Updating TRIZ:

2006-2008 Patent Research Findings

Darrell Mann (Systematic Innovation)

Abstract

The paper discusses findings from an ongoing programme of patent research. The primary aim of the research is to distil best practice and update three main knowledge databases; trends of evolution, function and contradictions. The paper summarises some of the key findings from these areas. A particular focus is applied to the contradictions with the detailing of 100 quasi-randomly selected patents included in order to show how the latest Contradiction Matrix tool is being calibrated relative to the original, Classical TRIZ Matrix. In this section we see the current relative effectiveness of the two matrices is 96% and 18% respectively.

1. Introduction

A large part of the strength and power of TRIZ exists because the methodology was built on the substantial foundations provided by the analysis of a very large number of patents. However, around 1985 this analysis was for the most part halted and the research focus was shifted to other important areas. In using some of the TRIZ tools in a world that has become much more ‘electronics’ and software biased in its outlook, it is evident that they are not providing users with as much assistance as they could. A large programme of patent analysis was instigated with this in mind in 2000. The aim of this research was to extend TRIZ to accommodate the changes brought about by the advances that have taken place in business and technology since 1985. This paper presents an update on the research, examining patents granted during the three year period 2006-2008. Around 140,000 patents from the period have been analysed and added to the assorted TRIZ knowledge-bases. The paper describes the form, focus and findings of some of the research. It includes the following sections:

- Level of Invention. All of the patents included in the analysis have been assessed in relation to the five levels of invention specified during the original TRIZ research. The paper reports the shifting dynamics of invention level that has taken place over the last 20 years and specifically the last 3 years.
- Trends of Evolution. In addition to uncovering a number of technology trends that have not previously been observed, the paper reports on the work done to evolve the concepts of evolutionary limits and evolutionary potential, explaining why evolution potential radar plots have been constructed for all of the patents analysed. The radar plots are shown to offer means of not only comparing similar patents, but also to present means of benchmarking technologies against a set of global datum points.
- Contradictions. In this, the longest section of the paper, previously published articles comparing the accuracy of the classical TRIZ Contradiction Matrix and the 2003 version are updated. We review the last three years in general and then focus on patents granted on a randomly selected date (July 8th 2008) to give a cross-calibratable spot-point assessment of how well the contradiction-challenging strategies being used by inventors today compare to the strategies that the two matrices would have recommended.

The paper ends with a short section examining the importance of maintaining an active programme of patent analysis, the need for customisation for different companies and industries, and finally a description of ongoing and planned future work.

2. Contradictions

We shall start with a description of the Contradictions aspect of our knowledge search activities. The way the research is conducted can be indicated by describing how we search patents for conflicts, looking for other information inside each new invention disclosure document examined.

This section represents the third published paper examining the differences between the original Contradiction Matrix of Classical TRIZ (Reference 1) and the 2003 updated version (Reference 2). As in the previous publications (References 3 and 4) we offer a detailed examination of how the two matrices compare by analyzing patents published since the Matrix 2003 book was completed. The aims of this activity are to explore the stability of the new Matrix and to provide quantified data on how well the two matrices predict the Inventive Principles being used by recent inventors. The structure of the work is similar to that reported in a previous piece of work to assess the accuracy of the original Matrix (Reference 4). A full description of the method can be found in that paper. The following points (a summary of the method used) will be helpful to readers of this article:

1) The titles, abstracts and assignees of all patents are given a preliminary assessment by an analyst in order to determine whether it is worth analyzing the patent in greater detail. Around 85-90% of patents get rejected at this stage simply because we don't have sufficient resource to analyse them all. Our aim in applying this filter is to try and identify the Level 3 and higher inventions since these offer the most important information in terms of 'best practice'.
2) For each of the 10-15% of patents we choose to analyse in greater detail, we identify what aspects of a design the inventor was seeking to improve, what parameters these aspects conflicted with, and how the inventor overcame the conflict. Of course, with many inventions the inventor is seeking to overcome a multiplicity of conflicts and contradictions. Rather than try to map all such instances, the analysis here has attempted to identify the one or two most significant aspects of the invention; asking such questions as 'what was the main motivation of the inventor in terms of the thing they wished to improve?' and 'what then was the main thing according to the prior art that prevented that improvement intention from being achieved?'

By way of example, the following is text from one of the patents included in the quasi-random sample of 100 included later in the Appendix:

Image blur is a common problem in photography. Some common causes of blur in a photograph are subject motion, camera motion (shake), and focusing errors. Blur is a particular problem for casual or amateur photographers who may not know how to diagnose the causes of blur or how to change their photographic technique to improve their results. As new consumer camera models are being produced with zoom lenses capable of very long focal lengths, blur due to camera shake is especially troublesome.

Various devices and techniques have been proposed to help address the problem of image blur due to camera shake. For example, Murakoshi (U.S. Pat. No. 4,448,510) uses an accelerometer to detect camera shake, and provides an indication to the user of the camera if the acceleration exceeds a threshold level.

Satoh (U.S. Pat. No. 6,101,332) also senses camera shake, and combines the shake information with other camera parameters to estimate how much image blur might result. A set of light emitting diodes communicates the estimate to the photographer.

Another approach has been to automate the camera operation, and let the camera choose settings that will minimize blur. For example, Bolle et al. (U.S. Pat. No. 6,301,440) applies a variety of image analysis techniques in an attempt to improve several aspects of photographs.

Each of these approaches has its drawbacks. The above techniques may require the addition of expensive electro-mechanical components to a camera, thereby increasing the camera cost. The techniques may address only one potential cause of image blur. The techniques give the camera user little guidance about how to improve her photographs, and in fact, additional automation that reduces the photographer's control of the camera may even add to the mystery of why a particular photograph is blurred.

