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Systematic Innovation

e-zine

Issue 38, May 2005

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.

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Send them to **darrell.mann@systematic-innovation.com**

Mental Leaps:

(Contradiction Emergence And Resolution In The Evolution Of Human Consciousness)

Those readers familiar with the 'Spiral Dynamics' work of Beck and Cowan (Reference 1) will be well aware of its significance in a psychological context. For those that are not familiar, 'spiral dynamics' a short TRIZ-oriented introduction may be useful.

Beck and Cowan (building on the foundations of the work of Dr Clare Graves to give due credit) were interested in solving human conflict problems in a primarily sociological and political context. From Graves' work they observed that an individual passes through a number of distinct stages of consciousness evolution through their life – Figure 1. They further identified the fact that a considerable proportion of all human conflict occurs when you have different people approaching a situation from a different consciousness level. The key element of spiral dynamics as far as this discussion is concerned are those jumps that take place as consciousness evolves and advances from one level to another.

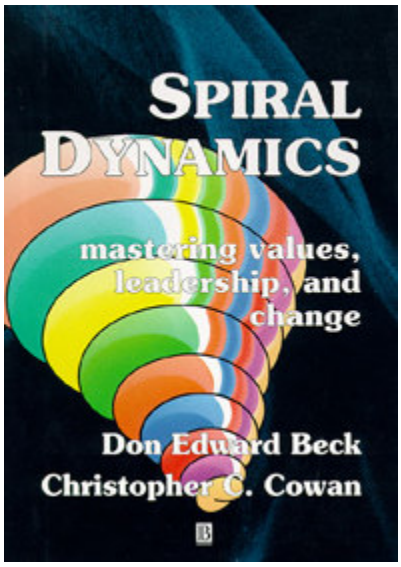


Figure 1: Beck & Cowan's Spiral Dynamics Model

As illustrated in Figure 2, spiral dynamics recognizes that human consciousness jumps through several different stages through the life-span of an individual – so that, as one level hits a limit, it provokes the shift to another level and so on.

The basic idea behind the model is that these various shifts take place over the course of a lifetime. An 'upward' shift from one level to another follows a general pattern of gradual movement towards the limits of one level, followed by an often sudden jump ('blinding flash of the obvious') to the next level. Important to note here is that even though upward progression occurs gradually, no-one totally leaves behind the consciousness of previous levels. Hence, we may find ourselves having a conversation at one level with somebody in one moment, and then switch to another level when we speak to someone else, or do something different. So, advancing to a new level for the first time takes time; switching between already present levels can occur very rapidly.

This idea of systems hitting limits and then making a shift to another level has, of course, a very strong connection to evolutionary s-curves. For the first time, Figure 2 shows the spiral dynamic consciousness levels as discontinuous shifts from one s-curve to another.

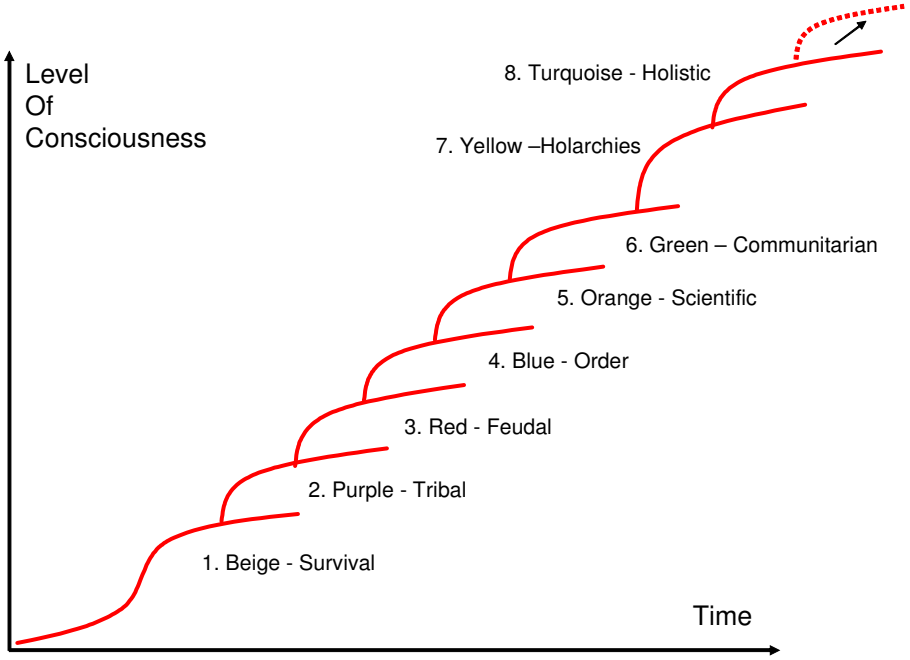


Figure 2: Different Levels Of Human Consciousness

The following Table presents a rough summary of the meaning and characteristic of each of the different stages in the spiral model, alongside an approximate indication of what proportion of the adult population is at a given consciousness level.

Consciousness Level	**Characteristics**
1. Beige (Survival) (≈0.1% of adult population)	newborn infant Alzheimer's victim shell-shock (unlikely to need TRIZ)
2. Purple (Tribal) (≈10% of adult population)	gangs/tribal rituals/magic blood oath
3. Red (Feudal) (≈20% of adult population)	power gods/ego feudal rule heroic predatory 'terrible two's'
4. Blue (Order) (≈40% of adult population)	codes of conduct hierarchy/order 'moral majority' chivalry puritan

5. Orange (Scientific) (≈25% of adult population)	materialism competitive self-interest science over politics 'nature tamed' 'management by objective'
6. Green (Communitarian) (≈4% of adult population)	'sensitive-self' deep ecology 'politically correct' reconciliation/consensus networking
7. Yellow (Holarchy) (≈1% of adult population)	natural hierarchies flexibility/adaptive inter-dependence co-opetition
8. Turquoise (Holistic) (≈0.1% of adult population)	holistic universal order 'Theory of Everything' spiritual harmony

The precise meaning of each stage need not, however, unduly concern us here. Suffice to say that as we pass through life our way of thinking passes through a characteristic set of distinct stages. Some people will pass through all of the stages, while others will stagnate at a stage part the way through the progression. In true s-curve fashion, the transition from each stage to the next involves the emergence and resolution of a contradiction. It is that emergence and resolution that is of primary interest to us here.

