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

Towards An Explanation Of The Rule Of Three

(Why Three? Part #13)

One of the high level business trends that continues to fascinate us is the 'rule of three' described by Jagdish Sheth in Reference 1. Sheth's book describes how all markets tend towards three players on regional, then national, then continental and then finally global levels. The compelling arguments made in the book add to the earlier thoughts in another classic management text by Utterback (Reference 2). When we combine the two, we get something like the picture illustrated in Figure 1:

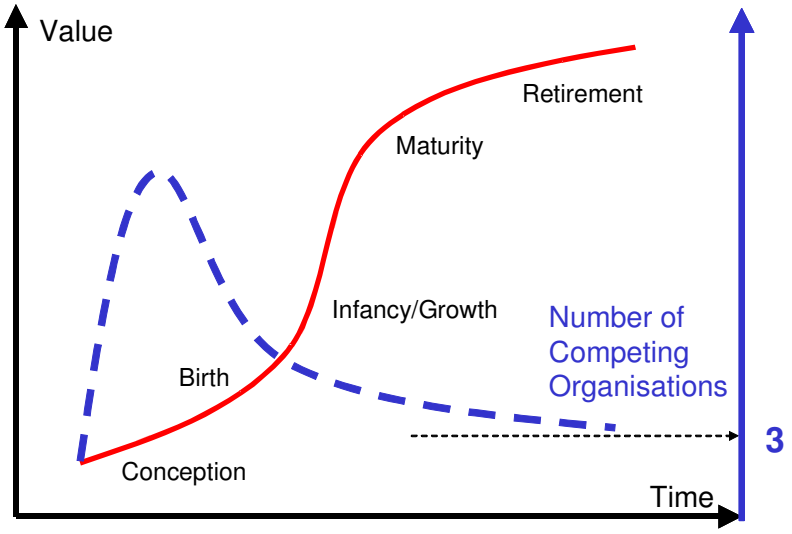


Figure 1: Markets Converge To Three Main Players

The fascination for us lies in the question 'why three?' Or, why don't markets converge to a smaller or higher number of key players?

One way to start thinking about the question is to examine the underlying DNA of the organizations that operate within a given market and the customers that buy from them. Crudely speaking we can extract this DNA when we start to think about Ideal Final Results. In Figure 2 we see a reproduction of a picture we use frequently on workshops.

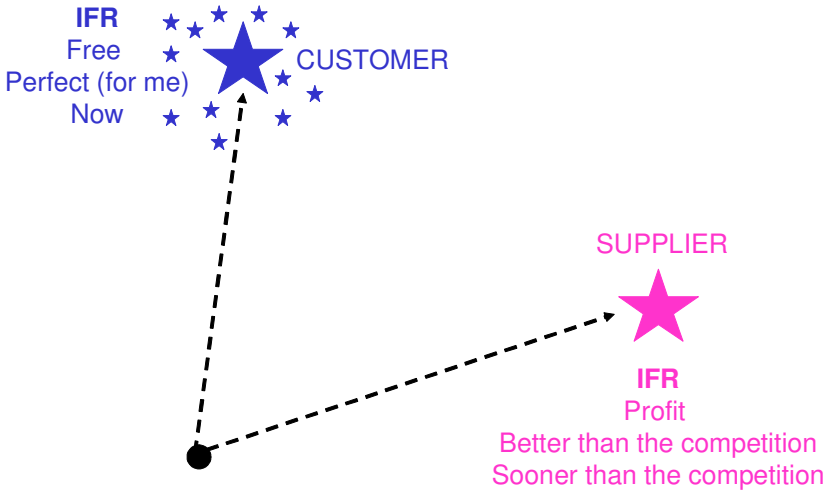


Figure 2: Ideal Final Result & Primary Market Drivers

The picture highlights the big difference in the basic drivers of our two players. Whether explicitly or implicitly, the figure suggests that customers are driven towards a 'free, perfect and now' end-point. 'Perfect' in this case is defined by each individual customer in their own context (hence the cluster of stars at the IFR position). The fact that potentially every single customer is different from every other one suggests that the number of potential requirements from the customer is very high indeed.

For the suppliers of the products and services demanded by customers on the other hand, the primary driving DNA is profit (Note: for those in NGOs and NPOs the same basic idea applies, 'profit' merely gets replaced with the need to generate sufficient revenues to allow the organization to survive in a sustainable manner).

Crudely speaking, if we consider that every customer is different from every other one then the customer driver should cause markets to evolve to considerably more than three suppliers. The supplier driver, conversely, should tend to cause markets to converge so that the competition is removed and we are left with one monopoly provider. (Remember this is a crude approximation – our interest here is in finding big first-order effects!)

From the customer perspective the monopoly provider situation is considered to be unacceptable in a capitalist economy. Monopoly's tend not serve the customer interests well. We can see why this is so when we look at communist economies – monopolies, or rather the lack of competition, tend to cause systems to evolve to the lowest common denominator solution rather than any kind of ideal – low quality, artificially high prices and no incentive to head towards a 'better' anything. With this in mind, it is easy to see, we think, that markets are very unlikely – under free conditions – to evolve to a single final player. Despite how much giant MNCs might wish otherwise.

So if one player doesn't work, what about two? To answer this question we might take a look at the so called Ice-Cream Seller analogy (Reference 3). The basic idea behind this analogy is ice-cream sellers on a beach. Imagining our beach as a straight, homogenous, evenly-populated strip of land, the analogy asks 'where is the best place for two competing ice-cream sellers to position themselves? – Figure 3.