A solution to the problem of image blur is needed that also addresses these difficulties.

This text represents the complete 'background to the invention' section of US7397500. This section is where we almost always start the search for contradictions. In the large majority of cases this is the section where the inventors provide answers to the two key contradiction finding questions; 'what are we trying to improve?' and 'what is stopping us?' In this particular case the answer to the first question is immediately clear – it is an attempt to reduce image blur. Answering the 'what's stopping us?' question is a little more difficult. On one level the patent states that the previous solutions have all resorted to 'addition of expensive electro-mechanical components'. At this point the decision could be made to try and map these words onto the Matrix by finding the words in the list of parameters that fit best to 'image blur' versus 'addition of expensive electro-mechanical components'. It would most likely be concluded that 'Stability' and 'System Complexity' are the two best matches. In the case of both translations it is necessary to be careful:

'Image blur' – 'Stability'*:* in the original Classical TRIZ Matrix, 'stability' is actually written as 'stability of the object's composition' implying something much more akin to chemical stability. In our research we have consistently taken the much more general interpretation of 'stability' and found few if any negative effects. Main point: in Matrix 2003 – as can be seen from the definitions therein (inertness, deformation, droop, tipping (over), distortion, oxidation, rusting, homogeneity, consistency, de-lamination) - 'stability' is a suitable match for 'image blur'.

'System Complexity': this is one of the most general of the parameters in the Matrix. Before deciding whether to map a particular improving or worsening feature of an invention to this parameter, we always try to drill-down to find a root cause explanation for why the complexity gets worse. The simplest strategy for doing this involves asking the usual root-cause finding 'why?' question. In the case of the US7397500 patent, the answer observed from the invention disclosure text as to why expensive electro-mechanical components are added is that those components exist to detect something that will allow the camera to know that there may be a blur problem. In other words, the deeper level contradiction is between image blur and the ability to detect it. (Note: if we try asking the 'why' question again to dig deeper still into the problem, the answer becomes circular – 'why do we want to detect blur? Answer: we want to detect blur so that that the camera knows there is blur. Once this circularity happens there is no point in digging further.)
It is also worth noting that the words 'ability to detect' never appeared in the invention disclosure. It required some degree of interpretative thinking to reason that this is the essence of the contradiction. This is mentioned to make the point that recent speculation that semantic processor software is 'able to find contradictions' should be treated with a high degree of skepticism. In our experience, semantic processors can at best only give a superficial level understanding of the real story. For this reason, although we have been able to partially automate the patent analysis process with our own semantic tools, there is still a requirement for a human to interpret the intent of the inventors of any given patent.

Returning to the US7397500 patent, we now see that it has been possible to dig one level deeper than 'System Complexity'. The key conflict is thus between image blur ('Stability') and our (in)ability to detect it ('Ability To Detect').

Having identified the main conflict, the next step is to uncover how the inventors resolved it. Our usual method for finding the relevant information typically starts with the 'Summary of Invention' section, then followed by the Claims section, and if that still hasn't given the necessary insight, the Detailed Description section of the disclosure document. As it transpires, the US7397500 patent gave an early clue to the key inventive step made by the inventor in the first sentence of the Summary section of the disclosure:

"A camera creates successive digital images of a scene, and computes a stability measure estimate blur in a final photograph of the scene."

Closer examination reveals that (very elegantly we think) the solution obtains the needed blur indication by using digital image data. The elegance is that it uses information that already exists, at least for a digital camera. As the inventors describe, the key to being able to detect the blur is to look at the changes that occur between successive images rather than just looking at one digital image. The next stage is to try to match this inventive step onto the Inventive Principles. In this case, the most sensible connection is to Principle 37, which in our updated terms is interpreted as 'Relative Change' (this is in addition to its initial Russian 'Thermal Expansion' definition).

In addition, there is a case for saying that the inventors have also used a Principle 28 'Mechanics Substitution' strategy, since by making better use of existing digital information they have eliminated the need for a mechanical shake detection device. As when mapping the conflict onto the 48 Matrix parameters, it is necessary to be careful that we have found the root inventive step. This can be another complex story. The simple strategy we typically begin with involves the question 'given this Inventive Principle as a solution strategy for this problem, would I have generated the solution?'

In this specific case that means the questions are *'would being told to eliminate the mechanical system and replacing it with a field get me to the solution?'* and *'would being told to look at the relative change between two different things get me to the solution'*. For us at least, the second of these two is significantly more likely to be a usable suggestion. As is often the case with Principle 28, simply being told to eliminate your mechanical thing is more likely to produce paralysis than a meaningful direction and productive answer. So is the answer here Principle 37 or Principles 28 and 37? With almost all of these either/or questions we have found another contradiction. The answer is almost always going to be neither, both or, more generally, 'it depends'. In our case, the 'it depends' conflict is separated based on whether we are calibrating or adding to the Contradiction database. In terms of calibrating the Matrix we would interpret this solution as an illustration of Principle 37; whereas in terms of updating the database we are likely to include both Principles 28 and 37.

Again it is important to note here that there is a strong element of human interpretation needed in order to get into the essence of the problem. There also is no current semantic processor technology capable of doing this job with any kind of reliability.

