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# Systematic Innovation

# e-zine

Issue 41, August 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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# Defining ‘Breakthrough Solutions’

When is a new solution a ‘breakthrough’, and when is it not? An important question. One that, if the global statistics on innovation are to be believed, the world of inventors and innovating companies is not so good at answering. The average likelihood that a novel product or service idea will be successful on the market is somewhere in the order of 5%. Clearly, therefore, there is a question to be asked about our ability to judge what is and is not going to be successful. In the first of a three part discussion of the subject, this article examines three ‘breakthrough’ case-studies. Each one is presented in terms of the Evolution Potential concept. The hope in doing this is to demonstrate that the objectivity provided by the technique will allow us to determine some guidelines that we might be able to reproducibly use to gauge the likely success of our own novel designs.

The second and third case studies look at a recent ‘failed’ breakthrough and one that has just entered the market and hence we don’t yet know whether it has been successful or not. We start, however, by going back in time to the early 1930s when the world of commercial air travel was just about to take-off:

**Douglas DC-3**

The Douglas DC-3 (Figure 1) was the father of the modern-day commercial airline business. As such it represented a genuine breakthrough. Despite several previous attempts to make viable passenger carrying aircraft, the DC-3 was the first one to actually succeed.

**Figure 1: Douglas DC-3**

The benefit of hindsight now allows us to see that the main reason why the DC-3 succeeded where others failed is because it was the first design to integrate five technologies. All of the technologies were already in existence, but no-one had managed to bring them all together before. In this sense the DC-3 is very important from a ‘breakthrough’ definition perspective. This is especially so when we examine the DC-3 alongside one of its contemporaries, the Boeing 247.

The five technologies integrated into the DC-3 were the variable pitch propeller, monocoque cabin structure, retractable undercarriage, radial air-cooled engines and wing flaps. The Boeing 247, on the other hand, featured only four of the five. The designers at Boeing built the 247 without wing-flaps. The consequence of this decision was that the aircraft had a tendency to become unstable during landings. As a result of this, the designers were forced to down-size the engines. And as a consequence of this, the payload of the aircraft proved to be insufficient to make it commercially attractive for

operators. This subtle and yet profound difference between the two aircraft offers us an important insight into the dynamics of innovation; that sometimes we need to combine multiple technical breakthroughs in order to create a commercial one. Looked at from the perspective of the Evolution Potential radar plot, we can see how commercial air transport only became viable when there had been a critical mass of jumps along the trends of evolution. Figure 2 shows a system level plot for the DC-3 highlighting the five jumps that were necessary to create the commercial breakthrough.

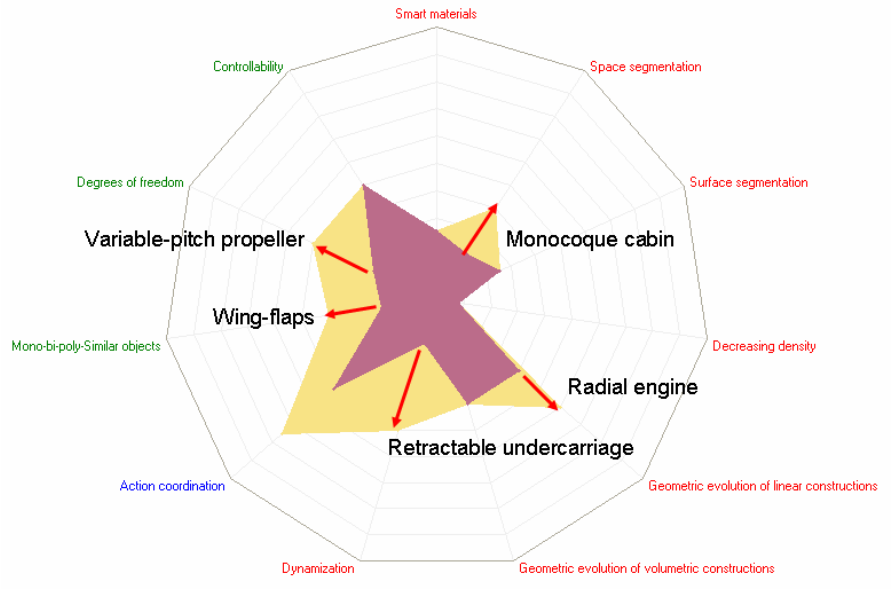



**Figure 2: System Level Evolution Potential Plot For Douglas DC-3**

So while it was perfectly possible to create a flight-worthy aircraft without any of the technologies integrated into the DC-3 (i.e. the purple region in the radar plot), it took the jumps to the buff-coloured plot before that flight-worthiness could be converted into commercial success.

Let us now move closer to the current date and examine another innovative product. This time the projection keyboard:

## Projection Keyboard

The field-based keyboard illustrated on the right-side of Figure 3 has oft been used by people in and around the TRIZ community as an example of the 'Dynamization' trend. Indeed, as shown in the figure, the humble keyboard does make a very nice illustration of the trend in action

**Figure 3: Keyboard Evolution To The 'Projection' Design**

There is only one problem with this case study, however, and that is that the projection keyboard has not proved to be the commercial 'breakthrough' that its inventors (and TRIZniks!) probably imagined. Inventors aside, we also need to understand the failure of the design a little better in the context of the Dynamization trend – which, after all, is there

to tell us that 'good things happen when we advance from left to right along the trend'. So what is going on here?