An analysis of spiral dynamics through the lens of contradiction should help in our understanding of how people 'work', why they move forward (and why they don't!), and what we might do to achieve a positive outcome in any interaction.

Let us then examine the transitions that occur between the various different levels of consciousness. The following Figure examines the transitions between each of the different levels, presenting in each case the primary contradiction(s) that emerge at one stage, and which ultimately provoke a resolution and transition to another stage. It is the shift in thinking from one level to another that permits the resolution of the contradiction.

Key aspects of this model and Spiral Dynamics thinking in general to keep in mind when exploring the table are, a) that no-one will make the transition from one level of consciousness to the next until such times as they have genuinely – as in genuinely – experienced the need to do so, and b) that there is no such thing as 'missing' stages – again, it is very difficult for a person to appreciate 'higher' consciousness levels until, again, they have experienced the contradiction. This failure to appreciate the perspective of people thinking at a level different to your own is, according to Beck & Cowan a primary source of all conflicts. In TRIZ/NLP terms, most people conflicts occur because different people have a different mental map of the territory.

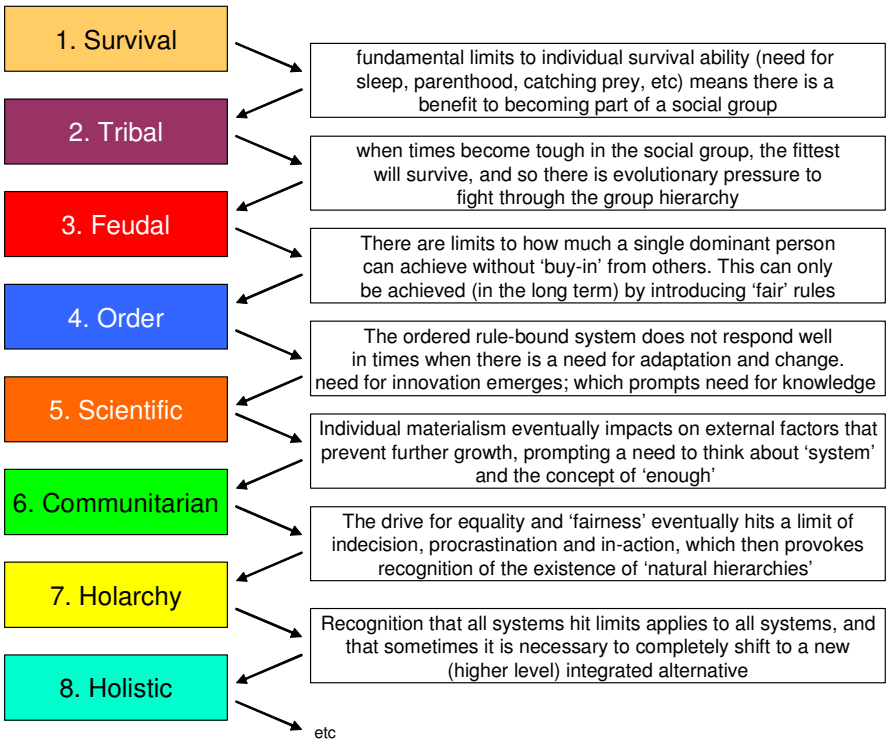


Figure 3: Emergence And Resolution Of Contradictions At Different Levels In The Spiral

What we might do next is to look a little closer at what happens as the various different level contradictions are resolved. As shown in Figure 4, it is possible to relate each of the level-jumps to the Inventive Principles of TRIZ. This is not to say that TRIZ was either used or needed to make the jumps, of course. Indeed, everyone seems to have managed quite well without it to date. What it does, however, indicate is that anywhere there is a contradiction being resolved, an discontinuous jump occurs, and that the Inventive Principles represent the only known (so far!) ways of achieving such jumps.

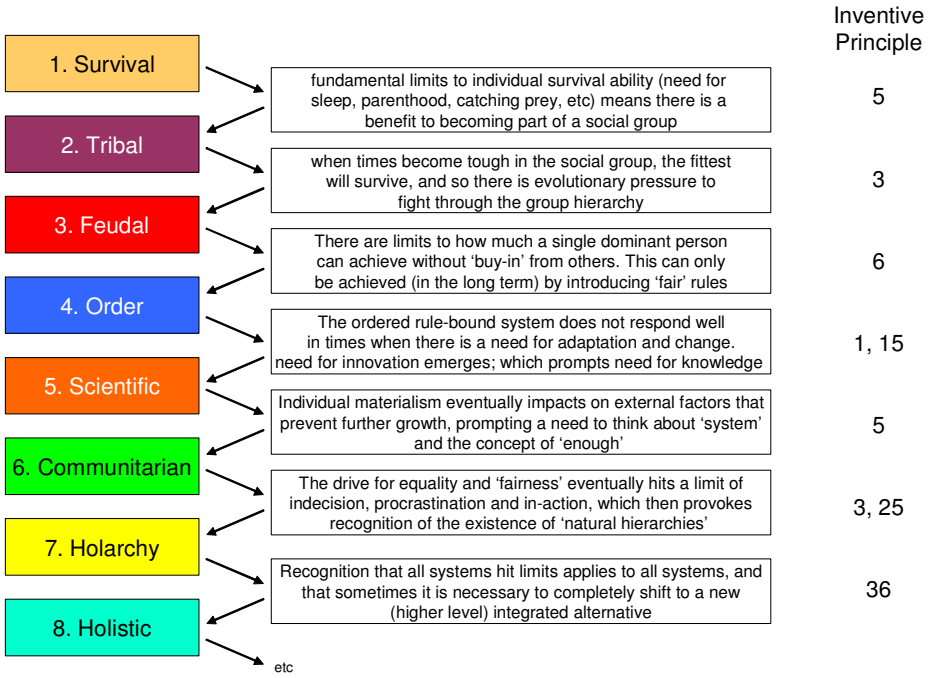


Figure 4: Consciousness Shifts And Inventive Principles

What is perhaps most interesting about this progression and the presence of the different Inventive Principles is the observation that there is a repeating cycle of jumps focused on individual change and jumps focused on collective change. The jump from Level 1 to Level 2 occurs because of the advantages conferred by a collective group. When this Level 2 group-dominant system hits its limit, the jump to the third Level occurs by shifting the focus again to the individual. Likewise, when the individual-dominant Level 3 system hits its limit, the way forward involves a shift back to the collective. This repeating individual-collective dominant recursive (so far!) cycle is illustrated in Figure 5.