Finally in the Contradiction analysis of the patent, we look up what the Matrix tools currently have to say about the particular conflict being examined:

Patent Number	Short Title	Improving Parameter	Worsening Parameter
US7397500 (HP)	Camera-Shake Warning System	Stability (21)	Ability to Detect (47)

Classical Matrix	Matrix 2003	Inventor Used..
3, 27, 16	7, 24, 17, 35, 9, 37, 32, 28	37

It is important to only do this after the patent has been analysed in order to minimize any distortion that might occur to 'make the data fit the predicted result'. Despite the conscious effort, there is always the potential for issues here. The best strategy we have found is to periodically have one patent analyst cast a critical eye over the analysis conducted by a colleague. Not as 'scientific' as we would ultimately like, but on the other hand, we are also conscious that it is preferable to have 100,000 'good' analyses than 1000 'absolute' ones.

Looking at the comparison table for this particular patent, the Matrix 2003 already includes Principle 37 as a recommendation for the Stability-versus-Ability-To-Detect conflict pair (it also contains Principle 28, the other possible Principle we could have chosen to include). The Classical Matrix, on the other hand, failed to suggest either Principle.

The Appendix at the back of the paper includes this patent plus 99 other patents granted on 8 July. The same analysis strategy and presentation format is used for all 100. We include the data so that readers can conduct their own analysis should they be so interested.

A slightly different selection strategy to the one previously described has been used for these 100 patents. Firstly a quasi- random set of patents from the US patent database were selected. The manner with which the US patent office numbers the patents they grant means that were we to choose a random number of consecutively numbered patents we would likely find that they all fell into the same category (i.e. all semi-conductor-based or all pharmaceutical). However, one of our aims here was to provide a representative microcosm look at what we do when we conduct the research. Our method in selecting a 'random' sample therefore has been to firstly select a random date (which turns out to be July 8th 2008, simply because this was the week we scheduled for writing this paper), then in order to get some kind of spread of patent focus areas, we decided to adopt a scheme of picking every 10th patent. Thirdly, we deliberately decided to start in the electronics domain, this time for the simple reasons that a) there is considerable interest in this domain within Japan, and b) not insignificantly, that we had a particular wish to overcome the frequent criticism that TRIZ 'is mainly for mechanical systems'. It is important to note that this strategy is merely the one used to identify the patents to include in the Appendix, not the usual strategy described earlier in the paper.

For the 100 patents included in the Appendix, the following results were obtained:

Matrix 2003 - 96%
Classical Matrix - 18%

These numbers reflect how many of the Inventive Principles illustrations present in the 100 patents were predicted by the Matrix tool. The Classical Matrix performed slightly worse than on average because the sample was strongly biased towards electronics and software-based inventions, so in many situations, the Matrix doesn't even have an entry for certain parameters (e.g. for problem involving parameters like 'noise', 'compatibility' and 'security'). The 96% score achieved by Matrix 2003 is, conversely, slightly higher than the expected average. Figure 1 illustrates the equivalent % scores for the two Matrix tools across different industry disciplines for the last three and a half years when we shift our focus to the full range of patents we have analysed:

	2005 (classic)	2006 (classic)	2007 (classic)	2008 (classic)
Mechanical	44	41	38	36
Electronics	26	23	22	20
Chem/Pharm	25	24	24	24
ICT	22	21	19	15
Overall Average	27	26	24	21

	2005 (M2003)	2006 (M2003)	2007 (M2003)	2008 (M2003)
Mechanical	96	96	96	95
Electronics	94	94	93	93
Chem/Pharm	95	95	93	91
ICT	94	92	90	89
Overall Average	95	94	93	91

Figure 1: Summary Of Matrix Accuracy Across Different Industry Disciplines

One of the reasons for the discrepancies between the results obtained from the 100 patents reproduced in the Appendix and these averages is that in the random sample there has been no filtering out of the 'weak' solutions that would normally be filtered during our initial sort of patents. However, looking at the assignees for the selected patents reveals that the large majority are owned by major corporations. For that reason alone the quality of the patents is superior to a global average. The reason why we have more than the average of major corporation inventions is an unplanned result of the choice we made to focus on electronics and IT patents.

Only two out of the 100 patents would appear to meet the criteria needed to describe a Level 3 invention; the large majority being Level 2 solutions. Again, under normal circumstances we would expect to filter out many Level 2 and nearly all Level 1 inventions. Which now brings us to a brief discussion on invention Levels in general:

3. Level of Invention

As reported in Reference 3, as a matter of course, we make an assessment of patent Level for every patent we look at, whether in great detail or superficially. What continues to be clear from doing this kind of analysis is that Altshuller's initial definitions of what constitutes Level 1, 2, 3, etc becomes less and less credible with time. This is certainly true in terms of the Level 3 test relating to whether inventors looked outside their company or industry. Nevertheless, Figure 2 illustrates our latest findings.

Strictly speaking it is almost impossible for us to cross-calibrate our data with that of Altshuller. However, it is legitimate to look at shifts that have taken place since we started the research. What Figure 2 shows in this regard is that we are seeing a rising percentage of Level 2 inventions and a corresponding reduction in Level 3 and 4 inventions. At this point in time we have no solid understanding or explanation for this trend. Anecdotally, our working hypothesis is that many industries are presently passing through a period of consolidation in which the primary objective is to 'own the incremental jumps' rather than seeking out the major leaps. Scientifically, we have insufficient evidence to make a satisfactory proof…

