

# Systematic Innovation



**e-zine**

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

Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.

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# OODA and TRIZ (Or: Systematic Agility Rules)

As progressively more industries veer into a world of seemingly continual disruption and innovation, the predominant business factor becomes agility. Agility is very definitely not the same thing as efficiency, the current or previous dominant business success factor. In fact many of the things demanded of an efficient ('continuous improvement') organization turn out to be the polar opposite of those needed to out-maneuvre competitors. In an agile innovation world, organizations need to learn some critical new skills and ways of thinking.

As we know from TRIZ, someone, somewhere has already been thinking about your problem. A consistently good way to go and find these people is to think of someone with a more extreme version of your problem. In the case of agility, few if any people have a greater agility problem than fighter aircraft pilots. Dog-fighting pilots measure their agility in split-seconds, and the consequences of them making the wrong decisions at the wrong time are usually fatal.

Looking for people who have had to tackle this kind of problem and one is quickly lead to the work of the late John Boyd – Figure 1. Boyd is the person who has effectively invented modern jet fighter strategy. He is the pilot who trained the people who train Top Guns. Frequently known as 'forty second Boyd', one of his most famous challenges to hotshot new pilots was that, starting from a losing position, he could beat anyone in a dogfight within forty seconds. Throughout his career, he remained undefeated.



**Figure 1: John Boyd & The Agility-First F-16 Fighter He Conceived**

Like any good model, Boyd's agility strategy was very simple. The OODA cycle. Observe-Orient-Decide-Act. And the pilot with the shortest cycle time wins. Likewise, when we translate Boyd's model to the world of business, the organization with the shortest OODA cycle time will be the one that will dominate competition.

The only problem with simple models, and simple ideas like Boyd's is that implementation is often far more difficult than the simplicity of the theory implies. The aim of this article, therefore, is to explore some of the synergies between the OODA cycle and TRIZ/SI. What might SI add to the OODA story in order to make it easier for organizations (and I guess fighter pilots too) to gain the maximum advantage from the theory?

The best way to begin this exploration is probably to take a closer look at the OODA cycle, reproduced in Figure 2:

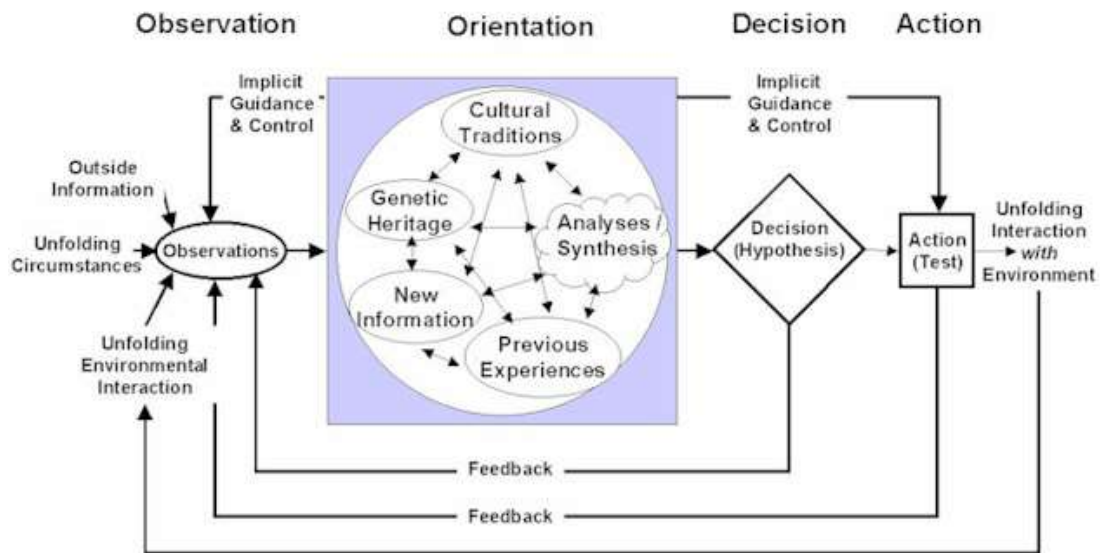


Figure 2: Boyd's Observe-Orient-Decide-Act Cycle

The first stage of the cycle is all about observation. This sounds simple, but immediately brings us to the problem (as it no doubt does for fighter pilots) of what precisely is that we should be observing? Clearly in any complex situation there are an awful lot of things that *could* be observed. In part, Boyd tries to help resolve this issue by recognizing that the feedback received from previous turns of the cycle should come to influence what we look for in the current observation part of the cycle. Look for the things that have changed is the central need here. This immediately simplifies the observation search process – look for the deltas rather than the absolutes – but can still leave an unmanageably large array of things to be looking at. What TRIZ/SI brings to this story, then, is the idea of further distilling the observation search to the identification of conflicts and contradictions. Linear changes can be managed by linear responses using known rules. The real problems (and opportunities) therefore come when change is non-linear. Non-linear change demands new rules of engagement. From both pilot and business leader perspectives, following today's rules happens automatically (sometimes literally), and as such are often called 'common sense'. The things that come along and kill us are the non-linearities.

### Orient

The second phase of the OODA cycle is all about Orientation. As suggested by the Figure 2 image, this is often the most complex part of the cycle, in that it requires both analytical consideration of any and all prevailing factors and a synthesis of those factors to envisage and design future possibilities. Having distilled the previous Observation stage down to the need to identify changes and contradictions, the Orient stage can likewise be somewhat simplified. At least in terms of what kinds of actions will and won't have a beneficial effect. In a change/contradiction driven world, the range of possible Orientation choices distils down to:

- a) Keep applying today's rules
- b) Keep applying today's rules and change what is being observed (either adding new things or deleting/modifying others)
- c) Reactive recognition that a conflict/contradiction has emerged and needs to be resolved

- d) Recognising that a conflict/contradiction hasn't yet emerged, but that we have the ability to change the rules pro-actively to create one for our competition

Of course, from a TRIZ/SI perspective, finding ourselves in the third or fourth situation allows us to tap into the known contradiction solving strategies and thus attain contradiction resolving solution options far more quickly than would otherwise be the case if we merely looked to brainstorm ideas. TRIZ/SI, in other words, allows us to do a far more effective job in the synthesis part of the Orientation task. By deliberately seeking to break the contradiction, we by definition change the rules.