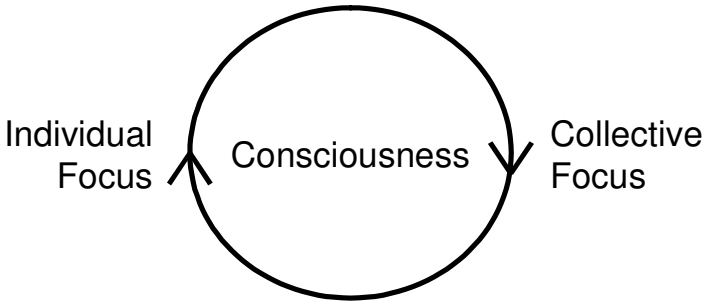


Figure 5: Recursive Individual-Collective Dominant Cycles In Evolution of Consciousness

So How Does This Affect Me?

According to Beck and Cowan, no-one can 'miss' stages along the spiral dynamic of consciousness evolution. In many ways, they suggest, the map is a *fait a compli*, with little or anything that any of us can do about it other than tread our weary way along the path. To date, in other words, how far or how fast someone progresses through the spiral during their lifetime depends on factors that are effectively beyond our control.

While it is not clear that TRIZ can (or should) do anything about this state, what emerges as new here is that we can make ourselves aware of the existence of the different discontinuous jumps between levels of consciousness. By so doing, in other words, by recognizing the dynamics of consciousness evolution and specifically the contradictions that will ultimately limit our thinking at our current level, we present ourselves with the foundations an early warning system. And a far more effective means of thinking about and handling problems involving different people with different opinions about what is right and what is not.

Reference

1) Beck, D.E., Cowan, C.C., 'Spiral Dynamics: Mastering Values, Leadership And Change', Blackwell Publishers, 1996.

Where Does The New S-Curve Start?

(Thoughts On The TRIZCON Presentation By Boris Zlotin)

Maybe he was just trying to be provocative. When Boris Zlotin announced at the beginning of his otherwise highly thought provoking after dinner marathon at the Altshuller Institute TRIZ Conference last month (see review elsewhere in this issue of the e-zine), that anyone drawing the relative position of two s-curves like that drawn in Figure 1 'didn't know what they were talking about', I suspect that quite a few in the audience were more than a little surprised.

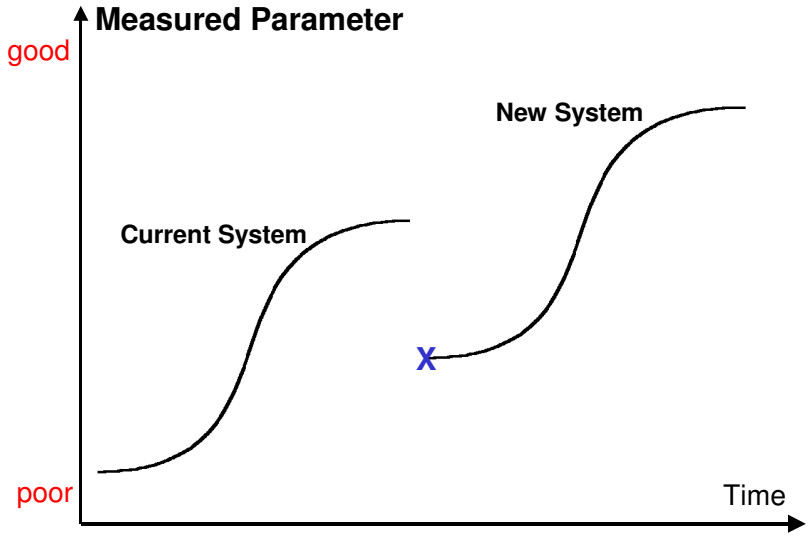


Figure 1: The 'Wrong' Way To Draw Two Adjacent S-Curves According To Boris Zlotin

Boris went on to state that in actual fact, the start of the new S-Curve – the point marked X in the above figure – should actually be drawn as shown in Figure 2.

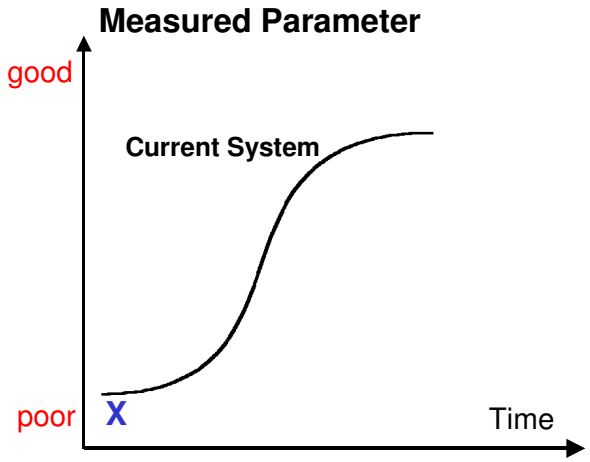


Figure 2: The 'Right' Way To Draw Two Adjacent S-Curves According To Boris Zlotin

The suggestion behind the placing of the start of the 'new' s-curve at or around the time of the start of the already existing s-curve is that two competing systems are devised at around the same time, but that because one is slightly superior to the other at the

beginning of its evolution, it is the one that initially succeeds. The 'new' s-curve then takes a slower rise to an ultimately higher state of ideality – or whatever the measured parameter up the y-axis of the plot is chosen to be. By way of example of where this 'general' phenomena occurred in history, the example of gas-turbine engines was cited.