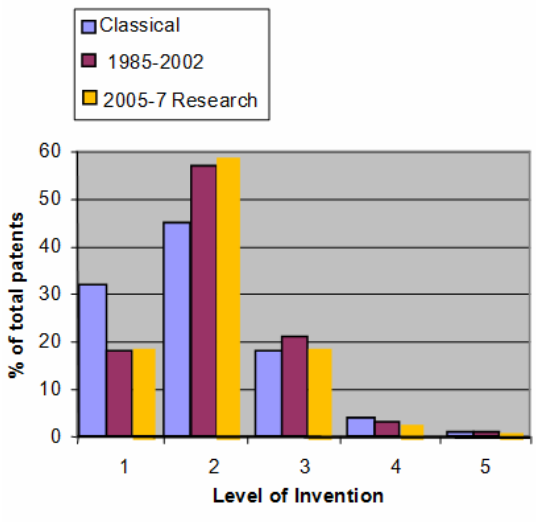


Figure 2: Shifting Pattern Of Invention Level Distribution Over Time

4. Trends of Evolution

One of the reasons we hold the consolidation period view is that our research on the discontinuous technology evolution Trends. Part of the method appears to be hitting a plateau in terms of uncovering new patterns and new stages at the end of existing patents. Were we to re-invent the Levels of Invention scale, we would likely as not relate the level of a given invention to how many and which jumps are made along the known trends. The only reason we haven't made such a switch is that we have not yet found a truly generic way of classifying which trends are more important than others. A jump along one trend in one industry can create a major breakthrough; while the same jump in another sector can elicit a 'so-what', Level 1, kind of reaction.

In the last three years the Trends story has not been completely static. The main additions to the Trends database have been:

a) Revisions to the 'Damping' Trend (Reference 5)
b) New 'Nesting' Trends (Reference 6)
c) Revisions to the 'Rhythm Co-ordination' Trend (Reference 7)

d) New 'Design For Sustainability' Trend (Reference 8)
e) New 'Customer Intangibles' Trend (Reference 9)

All of these trends have now been incorporated into our Evolution Potential radar-plot structure. The main value we continue to obtain by constructing evolution potential radar plots for each of the patents we analyse relates to the innovation timing question (Reference 10). Particularly in industries and technologies where the end consumer is only indirectly connected, it seems very clear that the historical rate of evolution (defined in terms of 'discontinuous jumps per year') is *the* dominant timing factor – Figure 3.

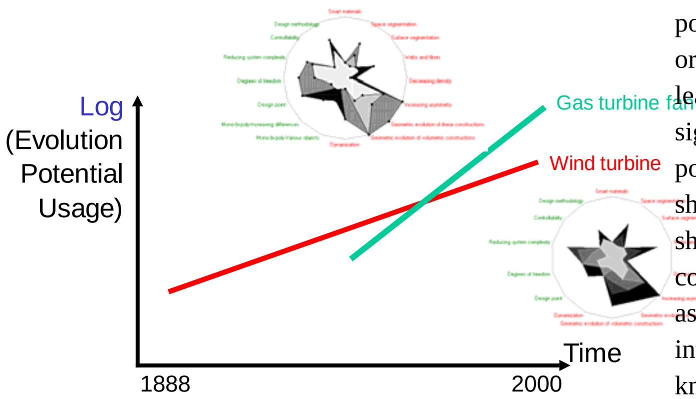


Figure 3: Discontinuities-Per-Year Helps Answer Innovation Timing Questions Into The Future

At one level, the discovery of new Trends is sufficient justification for continuing with our patent research programme. The main driver for this and all the other research has always centred around the idea that we learn more from anomaly than we do from similarity. The main outcome that emerges from this driver is that we are always looking to dis-prove rather than confirm what we know so far.

A good example of a result emerging from this 'anomaly-is-the-key' philosophy is the recognition that the biggest single factor causing the Contradiction Matrix accuracy to fall between 2005 and the present day is the increasing number of nano-scale inventions that have solved conflicts using strategies different to the ones recommended by either Matrix. Reference 11, for example, shows a good example of a potentially important, Level 4, nano-scale patent that has not used the strategies suggested by the Matrix.

Although we haven't found any without sufficient data to yet call them 'generically applicable', we also have cause to believe that there are a number of different trend patterns that are present at the nano-scale that are not present in our macro-level world. In order to gain a clearer understanding of both issues, we are presently sponsoring two PhD research programmes aimed specifically at reverse engineering best-practice nano-scale innovation strategies.

One of the additional drivers for this nano-scale research comes from organizations wishing to have their own specific in-company version of the TRIZ tools. There are several reasons why this seems like an important future direction for TRIZ. Firstly, since the tools are inherently generic, the distance between generic solution and specific solution is often considerable. By making an in-house version of the tools, it becomes possible to create and populate databases of relevant in-domain examples in order to help users more easily make the generic-specific leap. The second reason – and probably the more significant of the two – is that organizations inevitably possess proprietary information that they do not wish to share outside the organization, but which they do wish to share more easily within. The TRIZ function, trend and contradiction databases are increasingly being recognized as a very effective way of storing and allowing others to internally store, communicate and access this best practice knowledge.

For clients where we assist in this knowledge management task, we are typically building bespoke tools that are updated on a continuous basis. These activities are outside the public domain. What we have always stated regarding the publicly available generic tools is that when the overall average accuracy of, say, the Contradiction Matrix tool drops below 90% we will re-issue new versions. As shown by the results in Figure 1, we are not quite at that point yet. If the present trend continues, however, then we should anticipate a re-issue of an updated Matrix in 2009.

References

[1] www.triz-journal.com Contradiction Matrix.
[2] Mann, D.L., Dewulf, S., Zlotin, B., Zusman, A., 'Matrix 2003: Updating The TRIZ Contradiction Matrix', CREAX Press, July 2003.
[3] Mann, D.L., 'Assessing The Accuracy Of The Contradiction Matrix For Recent Mechanical Inventions', TRIZ Journal, February 2002.
[4] Mann, D.L., 'Comparing The Classical and New Contradiction Matrix Part 2- Zooming In', TRIZ Journal, July 2004.
[5] Systematic Innovation E-Zine, 'Revisions To The 'Damping' Trend', Issue 50, May 2006.