Again, construction of the complete Evolution Potential radar plot for the keyboard should hopefully give us a clearer picture. Such a picture is illustrated in Figure 4. What this plot shows is a comparison between a conventional keyboard (left hand side of Figure 3) and the current form of the projection keyboard.

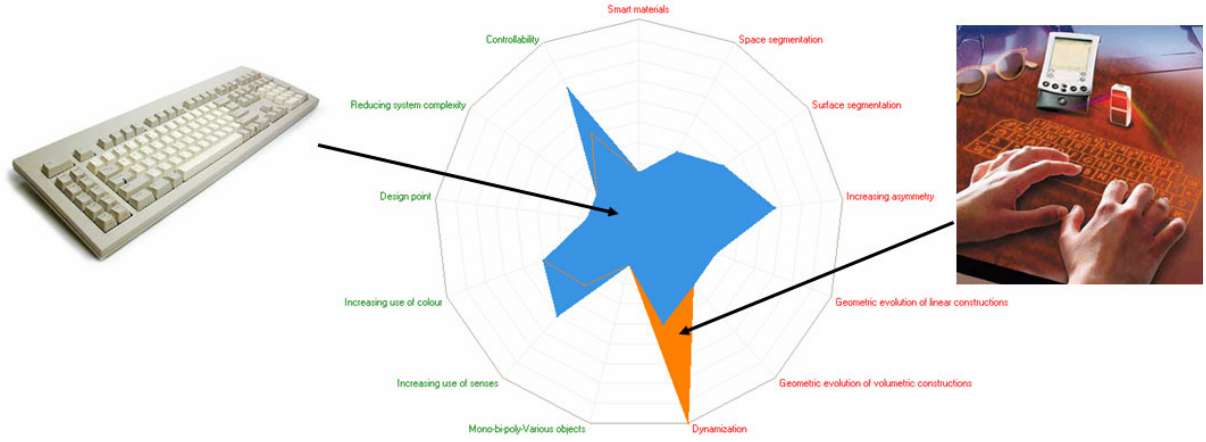



**Figure 4: Evolution Potential Difference Between Conventional and Projection Keyboard**

What figure 4 makes clear is that although the projection keyboard has made a very definite advance along the Dynamization trend, it has simultaneously made backwards jumps along two of the other trends. Namely, the projection keyboard does not have the same sense of touch and hence the same positive (controllability) feedback found in a conventional keyboard.

Whenever we see this kind of radar plot – where advances along one or more trends is countered by backwards jumps along other trends – then we have presented the consumer with a trade-off. While there is no hard and fast evidence to say that such a situation precludes the achievement of a breakthrough, the evidence tells us that we make the likelihood an awful lot lower than if no trade-off decision had been necessary.

One of the interesting aspects of the projection keyboard is that the initial perception of most people *seeing* it for the first time is that it is a great idea, bound to be a commercial success. Alas, that perception tends to disappear when one gets an opportunity to feel (or rather not feel) the keyboard in action. Hopefully this feel/feedback problem is one that is eminently solvable. Should this happen to the extent that the two backward trend jumps are reversed, the resulting radar plot would tend to suggest that the likelihood of commercial breakthrough is much more likely.

Let us now build from this case to an even more recent one. This time a product innovation that has not yet had sufficient time on the market to determine whether it will be a commercial breakthrough or not:

**Gillette M3 Power**

The new Gillette razor introduces pulsation into its razor products. In so doing, the razor makes a very definite advance along the Rhythm Co-ordination trend. Whether this technical breakthrough comes in response to the recent jump from three to four blades made by Wilkinson/Schick, or because of a desire to increase sales of the company's Duracell batteries, we shall probably never know. What we can see, however, when we construct a comparative Evolution Potential radar plot of the razor before and after the M3

Power is that yet again we see an advance along one trend countered by backward jumps along other trends. Figure 5 shows the plot.