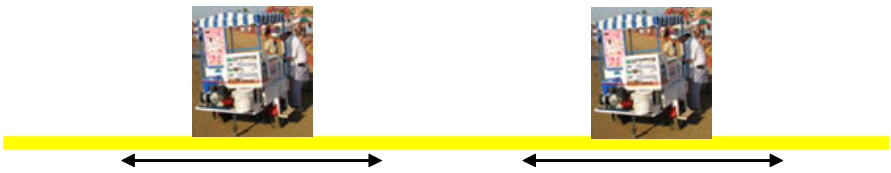


Figure 3: Positioning Two Ice-Cream Sellers On A Beach

Perhaps your logic (especially if you are an engineer and familiar with beam theory) tells you that the two sellers should position themselves to that they leave a gap of between 33% and 50% of the beach length between them. This way, they get to have an even share of the people on the beach, and those people on the beach have the shortest distance to walk in order to purchase an ice-cream. What tends to happen in this scenario in reality, however, is that first one and then the other ice-cream seller edges closer to the centre of the beach in an attempt to attract customers inbetween the two sellers to come and buy from them. Needless to say in this situation, the end result is that the two ice-cream sellers will eventually converge and sit side-by-side at the mid-point of the beach. We can see this ice-cream seller duopoly effect in many places, but quite vividly in many political systems. Any 'market' dominated by two players tends toward a middle-ground in which one is to all intents and purposes indistinguishable from another (Tory/Labour, Democrat/Republican, etc). In an economic setting there is ample evidence to show that a

duopoly situation tends to the same indistinguishable middle ground. A good example is the Australian domestic airline industry, which, following de-regulation allowed the entry of a second player. The aim of de-regulation was to increase competition and therefore decrease prices (Reference 4). The net result was that both players very quickly became indistinguishable one from the other and the customer saw little if any reduction in price. It seems then that markets that only have two players are ultimately little different to markets that only have one.

According to Reference 3, the game changes entirely as soon as the ice-cream seller model shifts to include a third player. Imagine first that a third player arrives into the duopoly situation where both of the incumbent companies have found their stable point at the centre of the beach. The third player could come and position himself also at the centre of the beach. However, more likely is that the third player arrives because he sees an opportunity – like for example the people at the far ends of the beach have a long way to walk to buy an ice-cream and are therefore not well served. Therefore, there is a definite advantage for the third seller to position themselves closer to one end of the beach. As soon as this happens, the competition dynamic changes. With a third player intruding onto one half of the market, the two incumbents can either accept that they will potentially lose this half of their market, or they have to start thinking about re-positioning to a more optimal position.

To save you time in trying to think this one through, what Reference 3 demonstrates for us is that there is no stable 'optimum' position for the three sellers on the beach. In other words, as soon as we add a third player to the competitive arena, the system becomes fundamentally complex and dynamic. Any player that makes a move to a new 'more ideal' spot on the beach will gain an advantage and at least one of the other two will lose out. As soon as this happens, the other players will have an incentive to recover what they have lost, and so will sooner or later be forced to re-optimise their position... which then affects the other two players and starts the cycle all over again.

With three players in the market, the customer finally gets a situation where suppliers have an incentive to think about their ideality. In theory, the customer should be even happier when a fourth supplier and a fifth and a sixth, etc, arrive on the scene. In practice it seems that – to take the ice-cream seller analogy one step further – there is no beach long enough that makes it worthwhile for such a large number of sellers to be able to make a worthwhile living. It also seems that customers after all don't always want to have to make more than three choices anyway. We will return to this thought in a future article. In the meantime, as a first order of magnitude approximation, we conclude that the rule of three exists because despite supplier drives towards one or two player markets, three is the smallest number that provides the market with genuine competition and a desire to evolve towards a customer defined Ideal Final Result.

References

1) Sheth, J., Sisodia, R., 'The Rule Of Three: Surviving And Thriving In Competitive Markets', The Free Press, Simon & Schuster, New York, 2002.
2) Utterback, J.M., '*Mastering The Dynamics of Innovation*', Harvard Business School Press, 1996.
3) Kay, J., 'Foundations Of Corporate Success: How Business Strategies Add Value', Oxford University Press, 1993.
4) http://www.uq.edu.au/economics/johnquiggin/news95/airfares9508.html

Accelerated Evolution

(Innovations Will Happen Anyway, So Why Do We Need TRIZ?)

A frequent complaint about TRIZ is that it delivers answers that are 'obvious'. Taken a step further this complaint then becomes 'we would have found that answer anyway'. The answer to both questions is 'of course; you are right'. Obviousness is often a test we will apply to determine the quality of a solution; if it doesn't look obvious in retrospect, it probably isn't the right solution. This article addresses the slightly more complicated issue of 'we would have found that answer anyway'.

The fact that the patent database is brim full of great ideas (even after we have extracted the millions of non-great ideas), and that almost no inventor 'used TRIZ' to create their particular invention is sure proof that no-one needs TRIZ – or any other method – in order to be inventive.

The point thus becomes not whether we 'need' TRIZ in order to be inventive, but rather does TRIZ give us any additional benefits that the natural creative process does not provide. To our mind, the answers to this question involve issues of timeliness and comprehensiveness.

A simple example should serve to illustrate both of these issues. US patent US5,709,691 is an endo-tracheal tube used in the treatment of chronic patients (Figure 1). The function of the device is to allow medical care givers to get liquid nourishment into the patient's stomach. The device, a plastic tube, is inserted through the mouth of the patient and into the esophagus. In order to prevent re-flux of the nourishment into the patient's windpipe, the tube has to contain a seal device. Such a seal is shown in detail in the figure.

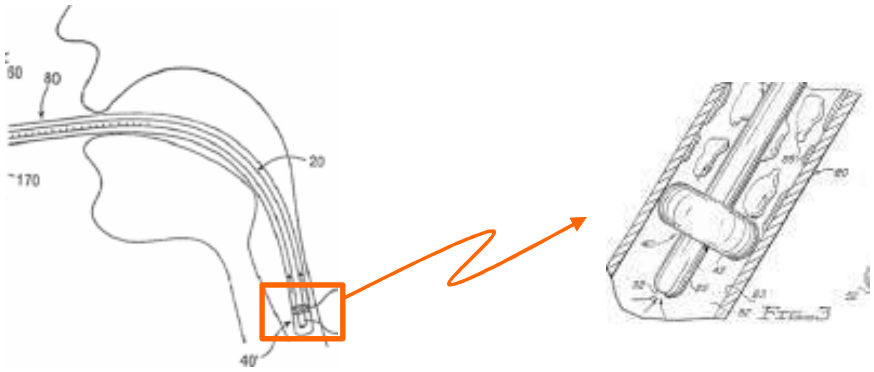


Figure 1: Patent US5,709,691 Endo-Tracheal Tube

This patent was granted in January 1998. Should we chose to conduct an evolution potential analysis of this patent, we will eventually wish to examine the seal part of the invention relative to the Surface Segmentation trend – Figure 2. As we can see from the figure, the seal surface as defined by the inventors is at the first stage of the trend. It is, in other words, a smooth surface. A perfectly logical position for a sealing surface.