**Decide**

Of course, having lots of solutions is better than having none or just one from the perspective of getting to the 'right' solution, but the inevitable downside is that lots of ideas needs lots of convergence activity in order to make the decision as to which of the options (or combinations thereof) is the most appropriate hypothesis. Again, TRIZ/SI can help us to manage this decision process by helping to see and manage the overall array of options. In typical fighter-pilot/organizational competition situations, the decision process effectively distils down to the 2x2 matrix illustrated in Figure 3:

<b>SENSE</b>	new rules apply	reactive wait-and-see (new measure?)	reactive change
	current rules apply	optimization	proactive change
		current response rules	new response rules

**RESPOND**

**Figure 3: Sense-Respond Decision Matrix**

Yet again, looking back at Figure 2, there is an implicit set of feedback loops to the Observation phase of the cycle in order to make sure that our designed action fits with the latest incoming data. For fighter pilots, this is going to happen in fractions of seconds. Fortunately, from a business perspective, the cycle time is likely to be measurable in weeks and months such that we often have the ability to conduct certain experiments in order to verify the efficacy of a variety of different design options. In theory at least – most organizations tend not to be looking for the right things and tend to aim to live life in the bottom left hand corner of the 2x2 matrix. That, after all, is where the organization has found its comfort zone.

**Act**

(Often referred to as 'Test' by Boyd.) Here's where the rubber meets the road and, after deciding the most appropriate course of action, the job becomes that of testing whether

the solution 'works'. In any complex situation (i.e. any real situation) all we can hope to do here is to provoke the system and measure whether our provocation has had the desired effect or at least desired direction of effect. Which takes us back to the Observation part of the cycle and Boyd's overall winning strategy of making sure we are running the cycle faster than our competition. Simple when you know how. Less simple when everyone around you knows the rules of the game. But that's a story for another day.

Meanwhile, 'planning is everything; the plan is nothing' underpins the secret of organizational agility. And planning is OODA.

# Breakthrough Advertising Campaign Design Using The RIGHT Process

Last month we examined the process of gleaning insight from raw consumer input. What was described in that article was one of five steps in a bigger process of designing breakthrough advertising campaigns. The purpose of this article is to describe the other four steps and to set all five into a broader context. Advertising in this sense doesn't have to mean a 30 second TV spot or a poster campaign aimed at end consumers, the same process applies equally well to any form of communication, and what entices people in general to engage with and take action when they receive a change-triggering message of any kind.

It is often said that during a typical day we are bombarded with something like 3000 advertising messages. As a consequence, we are all subject to chronic fatigue syndrome. Most advertising messages become little more than noise, and as a result, the large majority of the money invested by advertisers falls upon ears that are deaf and eyes that are blind. When systems become saturated like this it is usually a clear sign that a new system is required. A new advertising 'system' might soon come to mean a complete re-invention of the art. In the meantime, the RIGHT process has been designed to give advertisers the best chance that their output is acted-upon-signal rather than merely contributing to the noise.

In true nothing-new-under-the-sun fashion, there is nothing radically different about the RIGHT process compared to current advertising best practice. Our contribution to the story is rather that very few organizations seem to even make use of best practice. And if they do, it tends to be a partial vision of what might be seen as an end-to-end version of best practice, with some things being done well, and others being done extremely poorly indeed. Here, letter by letter, then, is what RIGHT looks like:

## R is for Reason

The first stage of the process involves mapping and understanding the reasons why target customers for a message should wish to listen to the message. The FMCG industry talks interminably about 'reasons to believe' in a product. What they're actually talking about is outcomes delivered (or 'jobs done') and 'meaning-delivered' by that product. While this is a good start, the high proportion of failed advertisements suggests that reason to believe alone is necessary but insufficient to determine success. Recognising that success comes from delivering desired outcomes, the Reason stage of RIGHT encourages users to think about 'reasons' from multiple different directions. Figure 1 reproduces a familiar template for structuring this search:

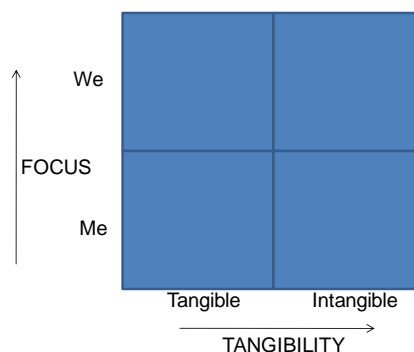


Figure 1: Structuring The Search For Reasons To Believe

From an advertising message perspective, there are two things in particular that need to emerge from filling this template:

- 1) In the words of JP Morgan, 'a person buys something for two reasons: the good reason and the real reason' – the 'good' reason being something in the tangible side of the picture, and the 'real' reason being something in the intangible side of the picture. Either explicitly or implicitly, our advertising message needs to cover both of these reasons. If we don't, our message becomes merely noise.
- 2) The more usual use of the Figure 1 template is to structure the search for new outcomes (reasons), it being the case that there are only two ways to innovate – solving contradictions or adding new outcomes. Not every advertisement needs to tap into a 'new outcome', but if we can find one, the task of being successful becomes that much easier.

### **I is for Insight**

In keeping with the idea that innovation success comes from new outcomes or solved contradictions, the Insight stage discussed in last month's article was very much focused on finding good contradictions to solve. One thing that appears very clear when studying successful versus unsuccessful advertising messages is that the successful ones invariably create some kind of a 'wow' reaction by creating and then resolving some kind of contradiction...

### **G is for Gap**

Every advertisement needs a setting and a context. The first part of the 'wow' DNA dynamic involves creating a setting and context that makes people sit up and take notice. This in turn means finding something that doesn't fit into current patterns of thinking. In simple terms, what we are trying to achieve in this Gap stage is to search for a setting that 'doesn't fit' and in so doing effectively sets up the start of a contradiction in the target customer's mind. The classic Yorkie chocolate bar – Figure 2 – offers a really good example of the main aim here. Common sense suggests that eliminating half the population from your product is not a great idea:

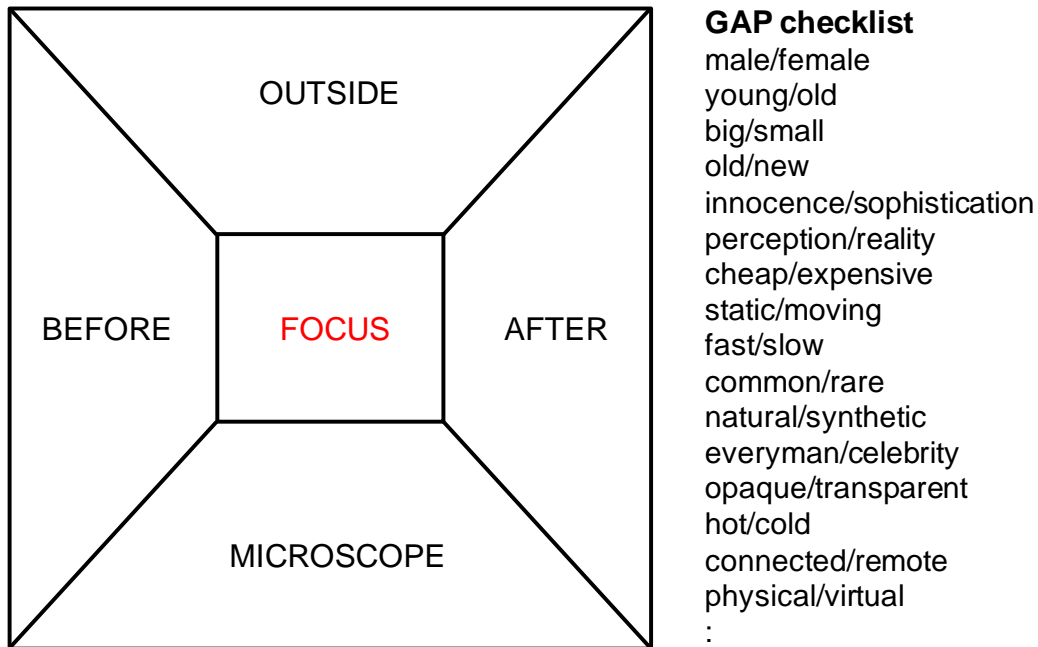


**Figure 2: Yorkie Bar 'It's Not For Girls' Campaign**

The previously unexploited 'gap' found by the agency responsible for the Yorkie ad is one between men and women. Prior to the ad appearing, there was no difference in the way that confectionery was presented to the two sexes, and now there was. The Yorkie ad makes people notice it because it creates and then exploits a gap.

The search for an appropriate gap to exploit like this is one of the more abstract aspects of any advertising campaign design. Figure 3 represents an attempt to turn the problem into a rather more concrete perspective tool and check-list:





**Figure 3: Finding The Gaps**

The box on the left of the figure is a simplified version of the 9-Windows tool from TRIZ. The simplification has happened for two reasons:

- a) Tests with advertising professionals have tended to show their limited patience in exploring nine different windows, and more seriously,
- b) Those same tests have shown that re-framing and looking for gaps in the five provided windows, when combined with the gap checklist on the right hand side of the picture has been shown to be consistently sufficient to identify appropriate gap opportunities.

The essential idea behind the five boxes is to force the designer to look at their product from a number of different directions. If the task is advertising corn-chips (say), we could choose to focus on the corn-chips themselves to see if there is a gap to exploit there – healthy versus unhealthy for example – or we could shift to look at the bigger picture (a bowl of corn-chips at a party?) or finer detail (a particle of flavouring sitting on a corn-chip) or ‘before’ (opening the packet) or ‘after’ (licking our fingers clean). The windows are first and foremost there to help identify a potential scene for our advertisement. After that, we need to identify the gap that will form the basis alongside our Insight of the contradiction we will look to resolve. The checklist on the right of the figure is designed to help structure such a search. It is by no means intended to be a comprehensive list, but rather series of triggers to promote thinking about finding any kind of exploitable gaps. Without wishing to over-complicate things here, we’ve often found a higher degree of gap-finding richness appears when we introduce teams to the Generation Cycles and Spiral Dynamics concepts underpinning the TrendDNA methodology (Reference 2).

### **T is for Twist**

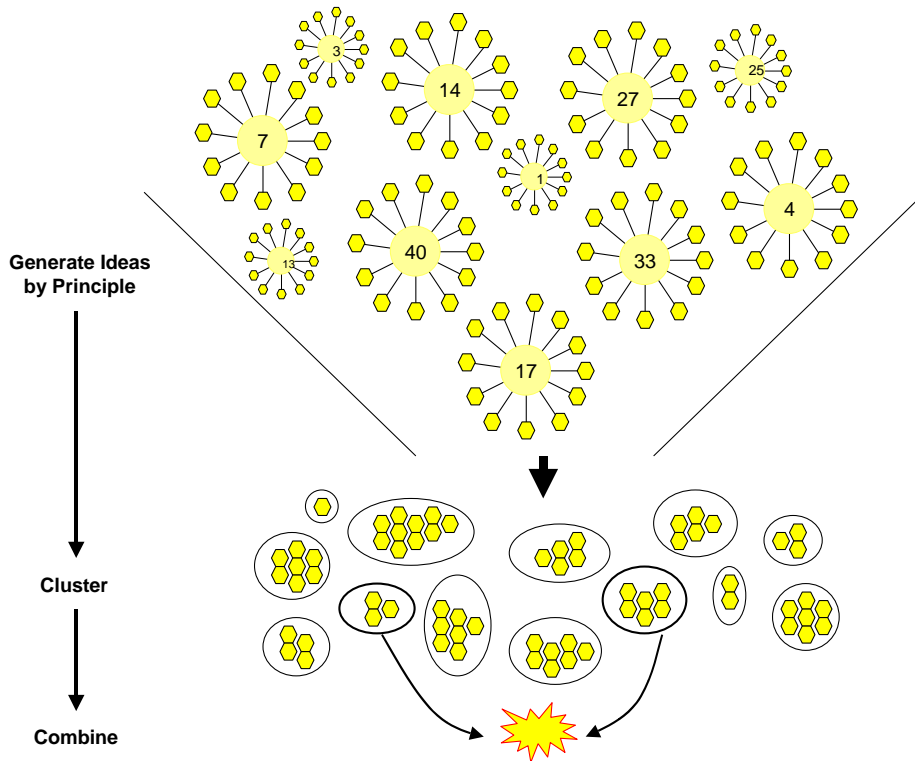
I know, H comes before T in RIGHT, but T does stand for Twist and so we’re figuring it’s okay to reverse the sequence of these last two letters. T for Twist is all about finding the twist in our advertisement that will resolve the contradiction created in the previous stages of the process. Solving contradictions is grist to the SI mill and so this stage is typically conducted by giving the design team an assortment of Inventive Principle triggers and asking them to devise possible twist solution ideas, clues and concepts. The key during this stage is to develop as many inputs as possible – quantity definitely beating quality at



this stage. The theory being that in a complex problem (as the fuzzy, missing-data world of advertising inherently is) the 'right' answer is very unlikely to come from a single 'silver bullet' idea.

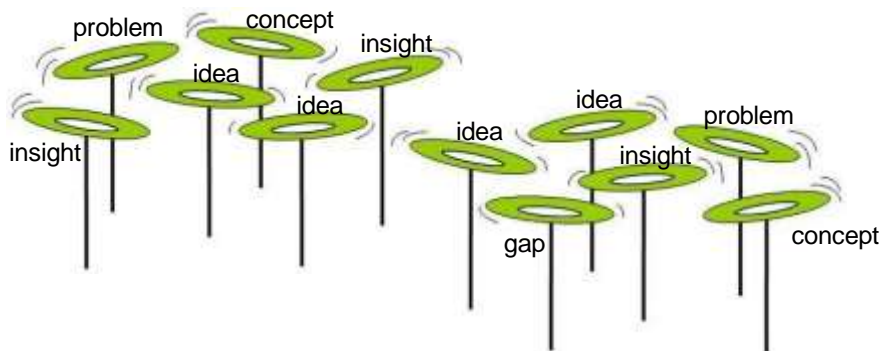
### H is for Herd

If Twist is all about generating lots of ideas, the final Herd stage is all about herding those ideas, through a process of clustering and combining, until we have something that we believe meets the client brief. Figure 4 describes what the process typically looks like. In many ways, what is happening in this phase is no different to the convergent phase of any ideation session.