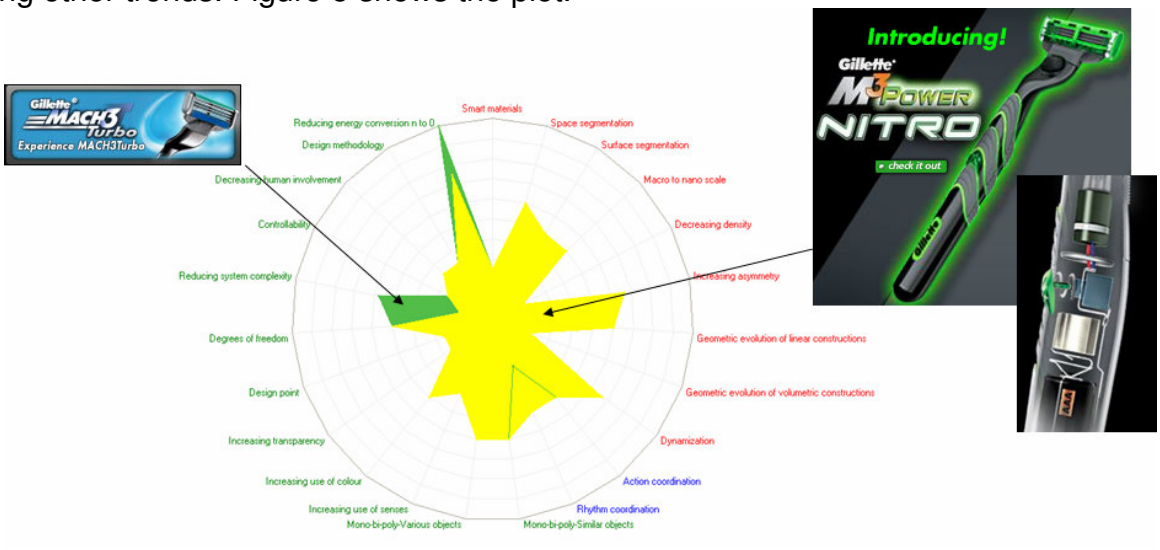



**Figure 5: Evolution Potential Difference Between Gillette Mach3 and M3 Power Razors**

In this case, the negative jumps have occurred along the Energy Conversion and Reducing Complexity trends. The addition of a battery to a previously passive device and – as shown in the inset close-up picture on the right hand side of the figure – the marked increase in complexity of the system together present the consumer with an interesting trade-off decision. As already stated, it remains to be seen whether the improvement in shaving performance delivered by the vibrating action will offset the inconvenience of having to purchase and replace batteries and increased likelihood of reliability/durability problems. From the evidence of other cases, like the earlier projection keyboard, it would appear that the M3 Power is not likely to become a significant commercial breakthrough. At least that is the prediction the radar plot allows us to be confident in making.

Again like the projection keyboard, the chances of achieving commercial breakthrough are markedly increased when the consumer is not presented with a trade-off decision. The real M3 breakthrough is likely to happen when someone finds a way of delivering the improved performance created by the blade vibration without the need to add an external power source, or to add so many components to the design. (As an aside, quite likely both are technically feasible with already existing technologies from other fields.)

## Final Thoughts

The likelihood that any product or service will be seen by the market as a ‘breakthrough’ depends on many factors. Our aim in this article has been to demonstrate the role that the TRIZ trends and the Evolution Potential concept have to play in the overall picture. Based on our experiences in drawing many thousands of these plots, it is quite clear to us that the chances of achieving ‘breakthrough’ are highly dependent on making positive advances along at least one trend (and very often – as in the DC-3 example – several), without making negative jumps along other trends.

In the next two parts of this series we will examine some of the other factors that we think will, when taken together, allow us to very systematically determine whether any kind of novel design is going to achieve commercial breakthrough status. For now, keep thinking about those radar plots.

# The Ever-Shifting Ideal Final Result

(Free, Perfect, Now and Google)

Although it is primarily used as a theoretical as opposed to practical evolutionary end-point, there are numerous examples of technical and business systems that have achieved some kind of an Ideal Final Result (IFR) state. One case that we frequently mention during workshops is Google. Google makes a good example of the IFR concept in action, because here is an organization that appears to have been built with the idea of 'free, perfect and now' at the core of its business. A user of Google is able to quickly and accurately find what they want on the Internet ('the 'perfect' part), in a timescale that is to all intents and purposes instantaneous ('now'), and – of course – at no cost ('free').

Some delegates frequently enter the discussion at this point with a claim that Google is not an example of IFR because 'someone has to pay'. The point of this short article is to explore this thought in a little more detail in order to see if we can extract some additional useful information on the manner in which systems evolve.

## 'Someone Has To Pay'

What is quite clear in the Google business model – as in any other – is that there is a need to generate the revenues that allow the company to survive and thrive as a business. In realizing that the maturity of the search engine business is at such a point that the customer expects to receive 'free, perfect and now', Google have had to find other sources of revenue. Primarily today this revenue appears to come from advertisers. What we then see here is the clear understanding that the customer expects the IFR – as illustrated by our usual cone image in Figure 1.

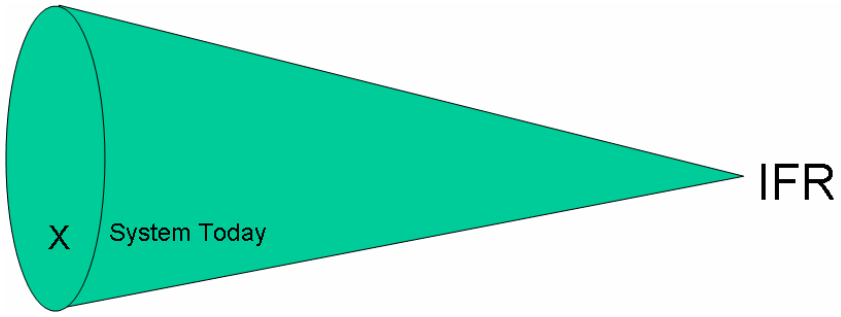



**Figure 1: IFR And Convergent Evolution**

In our terminology, one of these cones is used to represent each useful function delivered to a customer. This being the case, we can then hopefully start to imagine that we ought really to think about two cones to describe the Google business model; one to describe the 'search' function offered to the end customer, and another to describe the 'advertise your wares' function delivered to those wishing to use Google as a medium for advertising. This pair of cones is represented in Figure 2. What the figure also tries to make clear is that, while the current evolutionary position of the company on the first cone (representing the search function) is at the IFR end-point, on the second 'advertising' function cone, the current state has not yet reached the IFR. In other words, the 'advertising' function delivered by Google to its advertisers has not yet reached the 'free, perfect and now' end state. Most notably when thinking about that 'free, perfect and now' end-point for the advertising function, advertisers certainly do not get 'free'. They are expected to pay Google in order to have access to the medium.