There are so many flaws with this argument that it is difficult to know where to begin. There are probably three main points that need to be raised in order to prevent the errors in Boris' arguments from becoming accepted belief:

1) the erroneous logic that a small number of cases proves some kind of fundamental law of evolution dynamics
2) the lack of understanding of context – and the fact that different customers will position different s-curves at different positions relative to one another
3) exploring the rationale for drawing adjacent s-curves as in Figure 1 rather than Figure 2.

Let us take each of these points in turn:

1) Hypothesizing Laws Based On A Few Cases – while it is possible to make the argument that in *some* cases two distinct ways of achieving a function are derived at the around the same time – and hence that two competing s-curves commenced at the same time, it shouldn't take very long to find instances where the new system did not emerge until considerably after an incumbent. So, to take just a couple of examples, the abacus, slide-rule, pocket calculator or personal computer quite clearly did not appear at the same time as either each other or the 'analytical engine' created by Charles Babbage in 1856 – all five, of course, have the same overall function – and hence it is valid to draw the s-curve for all five on the same axes. Likewise the word-processor did not appear at the same time as the typewriter, which in turn did not appear at the same time as the pen or indeed Caxton's printing press.

   Just in case we might be interested in extracting some kind of 'law' from the thousands of cases of discontinuous innovations that represent new s-curves, then it is this: Relative to the previous s-curve, the start point of the new curve can be positioned just about anywhere relative to the first. A new s-curve, in other words, can start at any of the X's shown in Figure 3.

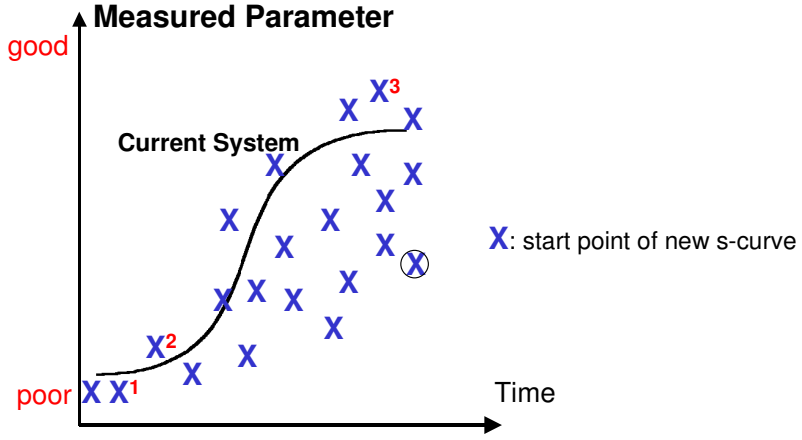


Figure 3: Where The New S-Curve Can *Actually* Start Relative To The Old Curve

The x-axis of the graph, for example, represents time. The actual law of the 'new' s-curve suggests that it could start at the same time, later, or conceivably even earlier than the 'old' s-curve. The y-axis represents whatever measure we are using to determine whether

one system is better than another. Again the 'law' states that the 'new' s-curve could be straight away better than the 'old' or it could be worse.

Hence Boris' suggested start-point, X^1 is but one of a million possible start points. A person more thorough than me might like to plot some actual cases in order to establish just how variable the relative start point positions can be.

2) Context - The biggest flaw in Boris' argument is that it takes no account of context. Again a small number of specific examples should allow us to swiftly cast aside the suggestion that a new s-curve will start at X^1. Let us start with the appearance of the first motorized vehicle. Here was a disontinuous innovation that was ultimately going to displace horse-drawn transport as the preferred mode of transport on the planet. Firstly we can again quickly see that the car first appeared some time after the horse-drawn carriage. More important than timing in this case, however, is the relative positioning of one to the other in terms of 'better'ness. So was the first motorized vehicle 'better' than a horse-drawn carriage? Answer: it depends. To some customers – those that value not having to tend to and stable their horses for example, the motor-vehicle will immediately be seen as superior. To those that valued reliability or convenience (in terms of accessibility of fuel or ability to traverse rough terrain), it was more likely that in those early days of motorized transport, the horse-drawn carriage would be viewed as superior.

   The main point here is that the relative positioning of the old and new s-curves depends on your perspective. When the first CDs appeared (again, somewhat later than the vinyl record or the wax cylinder), your perspective of whether CDs were better than records was inevitably coloured by what was important to you. So, if you valued acoustic clarity or resistance to damage, then the CD was at position X^3 relative to the s-curve for vinyl and you probably switched immediately to CDs. If, on the other hand, you were a vinyl collector and had several thousand vinyl records (as this author did) then the arrival of the CD was more likely to be viewed as a less ideal solution, and therefore you didn't.

   Figure 4 attempts to summarise this 'it depends' aspect of s-curve positioning. One man's gold is another man's poison.

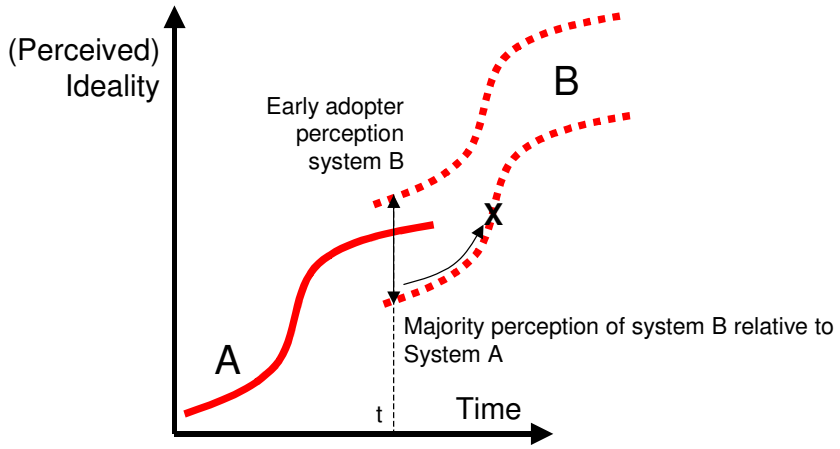


Figure 4: Relative Position Of Two S-Curves Depends On User Context

Using this Figure 4 image, it also becomes possible to explain another scenario, this time where the new s-curve was immediately superior to the incumbent (position X^2 on Figure 3) in the eyes of some early adopters, but that the incumbent nevertheless prevailed.