Once we have made this connection between design and a trend stage, the Trend then tries to tell us where the design is likely to evolve in the future. In this case that means, next, adding protrusions in two and then three dimensions. The Trend, of course, has no idea why such directions will be useful, but that simply speaking this is the direction that others have evolved their surfaces in order to deliver more ideal solutions. A swift examination of the 'reasons for jumps' information in the Trends reference section in the

technical edition of Hands-On Systematic Innovation would reveal such potential benefits as easier to grip, reduced drag, improved traction, improved heat transfer properties, increased surface area, improved location when joining, and so on. The job of the Trend user is to work out if these reasons (or any others – the question 'why might this be a good direction in my case?' is a very good thing to think about) might be beneficial in their specific situation.

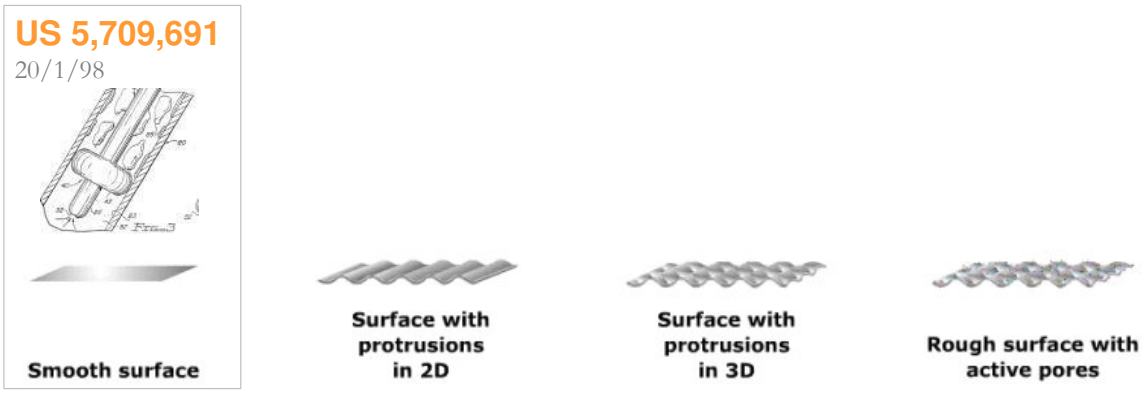


Figure 2: Seal Design In Relation To The Surface Segmentation Trend

Even if we know little about seals and even less about endo-tracheal tubes, we should soon realize that, for the 'protrusions in 2D' stage at least, we present the possibility of improving the sealing surface area and thus the overall functionality of the design. What we don't know, of course, is whether this advance will be useful in the context of the device under consideration. Perhaps the current smooth-surface seal is good enough?

We perhaps get the answer to this question when we examine a later patent granted to the same inventor as the first invention – Figure 3.

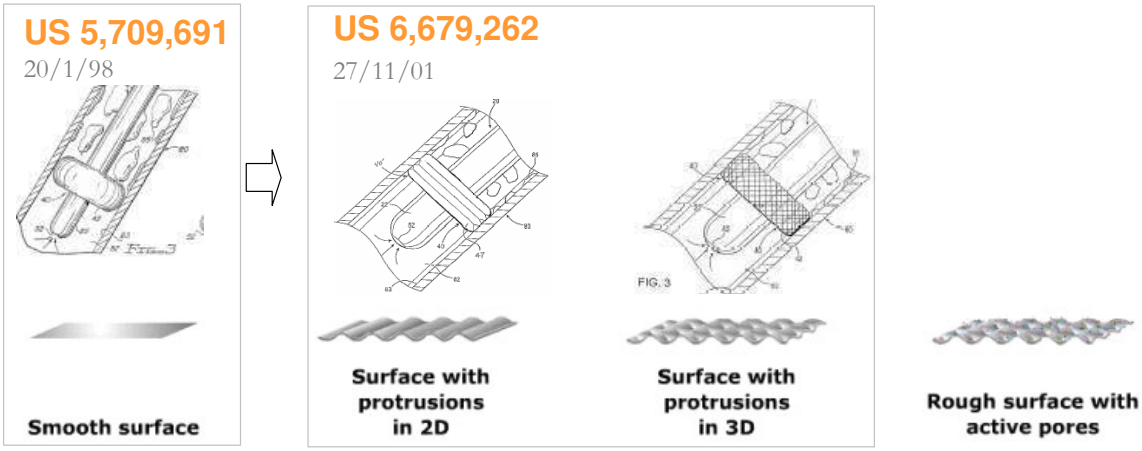


Figure 3: Later Evolution Of The US5,709,691 Seal Design

In November 2001 it appears clear that there is indeed an advantage in adding protrusions to the seal. The question now becomes, why did it take the inventor nearly 4 years to make and act upon this realization?

Perhaps one answer is that they were aware of the unmade evolution jumps when they submitted the first patent, and that what they wanted to do was delay the submission of the later jumps in order to provide a longer life-span of their IP protection. This would have been a perfectly legitimate strategy. Albeit one that, given the knowledge provided by the Surface Segmentation trend, we might now see as a risky one.

When we say that TRIZ is changing the world of intellectual property, this is one of the things we are thinking about. Anyone with knowledge of the TRIZ trends could very easily have patented the surface protrusion ideas the moment after they saw the initial smooth-surface seal patent.

Perhaps a second reason is that the second and third stage Trend jumps were not technically possible at the time that the first invention was made. In this case, this seems like a pretty unconvincing argument. Especially in the case of the jump to the ribbed seal idea that emerges from the second stage of the trend.