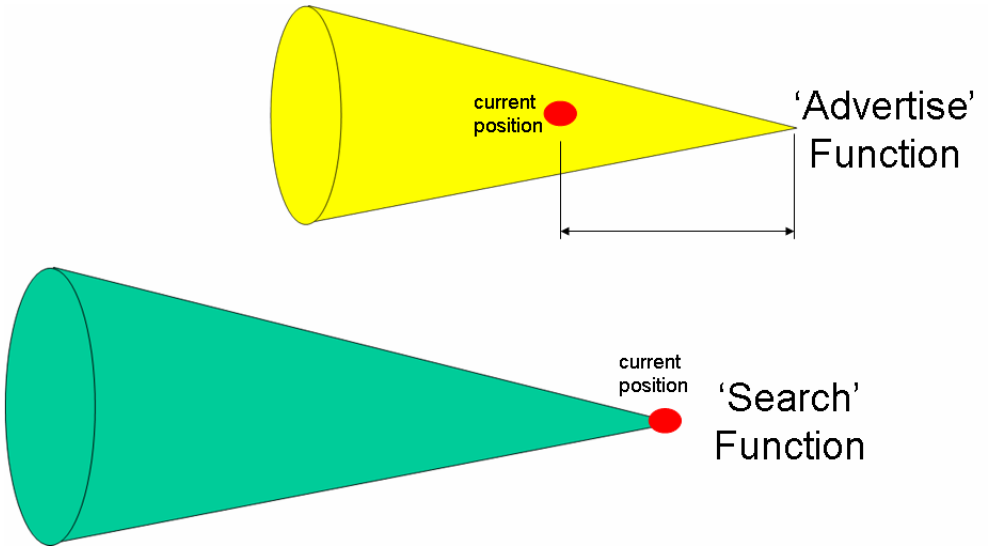



**Figure 2: Dual Function Cones In Google Business Model**

Google earns revenue from advertisers because those seeking to advertise through Google currently expect to have to pay for that privilege. Herein though lies a really important additional thought. The key word is 'currently'. What the IFR cone image tries to make clear is that evolution along the 'advertise' function cone has not 'currently' reached the IFR point, but that someday – whether Google like it or not – it absolutely will. In this sense, advertisers are no different from consumers; sooner or later the dynamics of system evolution mean that someone, somewhere will deliver to them a 'free, perfect and now' advertising medium. If Google are a smart company, they will already anticipating that advertisers will increasingly come to expect a more ideal service, and will consequently be looking at their business and the world around them to identify other functions (i.e. other cones), where they will be able to generate revenues when the advertising function begins to get too close to its IFR end-point – Figure 3.

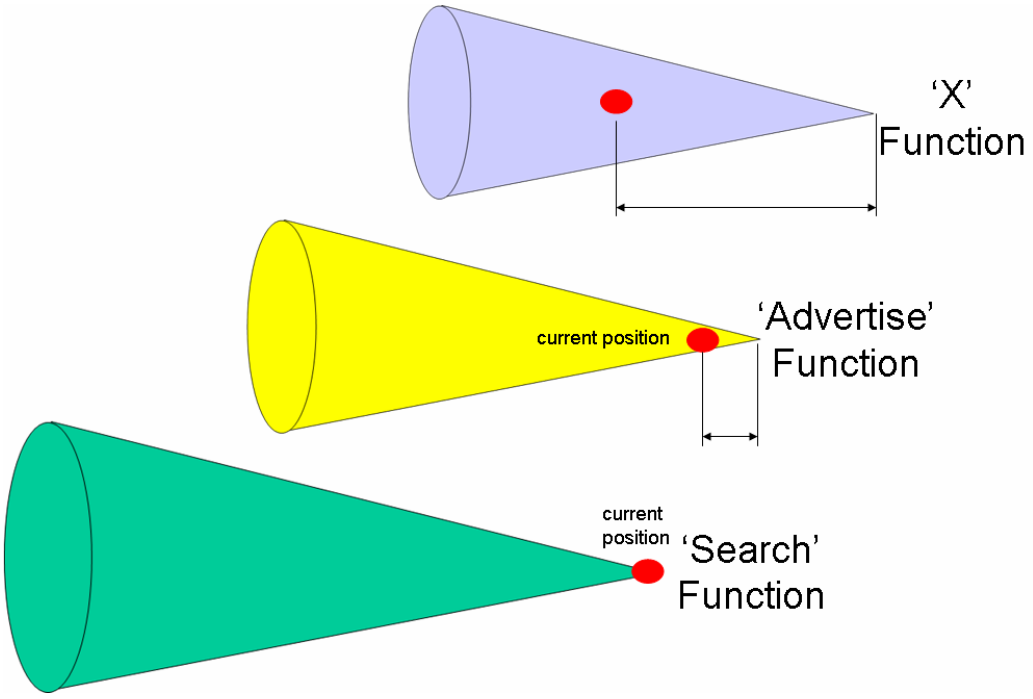



**Figure 3: As Each Function Approaches IFR, Businesses Need To Find New Functions**

It is probably too early to be able to speculate with any great confidence, but one possible

area in which we might see Google expanding in the future consistent with this model is selling some kind of ‘knowledge management’ function to corporate users.

**Perfect Shifts Too**

The ‘someone has to pay’ idea gives us a first perspective on the ever-moving nature of the IFR concept. What Google and the rest of us interested in the concept also need to keep a track of is the fact that the definition of ‘perfect’ is also liable to shift and expand as time moves on.