Again, the only general 'law' we can extract from these scenarios is that the position of the new s-curve relative to the old depends on perspective. To think that there is a single 'right' position of one curve relative to another is to fall into a serious misunderstanding of the dynamics of evolution.

3) Why Figure 1 is the most appropriate default way to plot two s-curves. TRIZ should tell us of course that there is rarely if ever a single 'right' way of thinking about anything. Rather there can only ever be a 'best' way given our current understanding of the world. Putting aside the previous two arguments that hopefully amply demonstrate why the new curve can be positioned just about anywhere relative to the old, showing the new curve starting later than the old is generally preferable since as a global average this is the way things happen. Showing the new curve starting at an inferior position to the current position of the old curve is also where we are likely to place it if we work on global averages. More important in this second case, however, is the recognition that the reason that so many major innovations come from a new player and not incumbents is that the incumbent is unable to accept the fact that their business may have to become worse for a period (Reference 1). This simply goes against what currently purports to be 'good management practice'. Good management practice, in other words, tells managers that they need to be continuously improving, optimizing and mazimising their return. It is a brave manager indeed that is prepared to face his or her stakeholders and suggest that the company should switch to a new way of doing things that is currently inferior to the present way of doing things. This is the fundamental basis of the 'innovator's dilemma (Reference 2).

There are, in other words, strong psychological reasons for drawing the default 'average' position of new s-curve as worse than the current s-curve. When we do this, we do not (or rather should not) forget that the actual position will depend on both history and the perspectives of our existing and future customers, but merely seek to highlight the extraordinary difficulties of making a successful transition from one curve to another.

Just in case the case hasn't been made strongly enough, we end this discussion with one more example of s-curve mapping. Figure 5 reproduces an Ideation picture that is often used to demonstrate why a potential client should work with them.

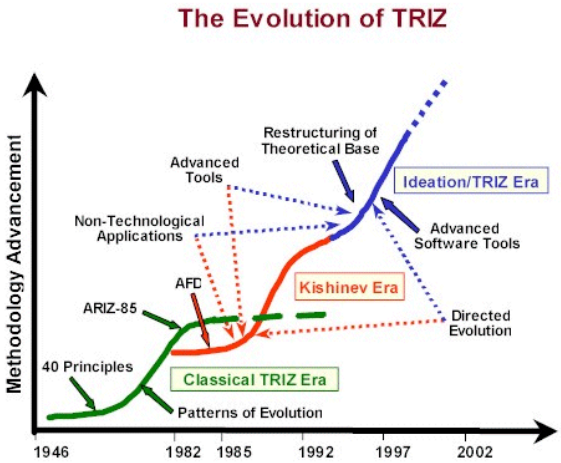


Figure 5: Relative Position Of I-TRIZ Relative to Other TRIZ Schools According To Ideation

Hopefully this graph serves to prove the more general s-curve positioning 'law' hypothesized here in that we can quite clearly see that the new curve whether it be Kishinev-era TRIZ or I-TRIZ neither started at the same time as Classical-era TRIZ, nor

did it start off from an inferior starting position.

We shall refrain from trying to place 'the s-curve' for our own Systematic Innovation Method on this figure since we believe, as ever, the answer will depend on the needs and perspectives of every individual client.

References

1) Utterback, J., 'Mastering The Dynamics Of Innovation: How Companies Can Seize Opportunities in the Face of Technological Change', Harvard Business School Press, 1996.
2) Christensen, C., 'The Innovator's Dilemma', Harvard Business School Press, 1997.

Humour – A New Software Provider?

You see some interesting things in China these days. Here's something we found as we were surfing during our last visit.

Any ideas what 'Wicrosoft' do for a living?
Not sure if this counts as a pure example of Principle 26. Or if we should give them the benefit of the doubt and suggest Principle 16. Or maybe a 13 in the company name department. You decide.

Patent of the Month

Patent of the month this month involves one of our favourite subjects; auxetic materials. Auxetic materials, for the un-initiated, are materials that possess a negative Poisson's ratio. What this means is that they don't behave like conventional materials. Take something like an eraser. Put a eraser on a desk and apply pressure to its top surface and you will see that as your action serves to reduce the height of the eraser, it also causes the sides to get slightly bigger. This is what any 'normal' material does – squeeze it in one direction and it will spread out in the other directions. An auxetic material on the other hand responds in the opposite manner – squeeze an auxetic material in one direction and it will actually shrink in the other directions. There are many potential applications for such a material.

The easiest auxetic materials – or rather structures – to manufacture tend to be foams. An early application of these auxetic foams is in things like mattresses and energy absorbing structures.

Our patent of the month takes the story a step further by introducing the possibility of auxetic fibres:

United States Patent *6,878,320*
Alderson , et al. **April 12, 2005**

Auxetic materials

Abstract

An auxetic polymeric material is manufactured in a filamentary or fibrous form. The auxetic polymeric material has a negative Poisson ratio so that it has the property of expanding or contracting transversely to a direction in which it is extended or compressed. The process for forming the material involves cohering and extruding heated polymer powder so that the cohesion and extrusion is effected with spinning to produce auxetic filaments. Typically, the power is heated to a temperature sufficient to allow some degree of surface melting yet not high enough to enable bulk melting.

Inventors: **Alderson; Kim Lesley** (Liverpool, GB); **Simkins; Virginia Ruth** (Lancashire, GB)

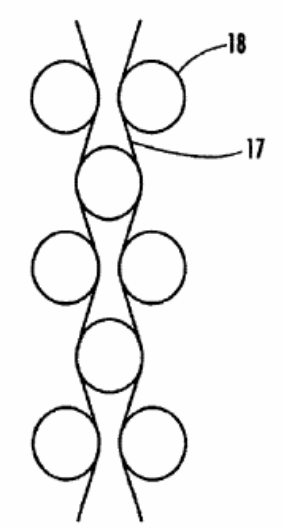
Assignee: **The University of Bolton, higher education corporation a UK corporation** (Bolton, GB)

This invention can probably be classed as Level 4 in the TRIZ context, being the first time that anyone has successfully found means of making a fibrous form of the material. This fact in turn makes it highly likely that a host of new applications (and lower level patents!) will follow.