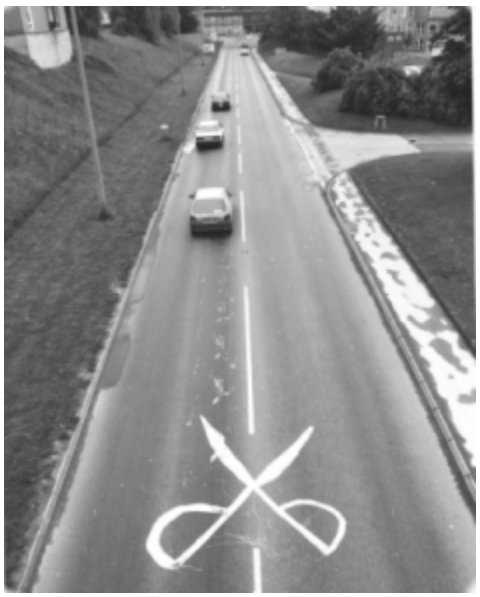
This then leaves us, in the specific case of this patent, with the strong belief that the inventor was simply unaware of either the Trend pattern or the need to consider how the seal might improve. We can see further evidence that this may be true when we look at the fourth stage of the trend and the addition of active elements to the surface. The inventor, as of the present day has still made no moves in the direction of this fourth stage. Again this might be due to a desire to increase overall life-span of the IP (they may already have the patent for a seal with active elements already drafted and ready to submit), or it may because they don't technically know what active elements to add or why. In light of our awareness of the Trend, either of these options sounds more than a little dangerous. Even with our limited knowledge of the sector it seems both logical and possible that the addition of some kind of active element will be a good idea (e.g. patentable concept – add a local anesthetic to the seal surface so that it doesn't hurt during insertion).

The overall point of this example then, is that what took this inventor nearly four years to realize, could very easily have been envisaged at the time when the original concept was derived. This is what 'systematic' offers - timeliness. The fact that there are 34 other Trends that the seal could have been compared against in terms of mapping where the design will evolve in the future is where we see the 'comprehensive' part of the story.

Clearly the inventor of this endo-tracheal tube did not *need* (or use) TRIZ to derive his inventions. In the future, when one or more of his competitors are, it is not so clear that he will be able to continue with relying on his natural creative talents. He could take the chance, of course, as can any of us. Given the choice, however, the rapidly accelerating, globalizing times we live in will perhaps favour the timeliness and comprehensiveness offered by systematic approaches.

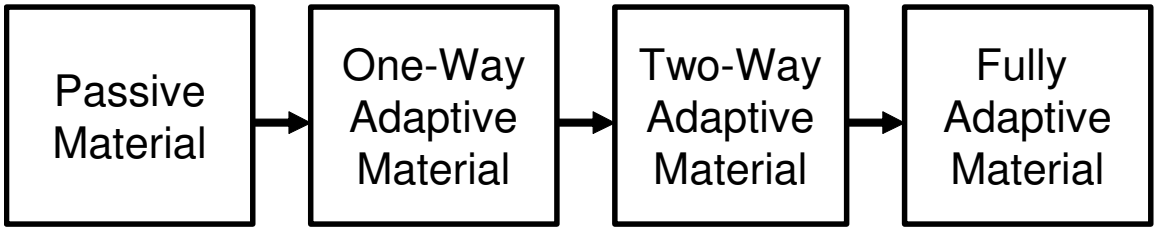
Humour – Increasing Segmentation

Spotted at the University of York recently, an attempt to try and help solve traffic congestion problems perhaps?



Patent of the Month – Tristate Electrochromic Device

A frequent source of confusion with our trends of evolution is the Smart Materials trend:



One of the main problems with the trend emerges from the fact that the vast majority of systems are still at the first stage of the trend – i.e. they are comprised wholly of materials that are passive. 'Simple' smart materials like shape memory alloys have made a jump to the second stage of the trend. 'One-way adaptive' in this sense is that these materials make a – usually reversible – transition from one state to another based on some form of incoming signal. Our patent of the month this month is a rare example of a material system that has made a jump to the third 'two-way adaptive' stage of the trend.

US7,075,697 'Tri-State Electrochromic Device' was granted to Michigan based Gentex Corporation on 11 July. Traditional electrochromic materials are able to change their colour or transparency according to an electrical input signal. The most common application of a thermochromic smart material is in glass that we wish to switch from transparent to opaque. Gentex, partnered with PPG, is one of the leading players in this industry. They will, for example, be a key supplier of electrochromic windows for the new Boeing 787 Dreamliner project.

While it is not clear whether Dreamliner will take advantage of this latest Gentex innovation, it does appear clear that there will be a range of other potential applications. The basic jump made by the trend is that the material – most likely a piece of glass, although the patent is written in more general terms – will be able to transition between three rather than just two states. By way of a very nice example of the sort of benefit that this offers, the invention disclosure discloses the ability to selectively filter out different frequencies of light. So:

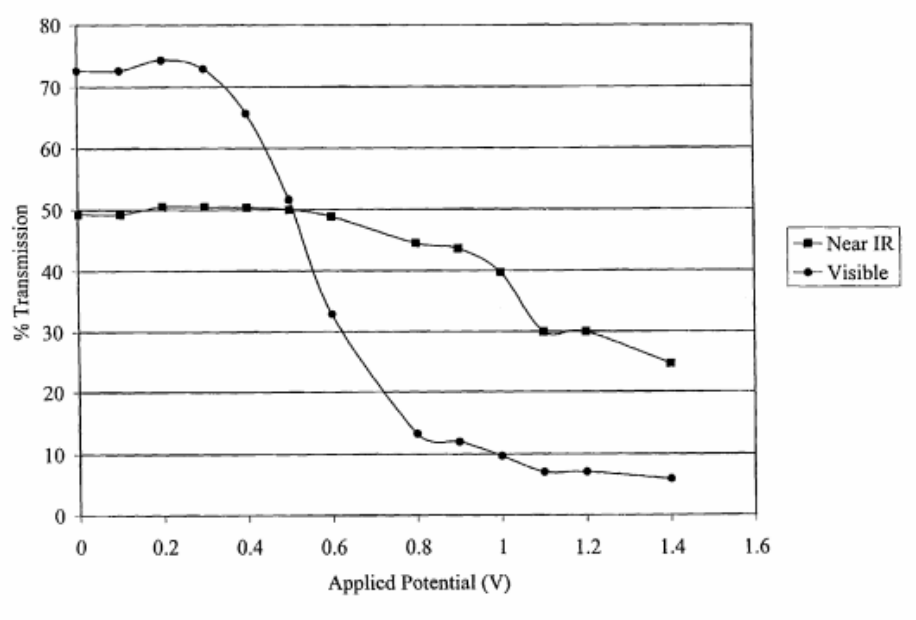
"During winter days in cold climates it may be desirable to have a device absorb only visible light during the coldest morning hours when the sun is low on the horizon and to allow the near-infrared light to enter and allow some solar warming of the interior of the building, while at the same time reducing unwanted glare. When the sun is higher in the sky, the device could be turned off to allow both visible light and near-infrared radiation to enter the building, thereby reducing the need for artificial illumination and allowing for solar heat to enter the building. Later in the afternoon, it may be desirable to block both the visible and near-infrared radiation for thermal and visual comfort".