[6] Systematic Innovation E-Zine, 'New Trends – 'Nest-Up' And 'Nest-Down'', Issue 51, June 2006.
[7] Systematic Innovation E-Zine, 'Revising The Rhythm Co-ordination Trend', Issue 71, February 2008.
[8] Systematic Innovation E-Zine, 'Sustainability: Discontinuous Trend Pattern', Issue 72, March 2008.
[9] Systematic Innovation E-Zine, 'New Trend: Customer Intangibles', Issue 77, August 2008.
[10] Mann, D.L., 'More On Innovation Timing: Discontinuity Rate', TRIZ Journal, March 2006.
[11] Systematic Innovation E-Zine, 'Patent of the Month – Ultra-High Pressure Generation', Issue 71, February 2008.

5. Appendix

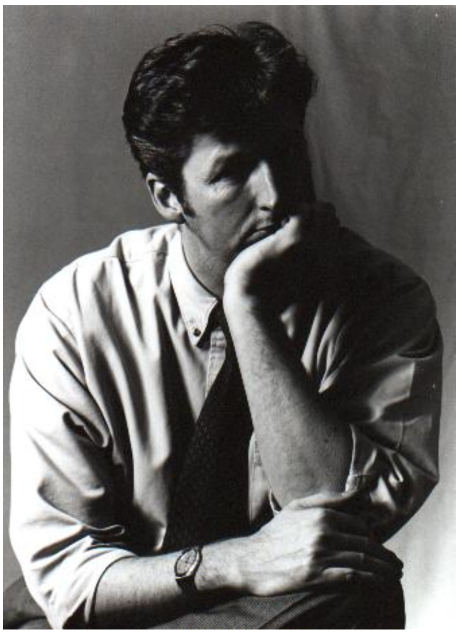
The following table summarises the analyses for each of the 100 patents considered during the investigation. In order to ensure consistency of analysis across each patent, this author has monitored each one individually. The table provides patent number, title, improving parameter(s), worsening parameter(s) (both using the numbering convention of the new Matrix – Figure 1), Inventive Principles recommended by the classic Matrix, and Inventive Principles used by the inventor. Anyone wishing to see the specific analysis for any of the patents in question may request a copy from the author. Alternatively, you may like to conduct a few analyses for yourself to see if you agree with the diagnoses presented here.

The new Matrix contains several parameters that are not featured in the classical Matrix. The Inventive Principle suggestions obtained from the original matrix for problems relating to the new parameters (noise, emissions, safety, security, etc) come from the nearest match of parameters in the original list of 39. Where there is no direct match between the conflict challenged by an inventor and the original matrix, the Inventive Principle suggestions are shown in parentheses. A '-' in the original Matrix recommendations column means that that box contained no recommendations.

Presenter's Profile: Darrell L Mann

Darrell is a mechanical engineer by background, having spent 15 years working at Rolls-Royce in various R&D related positions, and ultimately becoming responsible for the company's long term future helicopter engine strategy. He left the company in 1996 to first help set up a high technology company before entering a programme of systematic innovation research at the University of Bath. He first started using TRIZ in 1992, and by the time he left Rolls-Royce had generated over a dozen patents and patent applications. In 1998 he started teaching systematic innovation methods to both technical and business audiences, and to date has given courses to over 3000 delegates across a broad spectrum of industries and disciplines. He continues to actively use TRIZ in addition to teaching and researching, setting up an IPR-based company in 1997 which currently has over 200 patentable inventions at various stages of exploitation, and consulting regularly with companies around the world to solve problems or help exploit new opportunities. With over 600 systematic innovation-related papers and articles to his name, Darrell is now one of the most widely published authors on the subject in the world. He is a director of Systematic Innovation Ltd, a UK based innovation company with offices and affiliates in India, Malaysia, Korea, China, Japan, Denmark and Austria.

His consulting clients include Infosys, Intel, Hewlett Packard, Procter & Gamble, General Motors, Nestle, Mahindra & Mahindra, MindTree, Telekom Malaysia, Hong Kong government and, through EU-supported research and dissemination programmes, a wide roster of SME organisations. His work involves a spectrum of applications from strategy development to IP creation to problem solving in both technical and non-technical areas.



Averaging around 25 days per month on the road, Darrell has an average velocity of 40km/h and an average altitude of around 30metres.