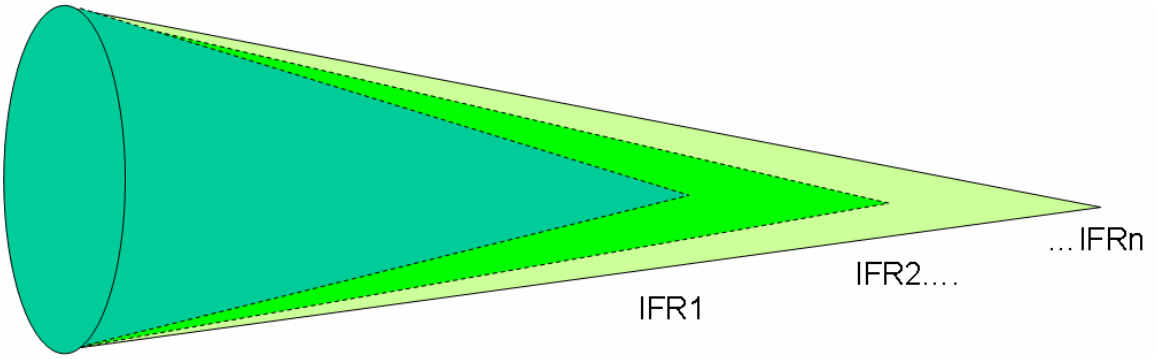



**Figure 4: IFR Definition Within A Function Is Likely To Shift**

We can already observe ample evidence of Google’s understanding of the shifting definition of ‘perfect’ from the users perspective through the emergence of the various national variants, the appearance of the increasingly wonderful ‘Google Images’, and a host of other emerging capabilities. What the multiple cone idea exists to do is remind us that the evolution dynamic driving the definition of ‘perfect’ in one function cone, will also cause a continual re-definition of the word ‘perfect’ in all of the other cones.

The IFR concept is intended to solve an important contradiction; being both a fixed thing and a moving thing. What needs to be fixed, stays fixed. What needs to move, moves. The overall concept and the idea of convergent evolution are fixed things. The definition of IFR at any point in time for any given function is merely transitory. In such a way does the world edge ever forwards.

**Not So Funny – Bad Self-X**

Systems that deliver functions 'by themselves' are generally seen to be well on their way to ideal. Think of a useful function and find a way of getting your existing resources to deliver that function is a good innovation strategy. Turn the story around 180 degrees, though, and things can often find themselves in an ever-descending spiral that rapidly passes from bad to worse.

Self-x functions like self-deception, self-delusion are examples discussed in earlier articles. Another is the so called 'self-interference' effect.

Our attention was drawn to this effect recently when we read a story from a back-issue of a golf magazine. Titled 'Why aren't we getting any better?', the article reported USGA director of handicaps Kevin O'Connor saying, 'the average handicap of 16.2 for men, and 26.5 for women, has been the same for 17 years.' The author then went on to report the oddity of this fact in light of the widespread introduction of new technology for balls and clubs; 24 hour golf on television, more instruction videos; more books; more golf schools; more lessons, and in many cases, more practice.

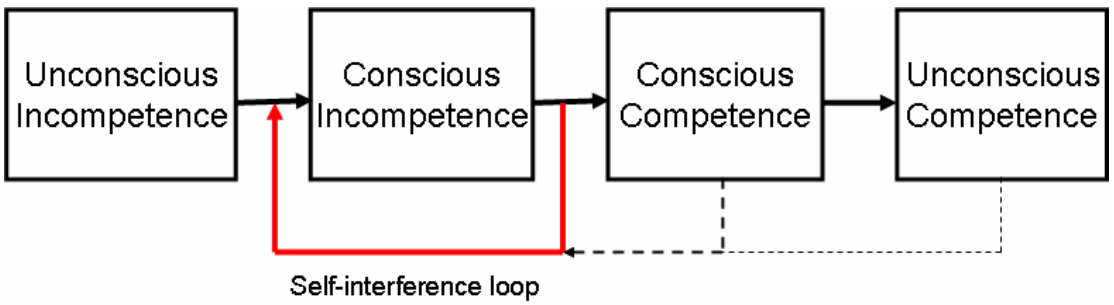
At the heart of this somewhat amazing lack of improvement is self-interference. Quoted from the article, 'humans are the only species on earth with the ability to interfere with their own performance. Self-interference is a learned skill; we are not born with it.'

The effect works something like this: You hit a poor drive on the golf-course; the ball hooks wildly into the rough. Your mind says, 'that was a terrible shot!' Later on, the same thing happens again; another wild hook into the rough. And then it happens again. After a few more hooked shots, your mind says, 'my driver shots are terrible!' Not too long after that, the comment becomes, 'I'll never be able to play good golf!' And now you have the strong beginnings of a self-interfering downward spiral. In the words of psychologist Robert Anton Wilson, the human brain operates in two basic modes; thinker and prover. The thinking part of your brain creates new thoughts, and then the prover part sifts your experiences in order to gather evidence to support and prove the validity of the new thoughts. Net result: 'what the thinker thinks, the prover proves'. The more you step up to the tee thinking that you will hook the ball, the more likely the prover part of your brain will prove you to be right.