The basic inventive step made by the inventors to create the tri-state capability can be reverse engineered as an example of Inventive Principle 3, Local Quality. Basically, the increase of a single voltage input is now able to deliver three different material states. Again, from the invention disclosure, we observe the following:

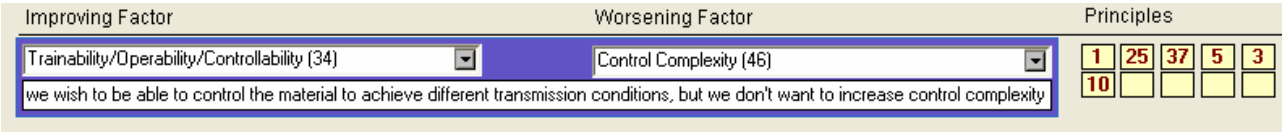
"It has now been surprisingly discovered that selective utilization of one or more anodic and/or cathodic electroactive materials enables an electrochromic medium, and, in turn, an electrochromic device, to operate between at least three regions or states (referred to

as a tristate device), namely (1) a first state (i.e. when a potential difference less than that sufficient to cause electrochemical oxidation or reduction of the anodic and cathodic materials is applied, a.k.a. the open circuit state or high transmission state) wherein the device has its maximum light transmission; (2) a second state (i.e. an applied potential between the minimum potential where oxidation or reduction of the anodic and cathodic materials occurs up to a "second" potential difference) wherein variable attenuation of either visible radiation or near-infrared radiation occurs to a significant extent depending on the device configuration without significant attenuation in the other spectral region; and (3) a third state (i.e. an applied potential between the "second" potential and a "third" potential difference) wherein variable attenuation occurs to a significant extent in the other spectral region depending on device configuration. It will be understood that attenuation refers to the relative change in transmission of a device as the potential is changed."

Essentially what is happening here is that the inventors have found anodic and cathodic materials that transmit IR and visible light differently as different voltages are applied:



The basic issue in this innovation is that the inventors had a desire to improve something – the ability to increase controllability of the colour/transparency of the material, but didn't know how to do it. In such 'administrative contradiction' cases it is difficult to map the problem onto the contradiction matrix tool. Probably the best we can do for this patent is to map it as follows:

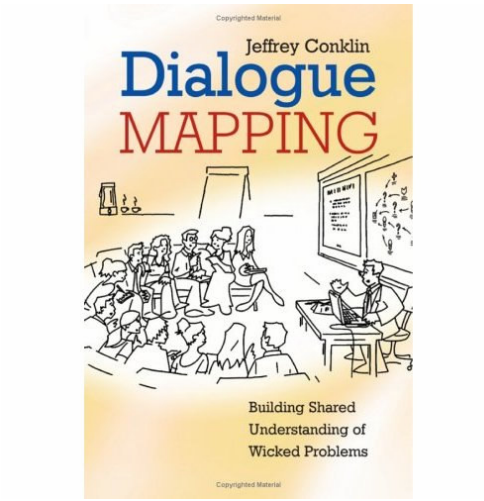


I think we can see that the recommendations made by the Matrix are highly consistent with the strategies used by the inventors.

The main reason for our selection of the Gentex patent is that the third stage Smart Materials trend jump is a rarity. We will be watching the commercial exploitation of the new capability with some interest. Those with a similar level of curiosity may wish to check out the Gentex website – www.gentex.com.

Best of the Month – Dialogue Mapping

Our clear winner for book of the month award this month is Dialogue Mapping: Building Shared Understanding Of Wicked Problems by Dr Jeffrey Conklin.



The book offers a compelling expose of the fallacy of the 'conventional wisdom' we expect to achieve and plan in problem solving processes. There is some excellent material here. Moreover it is material that should have a significant influence on how we think about the teaching and deployment of TRIZ and systematic innovation methods. All in the community have devoted at least some time (many have devoted almost all) to creating repeatable processes.

One of the key experiments recorded in the book relates to the MCC Elevator Study:

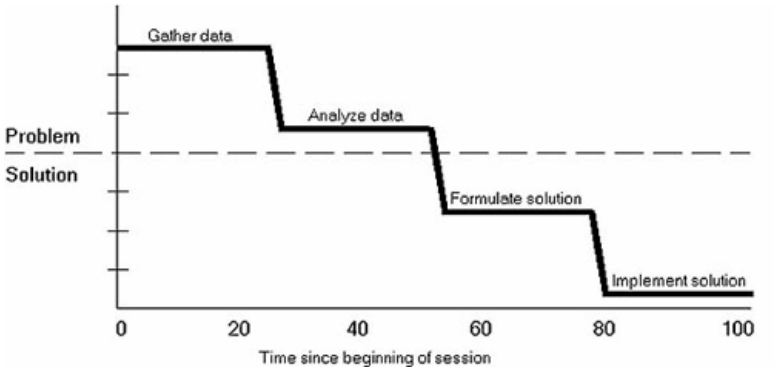
"A study at the Microelectronics and Computer Technology Corporation (MCC) examined how people solve problems. The study focused on design, but the results apply to virtually any kind of problem solving.

"A number of designers participated in an experiment. Each was asked to design an elevator control system for an office building. All the participants were experienced, expert designers, but none had worked on elevator systems. Participants were asked to think out loud while they worked on the problem. The sessions were videotaped and then analyzed.