**Figure 4: Herding Clues To Develop The Final Solution**

The key to success here, thanks to several years worth of live case study experience, is the ability to keep as many insights, gaps, clues, ideas and concepts alive as possible prior to commencement of the Herding process. The image we've found to be most useful is that of spinning plates – Figure 5 – every input from the first four parts of the RIGHT process is a spinning plate – fragile and requiring constant attention if it is to remain alive.



**Figure 5: Spinning Plates**

The human brain has evolved to be a very powerful parallel processor and therefore manager of complexity. Alas we often try to consciously bypass these abilities by over-simplifying problems. Crucially, the RIGHT process is designed to tap into our innate complexity management capabilities by forcing users to concentrate on different aspects of a challenge at a time while simultaneously keeping afloat a host of inputs from each of the different stages of the process.

That said, don't say those words too loudly in a session using the tools. Far better to show people there is a process – Figure 6 – and let them discover for themselves just how good a complexity manager the collective brain is.

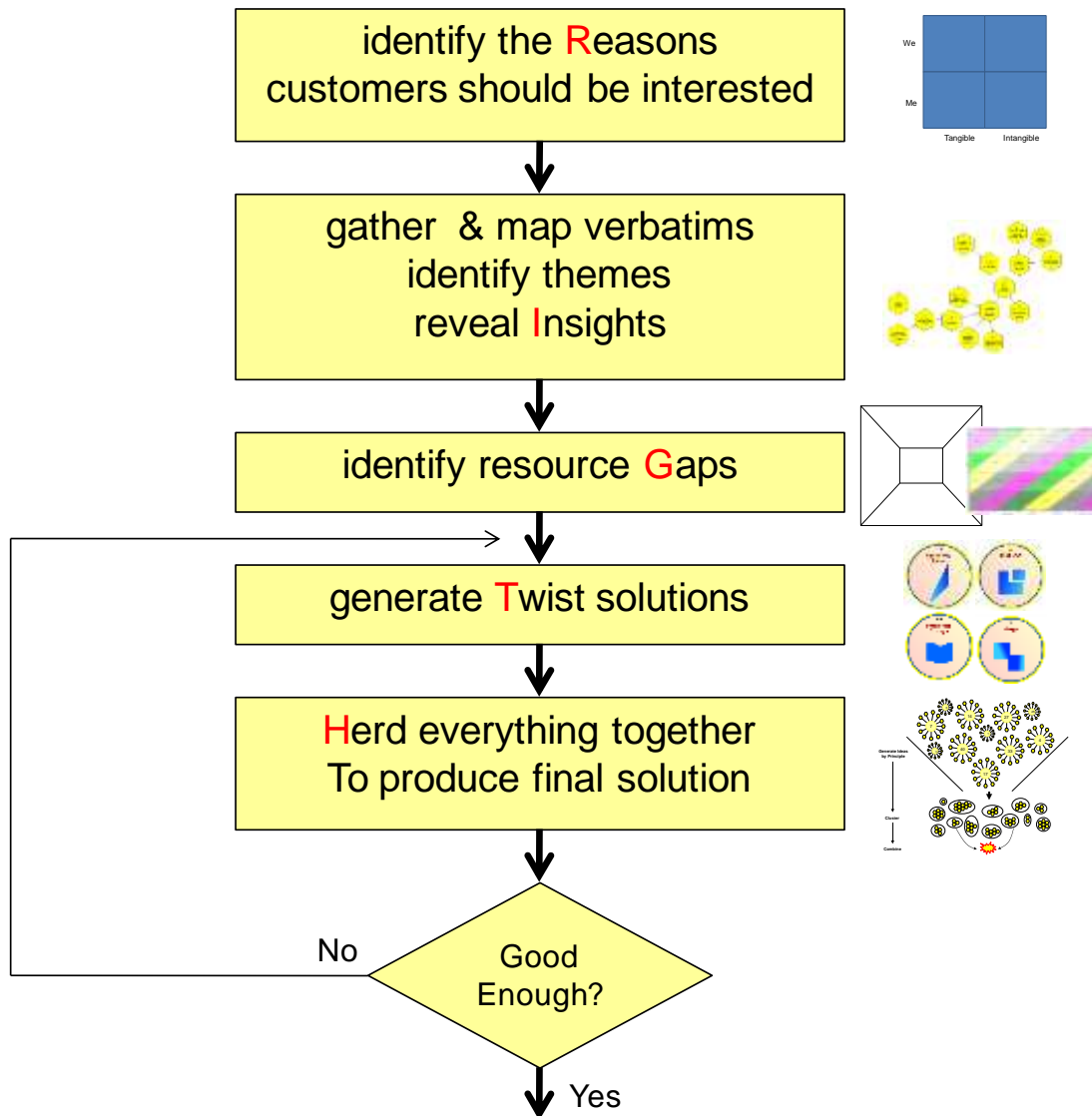


Figure 6: The RIGHT Process

## References

- 1) Mann, D.L., 'Disruptive Advertising: TRIZ And The Advertisement', TRIZ Journal, October 2002.
- 2) Mann, D.L., Özözer, Y., 'TrenDNA: Understanding Populations Better Than They Understand Themselves', IFR Press, 2009.

## Not So Funny – The Fine Art Of Crochet

Mention the word crochet and my childhood nervous tic is likely to return before you can say 'Beelzebub'. Nevertheless, crochet (twitch) is on the rise again. Something to do with people resorting to making clothing themselves when economic times are tough. I first experienced the phenomenon in an earlier tough economic era, when, as a small boy, I was forced to wear assorted crocheted items including (twitch) a particularly hideous purple tank-top sweater 'lovingly' (she said) made for me by my grandmother. Ah, the sound of other children laughing at my expense still resonates, and I feel a tear forming at the corner of my eye as I write these words.



Alas, that emotionally scarring purple tank-top is no longer with me, having failed to survive an accidental bonfire incident when I hit my teenage years.

Fortunately, times change, and today's cosseted youth have access to various official institutions – like the RSPCC – that mean they can escape the more overt forms of crochet-inspired humiliation. Crochet has now travelled to new worlds, boldly going where no- crochet hook has been before. Like these rather fetching shorts:



No doubt a godsend for those cold winter evenings. And quite likely targeted at those of my contemporaries so conditioned by their grandparents that they have now developed in incurable masochistic streak. If you're thinking these shorts might be a little bit too itchy for

everyday use, think twice, because someone found an even more intimate use for their crochet skills:



A tad expensive from a per-sheet perspective, but hey, nothing shows how much you love the family better than home-made. And who knows, maybe there is an additional environmental benefit by making the solution washable and re-usable?