The patent describes a manufacture process capable of producing continuous monofilaments, or short filaments or fibres, that may be twisted or otherwise combined to give multi-filament or fibrous yarns. These filamentary or fibrous materials may then be formed into textile structures such as woven, knitted or felted fabrics alone or in combination with any other suitable materials. Filaments or fibres made in accordance with the invention may be used as reinforcements in composite materials to impart

enhanced energy absorption properties and fibre pullout resistance. Sonic, ultrasonic and impact energy can be absorbed enabling superior composites to be made for sound insulation of walls of buildings, body parts for submarines or other vehicles, etc, bumpers for cars, etc. Auxetic materials also respond to impact to give local densification thereby giving enhanced indentation resilience.

Textile structures incorporating or made from filaments or fibres made in accordance with the invention may be used in protective clothing where enhanced indentation properties and low velocity impact resistance are advantageous. Such textile structures may also be used in healthcare. There are also other applications where the material of the invention can be used advantageously.



The breadth of potential applications (and scarcity of Level 4 inventions) is why we have featured the invention here. Beyond that, though, it is also useful to see the main inventive step made by the inventors in the context of the solved contradiction.

The inventive step, to transform a no-doubt long and arduous programme of research, into a mere sentence (very unfair of course), involve the introduction of a spinning motion into a normally static extrusion manufacture process:

"According to a further aspect of the invention therefore there is provided a method of forming an auxetic material comprising cohering and extruding heated thermoformable particulate polymeric material wherein cohesion and extrusion is effected with spinning to produce filamentary material having auxetic properties."

The core conflict that had to be solved was that the previously existing manufacture processes did not allow the production of long fibres. A good way to map this problem onto the Matrix would be as follows:

Improving Factor	Worsening Factor	Principles
Length/Angle of Stationary Object (4)	Manufacturability (41)	17 3 15 13 4 31 10
we want to be able to produce a fibrous auxetic material, but the current manufacture process prevents it		

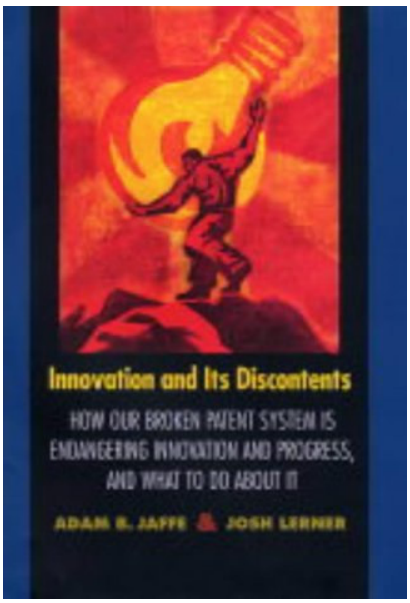
Encouraging to see both Inventive Principle 15 ('Dynamics' – the main inventive step), and 17 ('Another Dimension') deployed by the inventors in making the invention.

Best of the Month

SYSTEMATIC INNOVATION

Any readers that have found themselves looking despairingly at the US patent database in recent times, thinking ‘how on earth did that get granted’, will be interested in our best of the month recommendation this month.

The oddly titled ‘Innovation and Its Discontents by Adam Jaffe and Josh Lerner is a damning indictment of a patent system spiraling massively out of control.



The core of the book centres around two subtle shifts made to the US patent office policy in the 1980s, and the unexpected consequences they are now delivering. If you want to know how we now find ourselves living in a world where a patent typically receives less than 20hours of examiner time, where you stand a far better chance of having a patent granted if you’re from the US, where you can stop a competitor from producing a product before any kind of infringement has been proven, and where the granting policy has become ‘if in doubt grant it’, then look no further than this book.

While the author’s recommendations for putting things right appear to simply shift a massive trade-off from one place to another (it would definitely be nice to apply some TRIZ to the problem!), the book itself is beautifully written and sequenced, and therefore well worth your investment.

Conference – TRIZCON05 (Platitudes and Paradoxes, all opinions are those of the author, etc)

The US TRIZ conference was held in Brighton, Michigan over the period 16-19 April. I presented a one-day management workshop on the 16th and then a paper on renewable energy case studies on the first day of the conference proper. A version of this paper will be re-printed in a future issue of TRIZ Journal for anyone interested.

The conference this year was attended by around 140 people, a large proportion of who were employees of event host, Delphi. As ever, it was a great privilege to meet up with old friends and to make new acquaintances. As in 2003, there were more of the former than the latter. A pair of panel sessions and 24 papers were presented, the papers in two parallel sessions.

The first panel session, 'TRIZ – Theory and Practice' – probably couldn't have got the event off to a worse start. What newcomers to TRIZ thought when they were confronted with a bunch of TRIZ experts engaged in a plethora of either/or-I'm-right-you're-wrong nonsense doesn't bear thinking about. This session also managed to set a context of paradox that hung around for the remainder of the conference. The TRIZ community is really going to have to resolve some of these issues if it is ever going to take-off in the way that we all believe that it deserves to. Here are a few of the paradoxes that I noted during the first and subsequent sessions:

- One of the pillars of TRIZ is 'function', and yet when it comes to the function that TRIZ is supposed to deliver (achieving innovative solutions to problems I think), why do we spend so much time arguing about TRIZ versus other methods. Surely no real user of TRIZ is likely to be interested in TRIZ for its own sake. If you have a problem, you want to solve it, and likely as not, you don't care a damn for what tool gets you to where you want to be. And yet seemingly endless presentations and Russian-sermons drone on about TRIZ versus other methods. It probably doesn't need to be said yet again, but here is yet another pointless either/or discussion, the end point of which needs to include the words 'both' and 'and'.
- Thinking that there is a single 'right' way of teaching TRIZ. At one point during the first panel session we have the preposterous suggestion that the reason TRIZ hasn't taken off is because there isn't 'the standard teaching text'. Sure, TRIZ needs to be taught. In the same way that mathematics and grammar need to be taught. But is there a single mathematics text book? A single mathematics curriculum? The day there is a single, fixed standard way of teaching anything is the day we don't need academics and teachers anymore. So obviously every academic will inevitably go with the idea. Yeah, right.
- 'Someone, somewhere already solved my problem'. A great TRIZ idea. And yet one that apparently great swathes of the Russian-speaking TRIZ community appear to ignore when it comes to contemplating the possibility that someone, somewhere outside the former Soviet Union might already have solutions that fill in some of the weaknesses of TRIZ. Sure, TRIZ is a wonderful piece of work, but it is not the be-all and end-all of inventive problem solving. If TRIZ tells us not to re-invent the wheel why are so many people trying to evolve TRIZ in some kind of an isolation bubble that pretends there is nothing outside of TRIZ. Arrogance and ignorance tend not to make such good companions.
- TRIZ is about distilling excellence, putting all the good stuff in one place. To me this kind of implies the need for an open mind, and a willingness to admit that

occasionally along might come something that requires us to shift our mental model. When you see so-called TRIZ Masters suggesting that 'there haven't been any new ideas in TRIZ for 20 years', then you know you're in the presence of someone with a mind with the shutters down and a 'gone fishing' sign hanging up.

Now maybe this last paradox becomes a little more understandable when we consider the poor quality of the majority of the presentations at the conference (the Anti-TRIZ-Journal, would very simply have had a field day if they'd turned up). Sit through enough mediocrity, mis-interpretation and misguidedness and sooner or later you begin to question whether you ought to be hanging up the 'gone fishing' sign yourself.

No need to dwell too much on the low-lights, but more than a few were so bad that we are in danger of killing any chance of growing the status of 'obscure cult' if we don't say something. The major criminals this time around:

- 'Institutionalising Innovation' – absolutely nothing to do with TRIZ. Or institutionalizing innovation. A stream of platitudes, out-dated clichés and blather about nothing in particular. There was no point to this presentation other than a mis-guided attempt from someone on the periphery of TRIZ to sell us old rope. Re-arrange the following words into a well known phrase or saying; eggs, teach, grandmother, suck. Emphasis on the latter.
- 'Three Main Flops of TRIZ' – more platitudes, total misunderstanding of the meaning of the word 'customer' and a series of classic 'insert miracle here moments that work something along the lines 1) here is a problem with TRIZ, 2) this is what the world might look like if this problem didn't exist. Only problem then being a tiny missing intermediate step called 'this is how we might solve the problem'.
- 'The Seven Habits of Innovative Lean Design' – successful attempt to cram 30 seconds worth of content into an hour. The 30 seconds worth of content was a blatant attempt to sell a book with little or no relevance to TRIZ.
- 'Marketing TRIZ in the Global Marketplace' – yet more empty razzle dazzle. A triumph of form over content. Allowing this paper an hour of valuable programme time was a serious mistake.
- 'Use Of TRIZ At Creation Of New Materials' – half-baked mumbo-jumbo. Abstract, hypothetical and fatally flawed in its misguided scientific foundations. Mercifully brief, though, at 20 minutes.
- Use of EMS Models…' – sorry to say, but this was another in a long series of terrible cases in which someone starts from the wrong place and ends up with a really complicated way of doing something that could and should have been really simple. Do we really need a 20-slide dissertation showing how EMS and the 9-windows can be combined to think about killing mosquitoes in Africa, or might we have simply written down 'find a cheap way of killing mosquitoes' as the problem definition. For me, the latter would have been a better start point. For all of the EMS smoke and mirrors, we still ended up no nearer to solving the problem. And by this I mean that the suggested use of anaerobic digesters and fans and venturis really is nowhere near solving the problem.

Oh boy. Let's try pretend none of that lot happened, and move on. There was a positive side. It included solid contributions from a number of other presenters. Alla Zusman's paper on evolutionary resources contained a number of new ideas that make the paper well worth the read. Although I didn't see the presentation personally, the rotary compressor paper by Valery Krasnoslobodtsev is also impressive and well worth getting

hold of a copy. Last but not least, was Boris Zlotin's three-hour marathon session at the end of dinner on Monday evening on prediction of future trends in and around the automotive and energy sectors. Some of the logic appeared to be flawed and some of it was plain wrong (see article on s-curves elsewhere in this issue), but keeping people entertained for such a long time is a true gift, and at the very least the whole thing provoked a massive amount of thought. Much of what Boris discussed will be posted on the Ideation website in coming weeks. Needless to say, it should receive your attention irrespective of whether you are interested in automotive applications or energy systems.

Overall, then, it is difficult to assess whether the high points outweighed the lows. Probably on balance they did, but in terms of new content, I came away from Brighton with less than a page-worth of notes. Whether that counts as a good return on investment remains to be seen.

Fingers crossed for next year's conference.

Investments – Chicken Feathers

Here's one we stumbled across totally by accident. It came about during a project to help a client with a semi-conductor package de-lamination problem. Our task on the project was to look at the mis-matched coefficient of thermal expansion (CTE) in the different materials present in a package, and to see if there were already available means of tackling the problem. 'Readily available' generally means searching the Internet rather than the patent database. Amongst the things we found as we trawled the Net were chicken feathers. More specifically, the work being done at the University of Delaware to try and find something useful to do with the 5 billion pounds of chicken feathers left over after the food industry has taken the useful bits of the bird.

There is a close connection between the work that Delaware are doing and the theme of our paper on sustainability presented at TRIZCON last month; finding ways of transforming 'waste' into useful resource. In the case of chicken feathers, the industry has thus far found a home for chicken feathers in low grade animal feed. Scary. It seems that this practice – already banned in most parts of Europe – is likely to be stopped in the coming years. Good news for cows, not so good news for the industry, who get their 5 billion pound problem back again.