"The analysis showed that the designers focused on two areas: understanding the problem and formulating a solution. They tried to understand the problem in two ways:

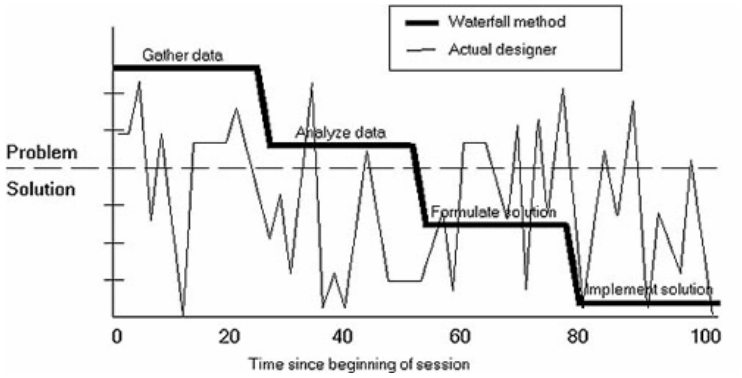
- By trying to identify the requirements for the system (from a one-page problem statement they were given), and
- By performing mental simulations (for example: "Let's see, I'm on the second floor, and the elevator is on the third floor, and I push the 'Up' button. That's going to....").

"Traditional thinking, cognitive studies, and existing design methods (including, should we care to reverse engineer it, TRIZ) all predicted that the best way to work on a problem like this was to follow an orderly and linear process, working from the problem to the solution. Everybody knows that. You begin by understanding the problem, which can include gathering and analyzing data. Once you have specified the problem and analyzed the data, you are ready to formulate-and then implement-a solution. This is illustrated in the figure below. In the software industry, this is known as the waterfall model because it suggests a waterfall as the design flows down the steps:



“This is the pattern of thinking that we all assume we follow when faced with a problem. The conventional wisdom is that the more complex the problem, the more important it is to follow this orderly flow. If you work in a large organization, you have probably seen the waterfall model of problem solving enshrined in policy manuals, text books, internal standards for the design process, and the most advanced organizational tools and methods. If you work with ARIZ, you will observe an extremely rigorous process.

“In the MCC study, however, the designers did not follow the waterfall model. They would start by trying to understand the problem, but would immediately jump to formulating potential solutions. Then they would go back to refining their understanding of the problem. Rather than being orderly and linear, the line plotting the course of their thinking looked more like a seismograph for a major earthquake:



“We call this pattern both chaotic, for obvious reasons, and opportunity-driven, because in each moment the designers are seeking the best opportunity to progress toward a solution.

“These designers were not being irrational. Their thought processes were something like this: "Let's see, idle elevators should return to the first floor, but then you only need one elevator on the first floor, so the others could move to an equitable distribution. But the elevators need to be vacuumed regularly. I suppose we could add a switch that brought idle elevators down to the first floor. But then what does that do to our energy efficiency? I need to reevaluate the requirements." What drove the flow of their thoughts was an internal drive to make the most headway possible, regardless of where it occurred, by making opportunity-driven leaps in the focus of their attention. Precisely because they were being creative, the flow of their thinking was full of unpredictable leaps.

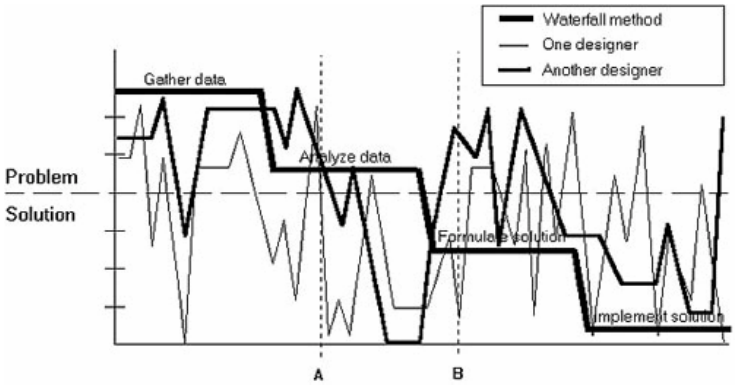
“The Figure also shows that problem understanding continued until the very end of the experiment. In observing people working on design or planning problems, our experience is that their understanding of the problem continues to evolve as long as the project does.

Even as the design or plan is being implemented, the nature of the problem, the "real issue," continues to change and grow.

“The natural pattern of human problem solving appears chaotic on the surface, but it is the chaos of an earthquake or the breaking of an ocean wave. It reveals deeper forces and flows that have their own order and pattern. The non-linear pattern of activity that expert designers follow gives us fresh insight into what happens when we work on a complex problem. It reveals that in normal problem-solving behavior, we may seem to wander about, making only halting progress towards the solution. This non-linear process is not a defect, not a sign of stupidity or lack of training, but rather the mark of a natural learning process. It suggests that humans are oriented more toward learning (a process that leaves us changed) than toward problem solving (a process focused on changing our surroundings).

“Most people are not surprised to learn of the non-linear pattern of problem solving. But the MCC Elevator Study is significant because, for the first time, we have a model of the process that people actually follow when they tackle hard problems. And it is not the orderly, linear process we have assumed is proper.”

When we add a second designer into the MCC equation, the picture becomes even more complex:



What we now see is that not only do both of the designers oscillate wildly between problem definition and solution generation, but that they are often highly mis-aligned, with, in the extreme case, one person deep into re-formulating the problem and the other generating solutions.

The principal message of Dialogue Mapping is first and foremost the recognition that our conventional wisdom concerning systematic problem solving processes for difficult problems is wildly askew. This in itself is a valuable addition to our thinking and planning of TRIZ problem solving sessions – where, almost by definition, our focus will be on ‘wicked’ problems.

E-zine subscribers interested in finding ways to cope with this inherent issue will be well advised to obtain a copy of Dialogue Mapping and see how we might have a chance of solving the ‘process’ AND ‘chaos’ contradiction. To be honest, the actual dialogue mapping process described in the later parts of the book seem more like a start point than an end… but then, that’s probably a good thing.