For some reason, crochet thrives in these slightly shady, more taboo aspects of life. Many men, for example, are still embarrassed to talk about 'feminine hygiene'. Imagine how that could change if this next idea takes off:



Tampon-cosies. How awesome is that? Not so sure about the banana analogy though, but maybe that's the point. These discussions need to be brought proudly into the open – banana tampon-cosies, good or bad idea? Discuss.

Or maybe we should all just take a vote on the idea of traumatizing a new generation of infants. After all, according to my therapist, it didn't do me any real lasting harm. Much.



She might be smiling now, but give her another eight years and then let's see...

## Patent of the Month – Variable Emittance Thermochromic Material

Patent of the month this month is this sly gem from the US space industry:

**United States Patent**  
**Kruzelecky , et al.**

**7,761,053**  
**July 20, 2010**

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Variable emittance thermochromic material and satellite system

### Abstract

The emittance value is a measure of an amount of energy expelled from a given surface area relative to a black-body reference. Depending on the specific coating a change in the emittance value is actively or passively effected. There are known active variable emittance thermal control coatings. However, such coatings are actually panels housing a mixture of both high and low emissivity materials that are electrically manipulated to control the emittance value of the panel. These "coatings" are classified as either electrochromic or electrophoretic. Both electrochromic and electrophoretic coatings require an applied voltage to cause a change in the emittance value of the coating. By contrast, aspects of the present invention do not include active variable emittance thermal control coatings. Aspects of the present invention do include passive variable emittance thermal control coatings and materials. In accordance with aspects of the present invention "passive" means that the variable emittance value changes in response to changes in the environment without active control (e.g. neither a voltage nor a current is applied). More specifically, in accordance with one aspect of the invention a passive variable emittance thermochromic material is provided that has a relatively low emittance value at low temperatures and a relatively high emittance value at high temperatures.

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Inventors: **Kruzelecky; Roman V.** (Beaconsfield, **CA**), **Haddad; Emile** (Montreal, **CA**), **Wong; Brian** (Montreal, **CA**), **Jamroz; Wes R.** (Montreal, **CA**)

Assignee: **MPB Communications Inc.** (Montreal, Quebec, **CA**)

The solution comes in the wake of a longstanding problem with design solutions being launched into space: the presence and absence of solar energy has the potential to respectively raise and lower the internal temperature of a structure or housing. These effects are felt terrestrially in buildings and in vehicles over the course of a day, week or month. However, for spacecrafts outside the protection of the atmosphere heating and cooling can happen significantly faster and over a wider range of temperatures ranging from below -150degC to above +150degC in a matter of minutes. Internal temperature regulation is required to maintain a suitable operating environment for spacecraft subsystems. For example, it is preferable to maintain the internal temperature of a satellite in the approximate range of -10degC to +30degC to ensure effective operation of communication and control electronics, such as transceivers and processors. The aforementioned rapid and expansive external temperature swings must be accounted for when designing systems and devices for controlling the internal temperature of a spacecraft.

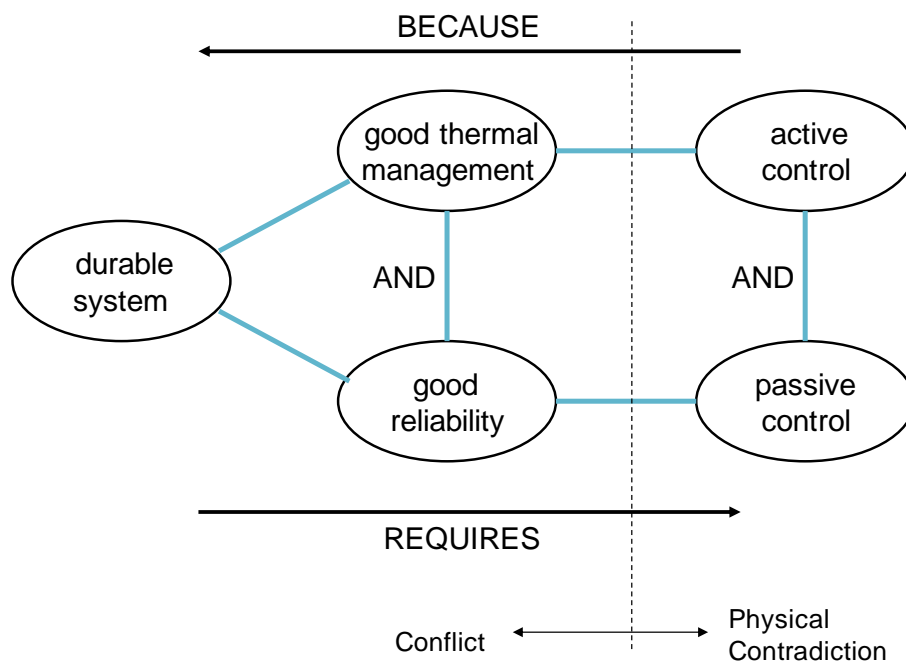
While smaller spacecraft are seen as one way in which current and future space science goals may be reached, the relatively low mass of such spacecrafts complicates the problem of temperature regulation. The relatively low mass of these spacecrafts means that they also have relatively low thermal capacitance, which makes them especially

susceptible to wide temperature swings. Accordingly, thermal control is seen as increasingly important for smaller spacecrafts. However, smaller spacecrafts typically have short design cycles and are expected to be cost effective. Consequently, there is limited space and weight provided for temperature regulators such as heaters and thermal radiators.

Most spacecraft rely on passive radiative surfaces to dissipate excess heat through thermal radiation into dark space. These types of passive thermal management systems typically employ thermal radiators that are sized for maximum power dissipation requirements. The thermal radiators typically include a coating with a fixed thermal emissivity value that is selected as a tradeoff between efficient heat dissipation at upper temperatures and sufficient heat retention at low temperatures.

In contrast active thermal management systems include some combination of electro-mechanical systems, heating and cooling pipes and/or voltage controlled variable emittance panels applied over thermal radiators. There are a number of problems associated with active thermal management systems including cost, complexity, size, weight, redundancy and the risk of catastrophic damage. The risk of catastrophic damage is exceptional in that such damage would occur in outer space where a satellite cannot easily be fixed, if at all. Thus, damage to an active thermal management system of a satellite may mean that the entire satellite is rendered inoperable.