Here are the summarized analyses for the 100 sample patents:-

Patent Number	Short Title	Improving Parameter	Worsening Parameter	Classical Matrix	New Matrix	Inventor Used..
US7397500 (HP)	Camera-Shake Warning System	Stability (21)	Ability to Detect (47)	3, 27, 16	7, 24, 17, 35, 9, 37, 32, 28	37
US7397510 (Canon)	Automatic Focus Adjustment Method	Stability (21)	Duration Of Action (Moving) (12)	13, 27, 10, 35	10, 13, 5, 35, 4, 19, 7, 40	10
US7397520 (Seiko)	Electro-Optical Device	Reliability (35)	Length (Moving) Object (3)	15, 9, 14, 4	14, 17, 15, 4, 35, 9, 40, 3	35, 40
US7397530 (Polydisplay)	Liquid Crystal Encapsulation Method	Manf. Precision (42)	Duration Action (Moving) (12)	3, 27, 40	5, 40, 16, 3, 20, 19	5, 16
US7397540 (Boeing)	Phase Diversity Ranging Sensor	Measure' Precision (48)	Power (18)	3, 6, 32	3, 5, 10, 24, 13, 28	24, 13, 3
US7397550 (-)	Parts Manipulation/ Inspection System	Measure' Precision (48)	Temp (22) Illumination Intensity (23)	6, 19, 1, 28, 24, 32	24, 6, 32, 10, 2, 28, 1, 35, 19	2, 1, 19
US7397560 (Agilent)	Surface Contamination Detection	Ability To Measure (47)	Reliability (35)	27, 40, 28, 8	28, 1, 40, 26, 35, 2..	28, 40
US7397570 (Mitutoyo)	Interferometer & Shape Measurement	Ability To Measure (47)	Shape (9)	27, 13, 1, 39	13, 28, 3, 1, 17, 26, 39, 24, 4	1, 19
US7397580 (Seiko)	Ejection Control Of Ink	Duration Of Action (Moving) (12)	Manufacture Consistency (42)	3, 27, 16, 40	3, 16, 40, 10, 37, 12, 25	16, 10, 37
US7397590 (Canon)	Optical Scanning Apparatus	Length (Stationary) (4)	Temperature (22)	3, 35, 38, 18	35, 36, 10, 24, 32, 3, 15, 17	15
US7397600 (DULY)	Laser Pulse Multiplier	Duration Of Action (Moving) (12)	Power (18)	19, 10, 35, 38	19, 18, 35, 10, 38, 13, 12	19, 10, 12
US7397610 (Canon)	Zoom-Lens & Projection Apparatus	Brightness Consistency (23, 42)	Volume (Moving) Complexity (7, 45)	13, 2, 32 10, 23, 26, 18	13, 2, 28, 18, 24, 25, 4, 5…	2, 13
US7397620 (Canon)	Image-Reading Apparatus	Length (Stationary) (4)	Loss Of Information (28)	24, 26	28, 24, 13, 3, 26, 14, 15, 17	3, 14
US7397630 (Fujitsu)	Signal Reproducing Method	Duration Of Action (Moving) (12)	Stability, Ability to Detect (21, 47)	13, 3, 35, 19, 29, 39	35, 19, 10, 24, 37, 40, 4…	35, 37
US7397640 (Hitachi)	Improved Read Sensors	Function Efficiency (24)	Stability (21)	-	35, 2, 19, 30, 9, 17...	35
US7397650 (Nisshinbo)	Electric Double-Layer Capacitor	-	-	-	-	No contradictio n identified
US7397660 (Dell)	Apparatus For Regulating Airflow	Amount of Substance (10)	Adaptability (32)	15, 3, 29	1, 15, 17, 29,24, 3	15
US7397670 (Zippy Tech)	Power Supply Device	Power (18)	Length (Stationary) (4)	-	17, 14, 1, 35, 4..	1

US7397680 (Power Integrations)	Balancing Capacitor Leakage Current	Power (18)	Adaptability (32)	19, 17, 34	15, 28, 19, 35, 3, 34, 17, 37, 12	15, 37
US7397690 (Ternary-logic)	Digital Information Retaining Elements	Speed (14)	Amount Of Information (11)	-	7, 2, 10, 5, 37, 28, 3	5
US7397700 (STMicro-electronics)	Non-Volatile Memory Device	Speed (14)	Adaptability (32)	15, 10, 26	15, 10, 28, 26, 1, 30, 35	1
US7397710 (NEC)	Voltage Level Control Circuit & Memory Device	Power (18)	Adaptability (32)	19, 17, 34	15, 28, 19, 35, 3, 34, 17, 37, 12	37, 15
US7397720 (Matsushita)	Semi-conductor Storage Device	Amount Of Substance (10)	Power (18)	35	35, 19, 18, 3, 12, 5, 2	19
US7397730 (Novo Nordisk)	Device With Time Indicating Means	Ease Of Use (34)	System Complexity (45)	32, 26, 12, 17	28, 29, 5, 12, 32, 17, 26	5
US7397740 (Mediatek)	Optical Disc Recording Device	Adaptability (32)	Duration Of Action (Moving) (12)	13, 1, 35	28, 29, 35, 13, 1, 24, 19, 12	23 (WEAK SOLUTIO N)
US7397750 (TEAC)	Optical Disc Apparatus	Power (18)	Adaptability (32)	19, 17, 34	15, 28, 19, 35, 3, 34,17, 37, 12	3, 37
US7397760 (Fujitsu)	Transmission Apparatus	Function Efficiency (24)	Loss Of Information (28)	-	3, 4, 19, 15, 32, 17..	3
US7397770 (IBM)	Checking & Repairing A Network Configuration	Repair-ability (36)	Compatibility (33)	-	2, 10, 13, 4, 17, 24	10
US7397780 (Qualcomm)	Method For Overlaying 2 CDMA Systems	Compat-ibility (33)	System Complexity (45)	-	28, 24, 13, 12, 5, 17, 4	24
US7397790 (Interdigital)	Packet Switched Connections	Security (37)	Function Efficiency (24)	-	2, 1, 17, 3, 10, 25	1, 25
US7397800 (Broadcom)	Displacement Of Out-Of Order TCP Segments	Speed (14)	Loss Of Information (28)	13, 26	10, 7, 6, 24, 26, 37, 3	10, 24
US7397810 (Rockwell Collins)	Artery Nodes	Function Efficiency (24)	Compatibility (33)	-	1, 4, 14, 7, 2, 24	7
US7397820 (Ericsson)	Voice Packets In IP Network	Compat-ibility (33)	Adaptability (32)	-	28, 10, 24, 6, 15, 7	7
US7397830 (Matsushita)	Semi-conductor Laser Device	Temper-ature (22)	Power (18)	2, 14, 17, 25	31, 3, 2, 17, 25, 35, 1, 14	2, 35
US7397840 (Aerospace Corp)	Spread Spectrum Communic-ation System	Loss Of Information (28)	Compatibility (33)	-	2, 24, 37, 4, 1, 13	1
US7397850 (-)	Reciprocal Index Look-Up	Control Complexity (46)	Ability To Detect (47)	-	13, 37, 10, 7, 3, 28..	10, 13
US7397860 (Brooktree)	Fractional Load-Peak Detection	Power (18)	Amount Of Information (11)	-	10, 28, 19, 12, 24, 37	10
US7397870 (Texas Instruments)	Ultra-Wideband Receiver	Power (18)	Measure-ment Precision (48)	32, 15, 2	2, 37, 15, 25, 10, 32	25, 37