Conference Report – Innovation Culture Conference, Kuala Lumpur

Organised by our partners, SMPP, in Malaysia, this event was held on the 25th and 26th of June. The second day was an innovation culture workshop delivered by Darrell Mann. The main day of the conference was the first day, the programme of which is reproduced below:

8:30 am Registration and Morning Coffee

9:00 am Opening and Welcome Remarks from the Chairperson

9:15 am **Introduction**

9:45 am **CREATING AWARENESS TOWARDS A MORE INNOVATIVE CULTURE**
- Why People Do Not Buy into Change?
- Effective Management Buy-In
- Strategies and Initiatives to Promote Innovation in Organisation

Darrell Mann
Managing Director
Systematic Innovation Ltd, UK

10:30 am Morning Refreshments

10:50 am **CASE STUDY: INNOVATION & CORE COMPETENCIES**
- Individual, Team and Organisation Competencies
- Challenges in Implementation
- Implementation in Performance Management
- Implementation in Learning Processes

Kalyan Kumar Banerjee
Senior Vice President and Co-Founder
MindTree Consulting Pvt Ltd, India

11:30 am **INNOVATION & CHANGE MANAGEMENT**
- Initiating, Building & Leading the Innovation Culture
- The Role of Management and Employees
- Results of Adopting and Adapting to an Innovation Culture
- The Process of Change to an "Innovative Organisation"

Richard Platt
Senior Instructor Innovation Methods
Advances Collaboration & Innovation – IT Innovation
Intel Corporation, US

12:15 pm **Case Study**
- Formulating/Editing the Innovation Process
- External and Internal Benchmarking

SungCheol Kim
Research Innovation Team
Samsung Advanced Institute of Technology

1:00 pm Networking Luncheon

2:15 pm **BUILDING GREEN GRASSROOTS INNOVATION MOVEMENT IN MALAYSIA**
- Lessons from Honey Bee Network

Prof Dr Anil K Gupta
Chair in Entrepreneurship
Indian Institute of Management, Ahmedabad

3:00 pm **INNOVATE, GROW & DELIVER - REALISING & SUSTAINING INNOVATION IN 3M**
- Culture of Innovation
- Aligning Technology Platforms to Market Opportunities
- Implementations Strategies for Innovation
- The Role of Leadership in Developing an Innovative Culture
- Case Studies - Of Products Brought to Market Using Technology and Market Innovation

Karen Albertson
Managing Director
3M Malaysia Sdn Bhd

4:00 pm Afternoon Refreshments

4:20 pm **PANEL DISCUSSION - CHALLENGES & OBSTACLES**
- Mitigating Obstacles
- Learn from the Mistakes or Learn from the Best

Karen Albertson,
3M Malaysia Sdn Bhd
Kalyan Kumar Banerjee,
MindTree Consulting Pvt Ltd, India

4:50 pm Question & Answer

5:00 pm Closing Remarks & Close of Day One

The event was attended by over 40 senior managers from in and around Malaysia. Judging by the post-event feedback it seems that the organizers achieved a perfect balance of industry and academic input. Each presenter gave the audience enormously valuable insights into the challenges of sustainable innovation. Kalyan Banerjee from one of our all-time favourite companies, MindTree, spoke eloquently about how innovation lies at the heart of India's fastest growing IT services company. The Intel and Samsung presentations then beautifully highlighted very different perspectives of innovation in two of the world's most successful organizations. Anyone thinking there might be a single right way to achieve an innovative culture would do well to study the contrasting approaches of these two giants. A third giant, 3M, arguably one of the world's most renowned innovators – with 500 new product launches per year – closed the formal presentations in frank and inspiring terms. The other end of the corporate spectrum was represented by Professor

Anil Gupta. Professor Gupta spoke passionately about the case for grass-roots innovation. He presented multiple case-studies highlighting how minimal financial resources in remote India have acted as a tremendous innovation spark. It is often said that the best innovation emerges from the greatest hardship, and here was ample evidence. Expect to see more about some of these case studies in future papers from our side.

Darrell Mann, Kalyan Banerjee, Richard Platt & SungCheol Kim – some of the presenters at the conference

Judging by the quantity and type of questions posed by the audience throughout the course of the day, it seems that the theme of the conference hit an important nerve in the corporate psyche in Malaysia. Seemingly everyone is now recognizing the importance of innovation. There is the first hurdle to cross. The second one is how to get the people inside the organization in a state where they want to help the change process. To quote the Samsung speaker, at the core of passing any of these hurdles is the need to 'find the contradiction' and then 'stay at least one contradiction ahead of the competition'.

Investments – ‘Very Deep UV’

Creating a film of silicon dioxide on the surface of silicon wafers is an important stage in chip manufacturing. It serves as the insulating layer into which electrical circuits are later etched using photolithography, and also as the "active gate layer" that helps switch the transistors.

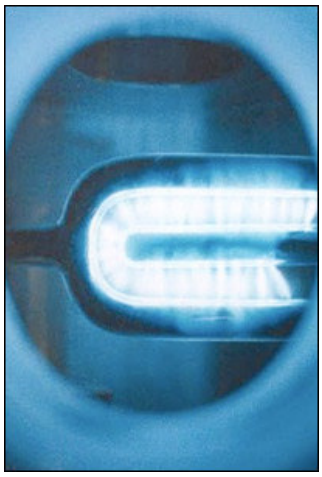
The dioxide builds up naturally when silicon is exposed to air, a bit like iron oxidises into rust, but the process is very slow at room temperature. Chip makers today bake silicon wafers in furnaces at up to 1,000 degrees centigrade to accelerate the process.

Engineers at University College London have found a way to speed up the dioxide creation at room temperature using UV lamps. Ian Boyd, chair of electronic materials at the university's Department of Electronic and Electrical Engineering, leads the project. They can create a suitable layer of dioxide in about the same amount of time it takes to blast the silicon in a furnace, he said.

A lot of testing remains and it could be several years before the technology is ready for commercial use, Boyd said. But the payoffs could be significant. The technique uses much less energy than a blast furnace, which could save millions of dollars for chip makers and allow them to reduce the prices of chips. It could also make chip manufacturing more efficient, since when furnaces are used, components added to the chips earlier in the manufacturing process can become diffused in the high temperatures.

The researchers have been contacted about their work by big chip equipment makers, and some chip manufacturers have also expressed interest, according to Boyd.

Key to the research was identifying the right type of UV light. The engineers experimented for years with UV light at wavelengths of 122 nanometers and 172 nms, but that still required heating the silicon to 400 degrees, Boyd said. They recently reduced the wavelength to 126 nms - creating what Boyd called "very deep UV" - and found they could create the dioxide at room temperature.



"When you break oxygen molecules into two oxygen atoms using UV radiation at 200 nanometers or so, the atoms are not very aggressive oxidizers. But with this very deep UV we've developed, one of the atoms becomes an extremely aggressive oxidiser, and that's the secret," he said.