The downward spiral may not stop there. It might be followed with, 'I'm too clumsy to be good at any sport.' Or eventually even, 'I'm a worthless person'. The essence of the prover part of our brain is that once a downward spiral has begun, it INTERFERES with the powerful abilities of the thinker part of the brain to break out of the spiral. Another psychologist, Gallwey has come up with the formula:

*Performance = Potential minus Interference.*

There is also a strong link to the well known competence evolution trend:



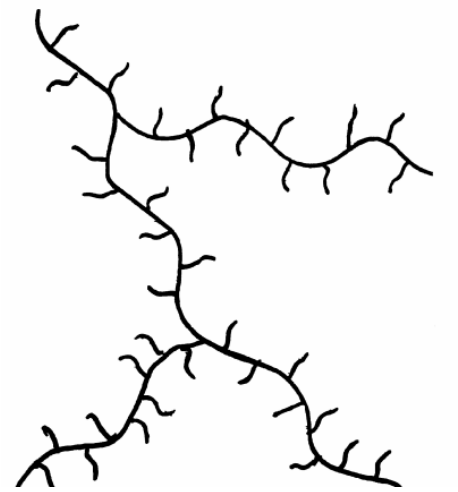
Here we see how self-interference can create a downward spiral in which the prover part of our brain continually gets to re-enforce the *idea* that we are not good at something, steadily increasing our conscious awareness that we *are* incompetent at something.

The seeds of the self-interference effect in all likelihood begin during the earlier 'unconscious incompetence' phase of the trend. Here psychology research tells us that the less competent you are in some area, the more likely you are to overestimate your competence in that area. Put another way, the least competent people are the most likely to dramatically overestimate their competence. Disadvantaged people consistently underestimate their disadvantages. Or, according to Charles Darwin, 'ignorance more frequently begets confidence than does knowledge'. This is actually the self-interference effect in its other form. Taken together, the two forms work something like this: before we try to do something new (i.e. when we are unconsciously incompetent), we are apt to think that because we have been good at other things, we will be able to master this new thing. As a result, self-interference means we overestimate our abilities. Then as we gradually progress from conscious incompetence to conscious competence, the self-interference effect tends to cause us to create downward spirals when things don't go our way. These downward spirals then – if allowed to progress long enough – see us plummeting further and further down the conscious incompetence hole.

Self-interference appears to be an innate human characteristic. Conscious awareness of the effect is a good first step towards avoiding its negative consequences. At the very least, it could save us a whole lot of money in lost golf-balls.

**Patent of the Month – Comb-Branched Polymers**

Well, we've often talked about the concept, but here it finally is. And in a commercially viable form too. The TRIZ 'surface segmentation' trend gives a very definite pointer towards the 'x-on-x' type structures. In this case we have polymer fibres with polymer fibres on them:

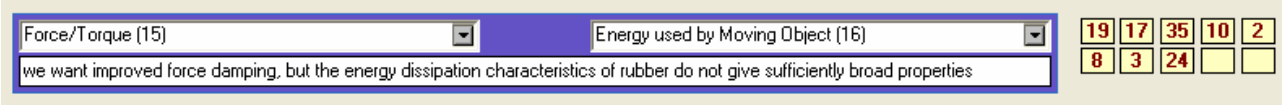


The invention is described in US6,921,793 awarded to Bridgestone on July 26. The Bridgestone inventors derived the novel polymer constructions in order to help resolve a damping-versus-energy problem in vehicular engine mounting structures. The invention builds on the following:

*The comb-branched polymers are prepared by preparing a mixture of living polymers including living polymers with at least two living ends (DiLi macromonomer) and living polymers with one living end (Li macromonomer), and coupling this mixture of living polymers with a coupling agent that has at least three reactive functionalities. This coupling reaction preferably takes place within an organic solvent. The main control parameters in synthesizing this class of polymers are the molecular weights of the Li and DiLi macromonomers. During the coupling reaction, the Li macromonomers are coupled to the macromolecule and form the smaller side-chains, and the DiLi macromonomers are coupled to form the longer branches….*

*…To the living polymer mixture is added a coupling agent having at least three reactive functionalities. Coupling agents can be added via a single charge at the completion of the polymerization of the monomers. Alternatively, they can be added in increments as two or more charges. Alternatively, coupling agents can be added continuously over a period of time, for example, five minutes to two hours. Incremental or continuous addition of the coupling agent is preferred to promote a maximum degree of coupling without overshooting the optimum level of coupling, which may cause gelation of the polymer in the reactor.*

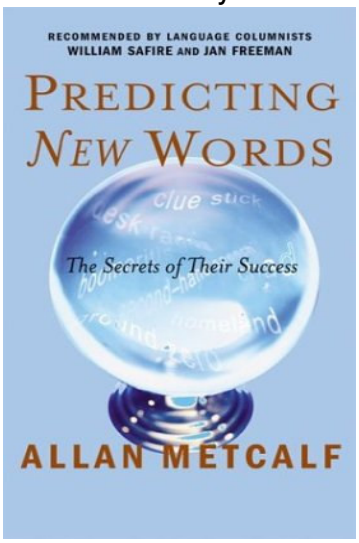
Here's how the basic conflict solved by the inventors maps onto the Contradiction Matrix:




Principle recommendations 3, 17, 24 and 10 map very nicely to the inventive steps made by the inventors, which is always re-assuring. Perhaps, more importantly, the invention opens the door to more 'x-on-x' type material solutions in other fields. Including yours?

**Best of the Month – Predicting New Words**

Our reading recommendation for this month is 'Predicting New Words' by Allan Metcalf. Although we have only just become aware of the book (or rather its potential relevance to 'innovation'), it was first published in 2002. As suggested by the title, the main thesis of the book is to explore the historical evolution of words. The aim then being to try and establish whether it might be possible to systematically predict the emergence of new words. The book very quickly demonstrates that of the many, many new words that people try (either consciously or unconsciously) to add to the language, very few in percentage terms will succeed in becoming a part of the standard vocabulary. It seems from Metcalf's careful research that the chance of a new word 'sticking' in the language is somewhat lower than that of an invention entering the marketplace. Herein, then, lies our interest in the book; is there anything that can be gleaned from the creation of new words that might help us to better understand the dynamics of how and whether other forms of 'new' will succeed.