US7397880 (Renesas)	Synchroniz-ation Circuit & Method	Stability (21)	Duration Of Action (Moving) (12)	13, 27, 10, 35	10, 13, 5, 35, 4, 19, 7, 40	10, 5, 19
US7397890 (Xoran)	CT System With Synthetic View Generation	Ability to Detect (47)	Angle (Moving) (3)	16, 17, 26, 24	26, 24, 28, 5, 17, 3, 37,16..	5, 17
US7397900 (Euratom)	Micro-Beam Collimator	Area (Stationary) (6)	Loss Of Energy (27)	17, 7, 30	17, 12, 30, 35, 7, 28, 26	35, 30
US7397910 (Callwave)	Expanded Telecommun-ications Service	-	-	-	-	No real contradictio n & weak solution
US7397920 (Sony)	Information Processing Device	Noise (29)	Connectivity (33)	-	2, 35, 9, 17, 28, 3	37, 2
US7397930 (Canon)	Position & Orientation Estimating Method	Measure-ment Precision (48)	Loss Of Information (28)	-	24, 7, 25, 37, 1, 6	37, 7, 25
US7397940 (ASML)	Object Positioning Method	Measure-ment Precision (48)	Manufacture Precision (42)	-	28, 26, 24, 23, 25, 1	24, 23
US7397950 (Microsoft)	Handwriting Layout Analysis	Loss Of Information (28)	Adaptability (32)	-	24, 5, 25, 9, 40, 35, 19	19
US7397960 (Konica Minolta)	Compression Of Document Image	Amount Of Information (11)	Adaptability (32)	-	3, 24, 4, 1, 29, 25, 31	3
US7397970 (Lockheed Martin)	Automatic Scene Correlation	Accuracy (6)	Amount Of Data (3)	-	17, 19, 3, 13, 1, 14 (IT Matrix)	3, 17
US7397980 (Optium)	Dual-Source Optical Wavelength Processor	Automation (43)	Adaptability (32)	27, 4, 1, 35	28, 1, 29, 10, 12, 4..	1
US7397990 (Emtelle)	Signal Transmitting Cable	Strength (20)	Area (Moving) (5)	3, 34, 40, 25	14, 17, 3, 7, 19, 4, 40, 5	3,17, 40
US7398000 (Microsoft)	Digital Video Segment Identification	Loss Of Information (28)	Ability to Detect (47)	35, 33	28, 32, 1, 10, 37, 7	10, 37
US7398010 (Pioneer)	Information Recording Medium	Amount of Data (3)	Speed (5)	-	15, 17, 4, 14, 1, 3.. (IT Matrix)	1
US7398020 (Samsung)	Multi-Point Gating Control Block	-	-	-	-	Adminis-trative Contra-diction only
US7398030 (Canon)	Image Forming Apparatus	Loss Of Substance (25)	Speed (14)	10, 13, 28, 38	28, 19, 13, 25, 10, 38, 3, 24	10, 3
US7398040 (Canon)	Developing Apparatus	Manuf'ture Consistency (42)	Force (15)	28, 19, 34, 36	12, 19, 28, 29, 3, 10..	28
US7398050 (Delphi)	Processing Air-borne Digital Data	Robustness (15)	Dynamic Size (2)	-	9, 13, 28, 1, 35, 40, 18 (IT Matrix)	1
US7398060	Method	Compat-ibility	Power/	-	6, 35, 29,	10, 24

(Avago)	Facilitating Inter-Mode Handoff	(33)	Stability (18, 21)		24, 25, 33, 28, 27, 12, 3, 16, 10, 2	
US7398070 (Alps)	Variable Gain Amplifying Circuit	Automation (43)	Loss Of Energy (27)	23, 28	28, 21, 3, 13, 34, 24	23, 24
US7398080 (Nokia)	Mobile Content Delivery System	Loss Of Time (26)	Amount Of Information (11)	-	2, 3, 10, 25, 5, 7	3
US7398090 (HP)	Defining A Smart Area	Ability to Detect (47)	Amount Of Information (11)	-	19, 3, 32, 7, 10, 13, 25, 4	25, 3
US7398100 (Motorola)	Controlling Transmission Power	Power (18)	Ability to Detect (47)	19, 35, 16	28, 35, 19, 3, 16, 32, 37, 25, 2	37
US7398110 (Intel)	Bandwidth Indicator	Amount Of Information (11)	Ability to Detect (47)	-	3, 4, 37, 25, 40, 2	3
US7398120 (Siemens)	Analysis Of Neuronal Activities	-	-	-	-	No Contra-diction Present
US7398130 (Hitachi)	Order Receiving System	-	-	-	-	No Contra-diction Identified
US7398140 (Wabtec)	Locomotive Operator Warning System	Robustness (35)	Amount Of Information (11)	-	10, 24, 32, 3, 25, 5, 2	24
US7398150 (Honda)	Calculating Work Done By IC Engine	Measure-ment Precision (48)	Noise (29)	-	9, 24, 2, 37, 25, 7, 13	37, 24
US7398160 (Southwest Research)	Gas Energy Meter	System Complexity (45)	Measure-ment Precision (48)	2, 26, 10, 34	28, 26, 10, 2, 34, 7, 37	28, 26
US7398170 (GE)	Transmitting Dynamic Data	Amount Of Information (11)	System Generated Harmful (31)	-	2, 10, 13, 17, 31, 28, 32	10
US7398180 (Daimler)	Technician Time-Clock Tool	-	-	-	-	No Contra-diction Present
US7398190 (Toshiba)	Linking Dynamic & Kinematic Simulations	Compat-ibility (33)	Amount Of Information (11)	-	10, 24, 3, 2, 37, 6	10, 24
US7398200 (Adobe)	Token Stream Differencing	Ability to Detect (47)	Control Complexity (46)	-	28, 32, 37, 3, 7, 10, 6, 24	7
US7398210 (Microsoft)	Analysis Of Word Variants	Measure-ment Precision (48)	Amount Of Information (11)	-	25, 2, 7, 32, 4, 3, 37, 10	7, 10
US7398220 (Certificate Exchange)	Internet Insurance Certificate Scheme	Duration Of Action (Stationary) (13)	System Complexity (45)	-	5, 10, 2, 25, 4, 17, 14	5
US7398230 (AT&T)	Automated Sales Support Device	-	-	-	-	Administrat ive Contradicti on Only
US7398240 (Accenture)	Future Value Analytics	-	-	-	-	Administrat ive Contradicti on Only