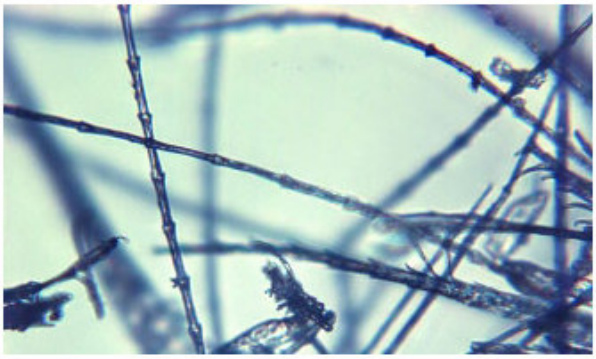
While the website does not make it clear how the connection between waste feathers and printed circuit boards, we can speculate that it has something to do with examining the properties of chicken feathers and seeing what products might benefit from such attributes. Among the main attributes of chicken feathers low dielectric constant and high strength-weight ratio appear to be two that suggest a potential link to PCBs.

Again no doubt missing a bunch of steps in the process, lead University researchers RP Wool and CK Hong have created a chicken feather keratin composite that uses soy-bean based epoxy as the bonding agent. According to the researchers, the best end product so far uses 30% keratin by weight, has a lower dielectric constant than conventional semiconductor insulator materials such as silicon dioxide or polyimides. For comparison, Wool says, whereas the dielectric constant of air is 1.0 and that of silicon dioxide is 3.8-4.2, keratin fibers have a dielectric constant of 1.6. That means electrons can move on the feather-based printed circuit boards at twice the speed as traditional circuit boards.

The new circuit boards also had enough strength and rigidity to satisfy industrial requirements, and a coefficient of thermal expansion similar to silicon dioxide and polyimides. "That's important," Wool explains, "because a high thermal expansion

coefficient can damage printed circuits and lead to brittleness and durability issues. Air has a very high thermal expansion coefficient, but an unexpected sidelight of this process is that the air merely expands out of the keratin fiber, giving you almost a convective cooling effect."

You might have spotted mention of CTE in that quote from the University. This is how we found it; another attribute of Wool's composite being that it helps a lot with the CTE mis-match problem we were working on. Closer inspection of the chicken feather reveals that the keratin fibres are hollow (TRIZ trend?):



The low-down on feathers. A micrograph of feathers (above) shows hollow keratin fibers, a light, tough material. These fibers are combined with a soy-based epoxy to make printed circuit boards (left) that are not only recyclable but also faster than conventional boards. image credits: C. K. Hong and R. P. Wool/University of Delaware

The figure also shows one of the PCBs built by the research team. Note the additional claim that the new board materials are also recyclable.

Let me get this straight. We take a plentiful waste product, mix it with a sustainable one, get a useful product that out-performs the expensive incumbent (virgin silicon is exceptionally expensive both monetarily and from an eco-footprint perspective) in virtually all important areas, and is recyclable when we've finished with it. Are we missing something here, or does this look like a there is something fundamentally right happening here?

Find out more at http://ehp.niehs.nih.gov/members/2004/112-10/innovations.html.

Biology – Springbok

Many mammals are able to influence the sex of their offspring. The method used in each case varies, and for the most part the mechanisms are not currently well understood.

The primary driving force of sex selection is survival. Since females become sexually inactive during pregnancy, but males can spread their genes to an entire harem, males tend to be the sex of choice in the majority of mammalian cases.

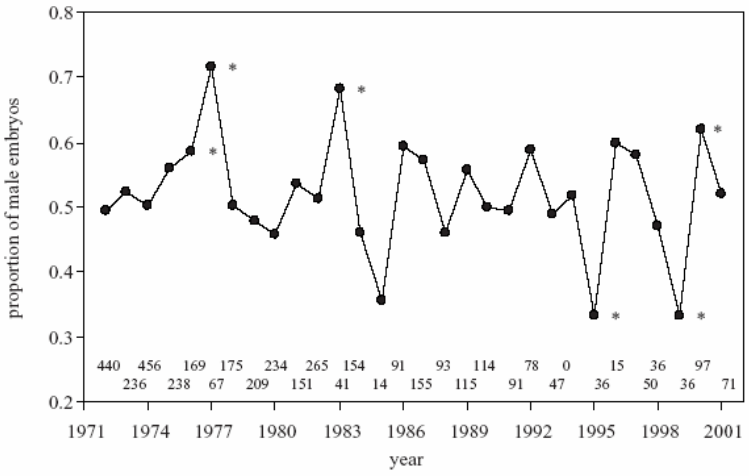
With the Springbok (*Antidorcas marsupialis*) of Kalaharan southern Africa, however, it seems that this bias shifts in the other direction depending on the prevailing environmental conditions. Recently published studies have shown that springboks give birth to proportionately more female offspring during times when the rains have been good and there is an abundance of food.

To understand why this preference occurs we need to appreciate that the springbok has a considerably higher reproductive rate than mammals of comparable size – females typically begin breeding a mere six months after birth, and may have several calves during each pregnancy. We also need to recognize the unpredictability of the Kalaharan weather.

Giving birth to daughters is only an advantage when they are born strong. A weak female is a liability to the herd. Strong ones on the other hand are able to reproduce earlier and produce their own healthier offspring, thus allowing the herd to grow more rapidly. So, when the environment is good, the number of available breeding females is the limiting factor on the herd.

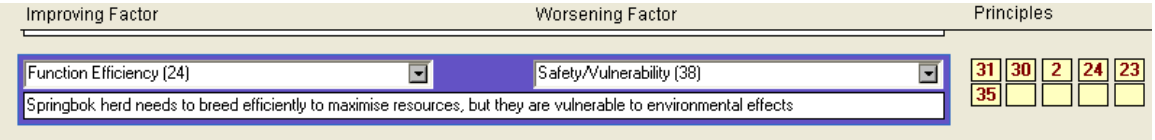
When times are more difficult, the limiting factor becomes availability of food. And so far better for the herd to let the 'survival of the fittest' dynamic weed out the weak.

The following picture gives some idea of the response rate achieved by the springbok in responding to prevailing environmental conditions:



What is particularly interesting, then, about the springbok is that the female is able to ‘choose’ the sex of her young before fertilization occurs. The precise mechanism by which she does this is not well understood, although clearly some kind of feedback link between environment and her reproductive system has evolved.

It is quite interesting to examine the solution evolved by the springbok in relation to the conflicts they face:



Nice, again to see a good match between conflict-resolving strategies in nature and those in the built environment.