The beginning of the book reviews the annual assessments made by the American Dialect Society on things like 'word of the year', 'most likely to succeed', 'most useful' and 'most creative'. This quickly reveals that the experts in the Society have a pretty dismal record at predicting which new words in a given year will still be around even a few years later. The list for 1990, for example, includes predictions like 'bushlips', 'notebook PC', 'right-sizing', 'technostupidity' and 'voice merging', none of which have become a part of everyday English in 2005. In fact the only 1990 new word prediction seen to still be thriving just fifteen years later is 'bungee jumping'. Ironically, it won the 'most amazing' category in the 1990 assessment.

Later on in the book, Metcalf identifies a number of heuristics that have emerged from his studies of words that have been successful. Without wishing to steal too much of his thunder, here are a few rules that will likely determine the long-term success of a new word:

1) conscious attempts to invent and introduce new words will invariably fail
2) conscious attempts to fill gaps in the language will also invariably fail – (e.g. there have been several historical attempts to create gender-less pronouns that have failed)
3) new words linked to fashionable jokes will invariably fail (unless they successfully distance themselves from the joke – e.g. 'couch potato' has become a standard part of the language, but almost no-one can remember its humorous origin)
4) the new word must appear unobtrusive – in effect it must enter the language by

passing ‘under the radar’

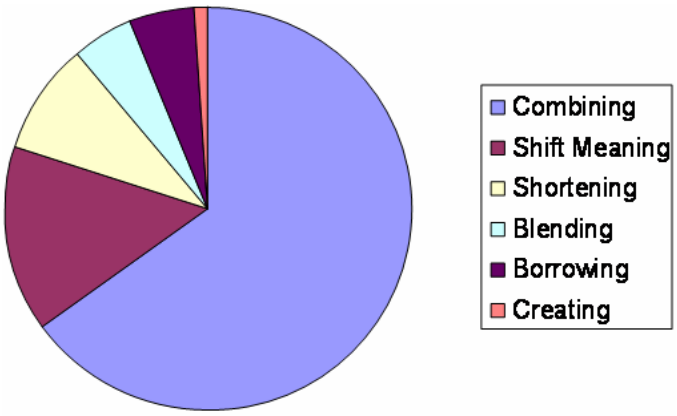
5) the new word must attract a diverse range of different users and usages (e.g. the Watergate scandal prompted the popularization of a whole series of –gate expressions; ditto ‘e-‘ words – e-commerce, e-book, etc)
6) users must be able to connect the new word to something – either to something they already know, or, if it is a new scientific discovery, say, the word must be evocative of that discovery

All in all, this list gives a fairly stark impression that the ‘new word’ business is considerably more fraught with difficulties than the new products business. Having said that, there is probably more common ground here than first meets the eye. At the very least, it is worth holding up any new product idea to the lens offered by these new word tests. Which is something you might like to try sometime.

Taken a step further, the book also reports an analysis done by academic etymologist John Algeo. Algeo conducted a systematic study of over 3000 new English words that succeeded in entering everyday language. A bit like a TRIZ-research programme on words. His findings reveal there to be six basic mechanisms by which new words appear:

a) through combination of existing words (e.g. ‘user-friendly’)
b) through a shift in meaning of an existing word (e.g. ‘spin’ now has a political as well as technical meaning)
c) through shortening of an existing word (e.g. ‘fax’)
d) through blending of existing words (e.g. ‘smog’ from smoke and fog)
e) borrowing of words from another language (e.g. ‘vindaloo’)
f) creation of a completely new word (e.g. ‘bebop’, ‘gobbledygook’)

In percentage terms, Algeo’s research further showed that some of these strategies were much more common than others. As shown in the pie-chart below, well over 50% of new words emerge through the combination of existing words.




Somewhat surprisingly, throughout the research, Algeo actually found no examples of new words appearing from the sixth ‘creation of a completely new word’ category.

More interesting from a TRIZ perspective is seeing how the five other strategies link to the Inventive Principles. The ‘Combining’ strategy, for example is directly analogous to Principle 5, Merging. We can similarly map ‘shift meaning’ to Principle 35 (and more precisely ‘Change Function’ in our re-defined Principle framework); ‘shortening’ to Principle 2, Taking-Out; ‘blending’ to a combination of Principles 2 and 5; and ‘borrowing’ to Principle 6, Universality.

A final chapter in the book makes a brave attempt to examine some currently fashionable new words and uses the success heuristics to predict whether they will still be with us in

40 years time. Only '-rage' (as in road-rage, desk-rage, air-rage, etc) and 'weapons grade' emerge as likely candidates. One of the words Metcalf consigns to the 'no-chance' category is 'paradessence'. Paradessence is 'the paradoxical essence of a product. Two opposing desires that promise to satisfy simultaneously'. A typical example of paradessence would be ice-cream – with its simultaneous sense of both innocence and eroticism. From a TRIZ contradiction-elimination perspective, paradessence perhaps deserves a better chance than Metcalf gives it. Its future lies in our paradescent hands!

By way of a small helping hand, may we offer the thought that 'Predicting New Words' is itself an excellent example of paradessence; being simultaneously entertaining and scholarly.