US7398250 (Microsoft)	Restricting The Usage Of Payment Accounts	-	-	-	-	Administrative Contradiction Only
US7398260 (Fiske)	Effector Machine Computation	-	-	-	-	Administrative Contradiction Only
US7398270 (-)	Clustering Optimization	-	-	-	-	Administrative Contradiction Only
US7398280 (Altera)	Manufacturing Integrated Circuits With Multiple Subcontractor	-	-	-	-	Administrative Contradiction Only
US7398290 (FujiXerox)	Device Retrieval System	Measure-ment Precision (48)	Amount Of Information (11)	-	10, 24, 3, 2, 37, 6	37, 3
US7398300 (Broadcom)	One-Shot RDMA Having A 2-Bit State	Control Complexity (46)	Connectivity (33)	-	6, 10, 13, 1, 2, 24	1, 24
US7398310 (Cisco)	Entity Tracking In A Network	Security (37)	Adaptability (32)	-	24, 35, 3, 1, 13, 28, 4, 15, 17, 29	24
US7398320 (Fujitsu)	Information Distribution/ Reproduction Control Apparatus	Amount Of Information (11)	Control Complexity (46)	-	25, 40, 10, 3, 7, 2, 4, 5	5, 7
US7398330 (Hitachi)	Command multiplex number monitoring control scheme	Amount Of Information (11)	Control Complexity (46)	-	25, 40, 10, 3, 7, 2, 4, 5	2, 7
US7398340 (STMicro-electronics)	Management Of Peripherals In Integrated Circuit	-	-	-	-	Administrative Contradiction Only
US7398350 (Symantec)	Distribution Of Data Volume Virtualization	-	-	-	-	Insufficient description to ascertain conflicts
US7398360 (Sun)	Multi-Socket SMP System For CMT Processors	Amount Of Information (11)	Speed (14)	-	10, 7, 13, 37, 3, 28, 12, 5	7
US7398370 (Toshiba)	Information Processing Apparatus	Adaptability (32)	Compatibility (33)	-	1, 5, 3, 28, 2, 25, 13	5
US7398380 (Fabric7)	Dynamic Hardware Partitioning	-	-	-	-	Administrative Contradiction Only
US7398390 (HP)	Method For Securing A Computer	Security (37)	Connectivity (33)	-	15, 17, 24, 4, 6, 37, 1	24
US7398400 (Qinetiq)	Computer System Protection	-	-	-	-	Administrative Contradiction Only
US7398410 (Tsing Hua University)	Processor Employing A Power Managing	Power (18)	Ability to Detect (47)	19, 35, 16	28, 35, 19, 3, 16, 32, 37, 25, 2	2

	Mechanism					
US7398420 (Hitachi)	Method For Keeping Snapshot Image	Loss Of Information (28)	Amount Of Information (11)	-	2, 7, 24, 3, 32, 5	2
US7398430 (Microsoft)	Self-Diagnosing System Crashes	Ability to Detect (47)	Amount Of Information (11)	-	19, 3, 32, 7, 10, 13, 25, 4	10, 7, 25
US7398440 (STMicro-electronics)	Tap Multiplexer	Ability to Detect (47)	Compatibility (33)	-	25, 1, 13, 15, 35, 28	1, 15
US7398450 (Mitsubishi)	Parallel Pre-Coder Circuit	Speed (14)	Control Complexity (46)	-	25, 10, 19, 1, 4, 3	1, 37
US7398460 (Network Appliance)	Organising and Distributing Parity Blocks	Loss Of Information (28)	Robustness (35)	10, 28, 23	13, 24, 10, 26, 6, 4, 3, 40, 17	1, 17
US7398470 (Vistaprint)	Remote Assistance Method	-	-	-	-	Administrat ive Contradicti on Only
US7398480 (Microsoft)	Method Of Providing Multiple Installation Actions	Ease Of Use (34)	Amount Of Information (11)	-	1, 7, 2, 10, 4, 17, 32	1
US7398490 (-)	Digital Circuit Layout Techniques	Ability to Detect (47)	Manufactur-ability (41)	5, 28, 11,29	5, 28, 37, 11, 2, 13, 29, 24	2