The scientists have grown dioxide films 10 nms to 15 nms thick -- more than sufficient for CMOS chip manufacture. A nm is about the length of three atoms side by side. The lamps resemble the florescent light tubes used in offices and can be made relatively cheaply, Boyd said. "They could be mass produced very easily. They'd need a bit of development, like the early light bulbs."

The next step for the scientists is to test the properties of the silicon dioxide in a clean room at the new London Center for Nanotechnology, to see if it's suitable for commercial use. They have to figure out things like how much voltage and current the dioxide can withstand before it breaks down, and how often the current can be passed back and forth before they become defective.

"Chip manufacturers tend to be very conservative and reluctant to change the way they do things," Boyd said. "You have to prove beyond all doubt that what you're doing will improve what they already have."

Biology – Blackback Land Crab *(Gecarcinus lateralis)*

Crabs rely on their rigid shell for protection and support. When it comes time for moulting, the crab is effectively without protection and so must quickly compensate. Marine crabs tend to deploy two different strategies to solve the problem. Hermit crabs, for example, make use of ready-made shells when they are looking for a larger home. Other carbs create a temporary exoskeleton by pumping their outer layers full of seawater. But what's a land crab to do?

The newly molted blackback land crab (*Gecarcinus lateralis*) traps air within its gut and squeezes, firming up its entire body.

Besides being the first known example of a gas-powered skeleton, the innovation may have been a key step in the evolution of land-based crustaceans, researchers in the 20 April issue of *Nature* speculated.

"It's kind of like blowing up a balloon inside the body," researcher Ms. Jennifer Taylor said.

She and supervisor, Dr. Kier at the University of North Carolina studied *Gecarcinus lateralis*, which are found in the Caribbean and other tropical regions. They measured the pressure within the crab at various points in the moulting process.

These crabs, whose bodies are about three inches wide, can take up only small amounts of water when they are on moist sediments. So to moult, the crab takes in air, trapping it in a cavity right behind the head. This inflated gut then puts pressure on the hemolymph, the bloodlike fluid within the crab.

Because crabs have an open circulatory system, pressurizing the hemolymph causes expansion throughout the body and provides the stiffness and support the crab needs while the shell hardens.

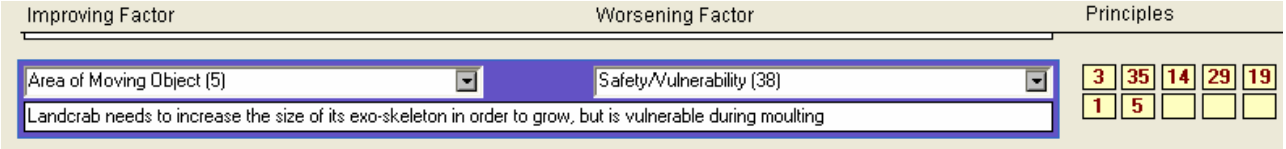
How do the crabs take in the air? The researchers suspect they swallow it, which is what many moulting insects do.

While this pneumo-hydrostatic skeleton (as the researchers call it) provides support, it makes the crab something less than a spring chicken, lacking its normal agility. "The crab's body is designed to work as a rigid system," Ms. Taylor said. During moulting, she

added, "it is less efficient because that same design is being used as a hydrostatic system."

The lack of agility may also be a behavioral response, she said. The more the crab moves, the greater the risk that some deformation will become permanent as the shell hardens.

From a contradiction resolution perspective, the blackback land crab moult represents a resolution of a growth (particular problem being the area of the exo-skeleton – 'area of moving object') versus safety and vulnerability. Here is what Matrix 2003 has to say on the subject:



Good to see that the hydrostatic strategy used by the crab is represented in the Matrix (Principle 29 – Fluids and Pneumatics, and also 5, Merging – with the combined use of air and moisture).

According to the researchers who identified the crab's novel solution, the resolution of the basic moulting conflict has come at the expense of reduced mobility during the transition process. It is not clear from the current understanding of the crab physiology whether this new conflict has been resolved – or whether it needs to be! – but irrespective of this fact, what is interesting from an evolutionary perspective is that as systems solve one conflict, another one will inevitably emerge. This is fundamental to the concept of contradiction-chains, and evolution towards the Ideal Final Result state – each contradiction solved should take us to a net more ideal system than where we started. The fact that the blackback land crab has evolved and maintained the hydrostatic solution would appear to bear out the fact that it is more ideal than other possible solutions.

Short Thort

From an all time classic psychology and ethics text:

"The quest for certainty blocks the search for meaning.
Uncertainty is the very condition to impel man to unfold his powers."
Erich Fromm, 'Man For Himself', 1947

News

Sustainability Conference Paper
We have a paper at the forthcoming Sustainable Innovation 06 conference to be held on 23rd and 24th October at the Stuart Graduate School of Business, Illinois Institute of Technology in Chicago. The conference – the 11th in the series run by the UK Centre for Sustainable design – this year has the theme of global challenges, issues and solutions. We will be presenting a paper describing some of our case studies developed in India and China. We will make the paper available on our website after the conference. Those wanting details of the conference should visit www.cfsd.org.uk.

Istanbul 'Retail Days' Conference
We have been invited to present a paper to the several thousand delegates expected at one of Euope's biggest retail conferences. The event takes place on the 29th and 30th of November.
More details (so far only in Turkish) at http://www.soysal.com.tr/soysal_icerik/1egitim.htm.
The theme of our presentation will be the application of systematic innovation techniques within and around the retail sector. We've been instructed by the conference organisers to take out about 95% of the content we normally expect to present. Don't mention 'innovation', 'method', 'matrix', etc. Just the benefits then. Should be interesting.

Hands-On Systematic Innovation For Business & Management Re-Print
We are around two months away from instructing our printers to re-print the next edition of the HOSI(B) book. One or two readers have suggested their willingness to provide a testimonial to be printed in the book. If there are any e-zine readers out there who would be interested in providing a quotation to feature on the rear cover or flyleaf of the book, we would love to hear from you.

Darrell Disappears…
Darrell will be locked away in a darkened room for half of August, and will not be allowed out until he delivers at least two finished book manuscripts. Apologies in advance if the email and phone response rate is worse than usual.