**Conference Report – Joint Consultants Forum, London**

The Joint Consultants Forum annual conference was held at the Institute of Physics in London on 13 July. Due to the unfortunate events in London on the previous week, attendance was down on the usual numbers, but nevertheless, there were still around 60 people present.

We were there to present a paper on 'plausible deniability and the consultant'. Interested readers can download a copy of the paper from our download page. The theme of our paper, and of the conference as a whole was about selling models for technical consultancy services. In the main, the focus was on small and medium-sized consultancies. The average company size represented at the event in fact was heavily biased towards the small (<5 people) end of the SME scale. The overall conference theme was "Contact – Collaboration – Co-ordination". The conference organizers aim was to help promote and underpin the aims of larger industrial and managerial organisations in both the manufacturing and services sectors of the global economy. That said, all of the speakers and just about all of the attendees came from the UK. Seven different papers were presented in all. The other six covered relationship networking, professional liability issues, joint service agreements and virtual teams. The latter presentation and its linked Amnesty International case study example was probably the thing that made attendance at the event worthwhile. Here was a group of independent consultants who successfully bid for and won a large IT contract with a global NGO. It is often said that bringing together independent consultants is like herding cats. Apparently not so in the IT sector. When the papers eventually get published on the iop.org website, the paper by Graham Oakes is well worth looking up.

Beyond this highlight, the remainder of the conference was a mainly depressing affair. Amazing to this author that a) so few consultants – supposedly at the technological and methodological forefront (to enable them to best inform their clients?) – had even heard of TRIZ, and, somewhat more worryingly, b) so many of the consultants had so few presentation and communication skills. The 'err'/'uhm' count during some presentations was hitting record heights. I mean, don't these people have to earn their living by communicating and convincing others? Strange.

**Investments – Nanograss Battery**

We find ourselves doing increasing amounts of work with low surface-energy material these days. The number of applications for these sorts of surface so far seems pretty endless. The latest one we have come across comes from start-up company mPhase Technology, using the 'nano-grass' technology developed at Bell Labs.

Anyone familiar with low-surface energy surfaces will know that they are not wetted by water:

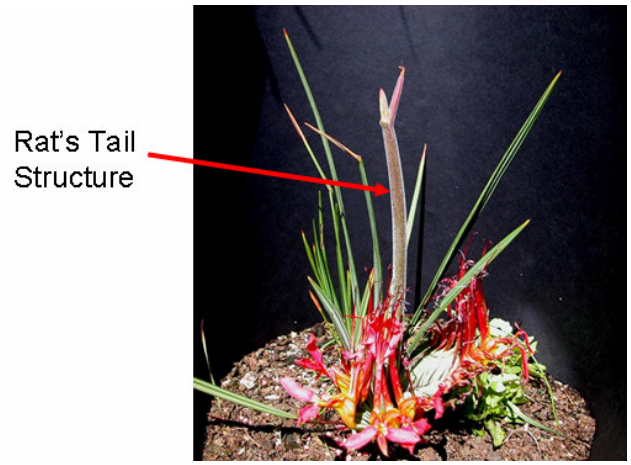
The basic idea now being developed by mPhase is a lightweight concept battery with increased storage density and a shelf-life that they claim will be of the order of 20 years. The underlying idea is that liquid droplets of an electrolyte will remain in a dormant state atop the nanograss until stimulated to flow – at which point they will trigger the reaction that will produce the current. Conventional batteries have a significant problem when it comes to shelf-life; typically discharging over a period of just a few months if left un-attended. The mPhase concept achieves stimulation of the flow of electrolyte over the nanograss using changing temperature, applying ultrasound or a small voltage. A voltage builds up an electrical field at the tips of the nanograss, and that changes its wettability through an effect called electrowetting.

An immediate defense and security application for the nanobattery is as an energy source to power remote sensors in areas lacking electricity.

Find out more from the company's website at http://www.mphasetech.com/

## Biology – Rat's Tail Plant

According to Nature magazine (vol. 435, pp41-2) botanists have long wondered what the elaborate 'rat's tail' structure grown by the rat's tail plant *Babiana ringens* is for. Quite clearly, nature always tries to make maximum use of available resources, and such a substantial part of the plant requires considerable effort to create.




Now scientists from South Africa and Canada have together confirmed that not only does the structure exist to act as a convenient perch for birds to land on the plant and feed from the flower, but that it also serves to manipulate the position of the birds in order to ensure that effective pollination occurs. As such, the rat's tail offers a great example of the sorts of lengths that nature will go to improve the efficiency of pollen dispersal.

From a conflict resolution perspective, the plant has successfully challenged the following:

| Improving Factor | Worsening Factor | Principles |
|---|---|---|
| Function Efficiency (24) | Trainability/Operability/Controllability (34) | 25 10 1 13 3 19 |
| rat's tail plant wishes to maximise pollenation efficiency but birds need to be assisted to achieve this | | |

Having used both Principles 25, Self-Service (i.e. the plant takes on the bird-assistance function itself) and 1, Segmentation (where a separate rat's tail structure is grown alongside the flowering parts of the plant), we can again see a good match between the strategies used by nature and those by human designers.

Also interesting to note is that the related Rat's Tail Cactus (*Aporocactus flagelliformis*) uses a similar bird-feeding assistance strategy. Only this time, it makes positive use of gravity (and Principle 13!) to avoid having to make the rat's tail into a rigid structure:



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