage of evolution creates in its wake a wash of problems.”
p163

News

GenerationDNA
In the bow-wave of the forthcoming GenerationDNA book we’ve been putting together, we will be running a one-day workshop dedicated to the Generations subject at our Clevedon HQ later this year. The date in question will be 3 October. Tell all your Marketing and anthropology friends. Book places through the on-line shop.

RTTP Introduction
Speaking of workshops, following the launch (I can’t believe I’m holding a copy of the actual book!) of Edward Matchett’s ‘Road To True Professionalism’, we’ll be running a one-day session overviewing the book’s content and – hopefully – having Ted’s widow, Brenda, come along to say a few words about the great man. 1 November is the day to mark in your diaries. Again, book places through the on-line shop.

ICMM
The Innovation Capability Maturity Model ‘soft-launch’ strategy has recently hopped to its next stage with us signing agreements to translate the books and protocols into Korean (something useful did come out of the trip after all!), and to publish and promote through our good friends at Taylor’s University in Malaysia.

New Projects
This month’s new projects from around the Network:
FMCG – Product Family Evolution Potential & TrenDNA study

O&G – workshop series
Aerospace – service transformation project
Medical devices – Eyes on the World study
Medical devices – ‘Game-changer’ strategic study
Government – ‘Innovation spark’ strategic study
O&G – Eyes on the World study
Pharma – Sweat the Assets project
IT – Future-proof IP project