From a conflict resolution perspective, the high level problem looks like this:



Here's how we might map the conflict aspect of this problem onto the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Reliability/Robustness (35)

WORSENING PARAMETERS YOU HAVE SELECTED:

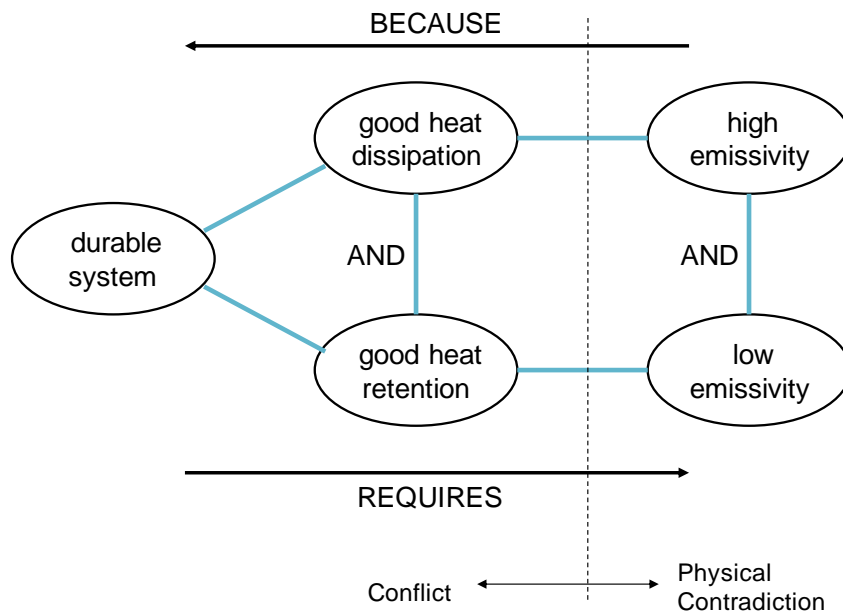
Temperature (22) and Control Complexity (46)

SUGGESTED INVENTIVE PRINCIPLES:

1, 10, 37, 3, 35, 19, 15, 25, 30, 36



Alternatively, digging a little deeper, the root problem looks more like this:



Which in turn might be mapped as:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Loss of Energy (27)

WORSENING PARAMETERS YOU HAVE SELECTED:

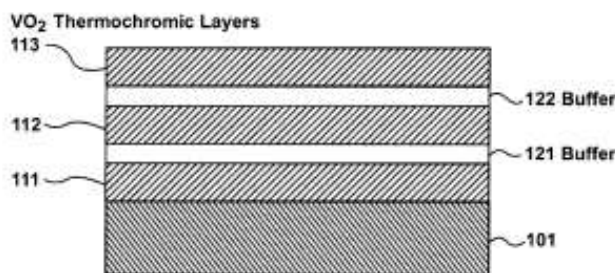
Temperature (22) and Illumination Intensity (23)

SUGGESTED INVENTIVE PRINCIPLES:

35, 19, 7, 24, 31, 5, 34, 13, 21, 32, 1, 15

The solution created by the inventors involves...

*...a variable emittance thermochromic material including: spatially isolated particles, wherein the particles are of a transition metal based complex having temperature dependent properties including a range of non-metallic properties at relatively low temperatures including low emittance, a range of metallic properties at relatively high temperatures and a range of semi-metallic properties, including high emittance, within a temperature range below relatively high temperatures, and the particles are dimensioned such that the particles retain the semi-metallic properties at relatively high temperatures, but would otherwise transition to a range of metallic properties if not spatially isolated and appropriately dimensioned; and a separator for maintaining spatial isolation of the particles.*



Which sounds a lot like pretty good illustrations of Principles:

- 1 – Segmentation ('spatially isolated particles')
- 3 – Local Quality (different properties in different layers, and
- 35 – Parameter Changes (or 15, Dynamics)  
(different properties at different temperatures)

All in all, a very elegant solution, and one that we suspect will evolve to eventually take over a number of Earth-bound problems in due course. Think roof-tiles, building facades and assorted forms of transport.

## Best of the Month – Sex, Science & Profits

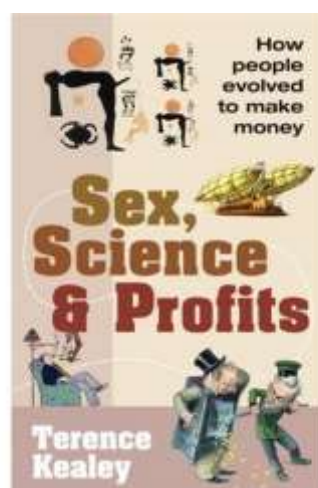
I like this book. I like this book a lot. Author Terence Kealey is a clinical biochemist and Vice-Chancellor of the University of Buckingham in the UK. The main theme of Sex, Science and Profits centres around an attack on the value of government funding of scientific research. At first blush this might seem like an odd thing for an academic to be doing. Judging by the widespread public criticism Kealey has since faced from UK academia, it is also a very brave move on his part.

Henry Kissinger is famously quoted as saying that fights between academics get vicious only because the stakes are so low. Here, however, the stakes appear pretty high – universities effectively only survive these days thanks to the external research funding they are able to attract. In the EU in the next 5 years, for example, universities across the continent can expect to share over 50 Billion Euros of R&D funding support. If Kealey had his way, all of this money would disappear. Or rather wouldn't be given to academia.

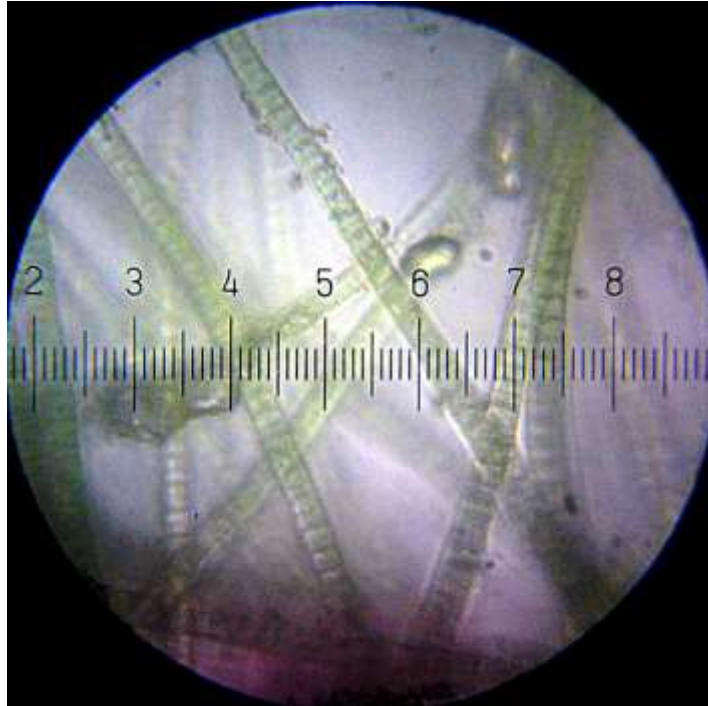
To make his point, Kealey travels back to the Stone Age and then takes the reader on a compelling ride through subsequent Ages to the present day to, first, understand where the concept of government-funded science started (stand up, Sir Francis Bacon) and why it inevitably gives such a depressingly poor return on investment. A return that Kealey convincingly argues is but a fraction of that which gets delivered when industry funds their own research.

The underlying logic, consistent through history, is that those closest to customer problems are best placed to derive solutions. Necessity being the mother of invention, these people at the coal-face tend to be pragmatic engineers that do what is necessary rather than what science tells them is or isn't possible. In other words, the innovators are the ones that come along and break the rules the academic scientists devise and say can't be broken. Rather than science driving innovation, Kealey reveals, the real world operates the other way around. Science follows innovation when, after the innovators have demonstrated that the rules weren't rules after all, the academics come along and re-think the rules... no doubt so that a future generation of innovators gets to break those too next time necessities head is raised.

Written in a beautifully acerbic style, Sex, Science & Profits is a shot across the bow for the academic community around the world, and one of the best calls to arms for an innovation world driven by pragmatism that has appeared for a very long time. Time for everyone to re-think and as such, completely essential reading.



## Investments – Photosynthetic Bacteria



Researchers from the Wyss Institute for Biologically Inspired Engineering at Harvard and Harvard Medical School announced in this month's issue of *Applied and Environmental Biology*, that they have engineered photosynthetic bacteria to produce simple sugars and lactic acid. This innovation could lead to new, environmentally friendly methods for producing commodity chemicals in bulk.

This photosynthetic factory could also reduce the carbon dioxide emissions associated with transporting sugar globally from producing countries; lead to greater availability of biodegradable plastics; and allow capture of harmful CO<sub>2</sub> emissions from power plants and industrial facilities. In addition to its positive environmental impact, the technology offers potential economic advantages. Because the production methods use photosynthesis -- the process by which living things are assembled using only CO<sub>2</sub> and sunlight -- the cost of making sugars, lactic acid, and other compounds would be significantly lower than traditional methods.

"What we're doing is using genetic engineering to get organisms to act the way we want them to - in this case producing food additives," said Wyss Institute senior staff scientist Jeffrey Way, Ph.D. "These discoveries have significant practical implications in moving toward a green economy."

Sugar is primarily produced from sugar cane, which grows only in tropical and subtropical climates. By enabling production almost anywhere in the world, this living cellular manufacturing plant could greatly reduce the cost and emissions associated with transporting millions of tons of sugar to consumers every year. It could also expand the availability of biodegradable plastics by reducing the cost of lactic acid, a key building block in their production.

The current work by Way and Silver's team is the latest innovation in a wide-ranging program in which the Wyss Institute is working with various partner institutions to develop

environmentally sustainable ways to produce biofuels, hydrogen, and other high value chemicals and food additives.

"Our mission at the Wyss Institute is to use Nature's design principles to create solutions in medicine, manufacturing, energy, and architecture that will lead to a more sustainable world," said Don Ingber, Ph.D., M.D., Founding Director of the Wyss Institute. "This work is an important step in that direction."

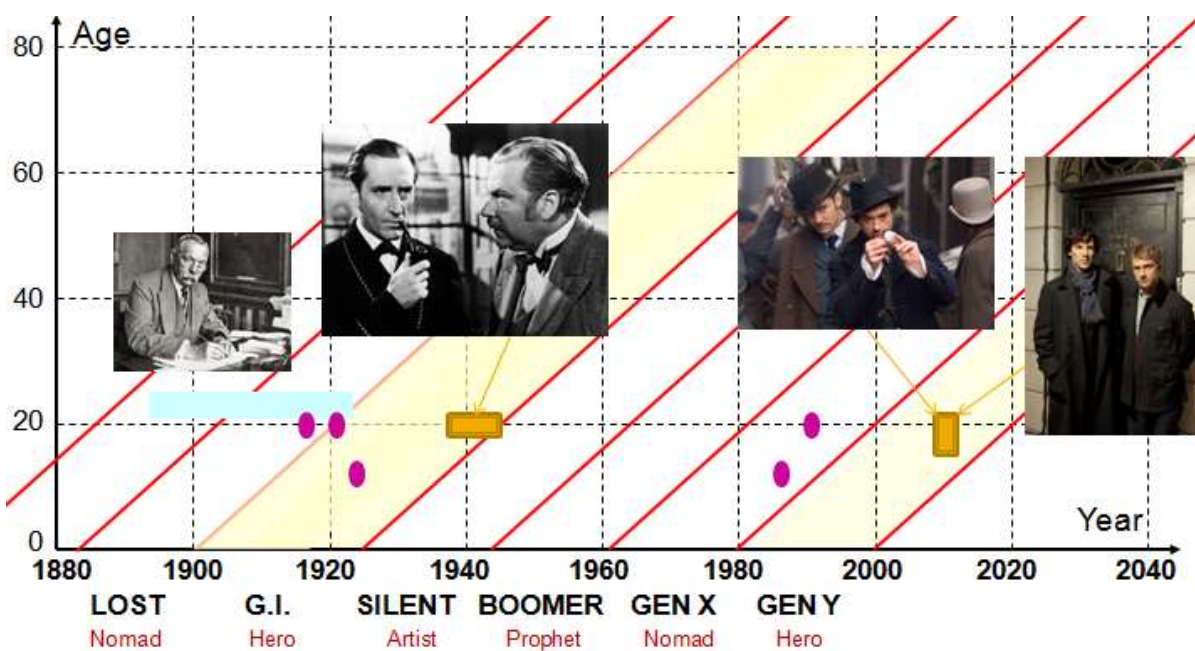
<http://wyss.harvard.edu/viewmedia/143/jeffrey-way-on-producing-sugar-from-cyanobacteria>

## Generational Cycles – Elementary, My Dear Watson

Since Sir Arthur Conan Doyle wrote the first Sherlock Holmes novel in 1887, the Holmes character has become one of the most enduring literary creations of all time, with the majority of the close to sixty books remaining consistently in print since their first appearance.

Holmes' transition to film, however, has been somewhat more patchy. Most film or TV attempts at bringing the stories to life have tended to fail badly. In terms of mass popularity, there have been only three successful versions – the immortal Basil Rathbone version in the late 30s and WW2 years, and, bringing things right up to date, the fantastic re-invention by Robert Downey Jr in 2009, and the even more fantastic updating in 2010 by the BBC with Benedict Cumberbatch in the title role.

Here's what the story looks like when plotted onto a Generations map:



*Orange regions: year and primary target audience for successful films*

*Purple ovals: year and primary target audience for unsuccessful films/tv-series*

*Blue region: years during which Sir Arthur Conan Doyle was writing the books*

Looking at the orange regions quickly reveals an interesting commonality – both Rathbone and DowneyJr/Cumberbatch have been Sherlock Holmes films targeted at Heroes.

Thinking about it, and it seems to make perfect sense. Holmes is in many ways the ultimate Hero – containing the winning combination of other-worldly brilliance and deep character flaws in terms of absent social skills. The Robert Downey Jr and Cumberbatch characters in particular send the clear message that intelligence is good and that it is not, just okay to be flawed, but positively recommended. Something that the Nomads, Prophets and Artists probably don't appreciate or get, but, hey, that's probably the point.



## Biology – Spitting Cobra (*Naja spp.*)

Bruce Young from the University of Massachusetts is antagonising a spitting cobra. He approaches, keeping outside of the snake's strike radius, while moving his head from side to side. The cobra doesn't like it and erects its hood in warning. Young persists, and the snake retaliates by launching twin streams of venom at him from forward-facing holes in its fangs. The aim is spot-on: right at Young's eyes. Fortunately, he is wearing a Perspex visor that catches the spray; without it, the venom would start destroying his corneas, giving him minutes to seek medical aid before permanent blindness set in.



It may seem a bit daft to provoke a snake that can poison you from afar, but Young's antics were all part of an attempt to show just how spitting cobras make their shots. Their venom is a potent defensive weapon, but it's also completely useless if it lands on the skin or even in the mouth. To work, the cobra must aim for the eyes. Just think about how hard that is. The cobra must hit a moving target that's up to 1.5 metres away, using a squirt gun attached to their mouth. The fang is fixed with no movable nozzle for fine-tuned aiming. And the venom spray lasts just 50 milliseconds – not long enough to correct the stream after watching its arc.

By taunting cobras from behind his visor, Young discovered their secret. The snake waits for a particularly jerky movement to trigger its attack and synchronise the movements of its heads in the same way. It shakes its head rapidly from side to side to achieve a wide spray of venom. And it even predicts the position of its target 200 milliseconds later and shoots its venom at where its eyes are going to be.

There are several species of Asian and African spitting cobras, and Young had individuals of three – the red, black-necked, and black-and-white spitting cobras. Getting the snakes was straightforward enough; getting them to spit is another matter. It's very difficult to provoke a cobra to spit at a stationary object – you need a moving target for the best results. That sounds like the sort of job that graduate students normally do, but Young stepped up to it himself. As he wryly writes, "To maximize consistency, the last author served as a target for all trials."

His visor was fitted with accelerometers that recorded his own head movements, while his colleagues Guido Westhoff and Melissa Boetig filmed the snakes with a high-speed camera. Both films were synchronised with a laser pulse and together, the team recorded data from over 100 spits.

They found that a particular type of head wiggle provoked the snakes into spitting – not necessarily large or long-lasting, but always involving a jerky change of direction. This makes sense for the snake. At the moment when the target's head changes direction, its movements are probably going to keep in the same direction for a short while. Also, to change direction, the head must briefly slow down before speeding up again, giving the snake more time to predict its future position.

On average, the cobra starts spitting 200 milliseconds after such movements, which is roughly the same as a human's reaction time between sight and movement. But if it takes that long for the snake to contract its venom-shooting muscles, it's at a 200 ms disadvantage. How can it possibly gun down a moving target and avoid spitting into empty space?

The answer is simple – even before the first droplets of venom emerge, the cobra is already taking aim. Around 65 ms before, it starts to waggle its head up and down, and from side to side, perfectly tracking the zig-zagging of its target's face. When it actually starts to spit, it stops this synchronous bobbing and rapidly accelerates its head in the same direction as its target's. The snake is compensating for its moving bull's-eye, predicting where it's going to be 200 ms in the future and 'catching up' to it well ahead of time.

Young thinks that the cobra's calculations would be accurate enough to hit the eyes if it focused its venom jets on a specific point. As it is, the snake increases the odds of hitting its target even further by wiggling its head from side to side while releasing its poisonous payload. The result: a massive chance of a direct hit, and a reeling animal that will think twice about approaching a spitting cobra again.

From a conflict resolution perspective, the spitting cobra provides a very elegant example of an accuracy versus speed problem. Here's how human engineers have tended to resolve such fights:

IMPROVING PARAMETERS YOU HAVE  
SELECTED:

Measurement Precision (48)

WORSENING PARAMETERS YOU HAVE  
SELECTED:

Speed (14)

SUGGESTED INVENTIVE PRINCIPLES:

28, 13, 24, 5, 32, 35, 37

Interesting to note that the cobra also makes use of Principle 37 in its generalised 'Relative Change' form. Also interesting is the idea of only firing its venom after a sudden movement – conventional logic might have suggested that a stationary target might be the easier one – which seems to fit nicely with the idea of Principle 13, and turning logic the Other Way Around.

Read more details at J Exp Biol <http://dx.doi.org/10.1242/jeb.037135>

And watch a video at:

<http://news.discovery.com/videos/news-cobras-methodically-spray-venom.html>

## Short Thort

“Wes Montgomery played impossible things on the guitar because it was never pointed out to him that they were impossible.”



## News

### ChangeHub

Starting from September, we are opening up our Clevedon HQ as a creative space for hire. The systematic innovation office is a treasure-trove of objects from children's toys to jet-engines, zoological exhibits to one of the best business libraries in the UK. It is ideally suited to creative workshops, idea generation or brainstorm sessions. It also provides an inspirational venue for company away days and business or team meetings.



Whether wishing to run your own session, or use one of our full-time, change facilitators, interested parties should download the enquiry form from the website or contact Hannah on 01275 337500 or [hannah@systematic-innovation.com](mailto:hannah@systematic-innovation.com).

## **TrenDNA(DE)**

Wow! The first print-run of the German edition of TrenDNA has already sold out. A new run has been commissioned and will be available shortly. Along with a new round of workshops to be held in various parts of Germany and Austria by co-author, Viktoria Zinner. Interested parties should check out [www.zinner.cc](http://www.zinner.cc).

## **Whispered Voices**

Speaking of TrenDNA, we're happy to announce that we will be conducting the first public US version of the accompanying 'Whispered Voices' workshop on the Saturday immediately after the Altshuller Institute TRIZ conference, at the conference venue. Saturday 9 October is the date for your diary.

## **Hargraves 2011**

The major event in the Australian innovation calendar is rapidly becoming the Hargraves' main annual conference. The dates for the 2011 event have now been set as 16 and 17 March. With a following wind, we're hoping to be presenting some of our latest research findings there.

## **Short Notice...**

We're running a semi-formal 'how to search patents more effectively' workshop in the UK in August. Anyone interested in attending should email Darrell for details.

## **Breakthrough Selling**

October sees the simultaneous Australia and UK launch of a new one-day workshop aimed at helping sales teams to turbocharge their performance. Building on key insights gained through the TrenDNA findings, and simplified elements of SI, the main concept of the workshop is to run the whole day through a series of hands-on tests and trials. More details on the Experience page of the website.

## **New Projects**

This month's new projects from around the Network:

- Telecom – workshop series
- Medical Devices – IP creation
- Medical Devices – Eyes-on-the-World
- Logistics – IP creation
- FMCG – Next generation product conceptualization study
- Entertainment – Generations workshop
- Industrial Automation – disruptive innovation opportunity study