Comparing The Classical and New Contradiction Matrix
Part 2 - Zooming In

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Introduction

This article represents the second of a pair examining the differences between the original Contradiction Matrix of Classical TRIZ (Reference 1) and the 2003 updated version (Reference 2). In this second article, we describe a detailed examination of how the two matrices compare when we analyze patents published since the Matrix 2003 book was completed. The aims 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.

Method

In keeping with the desire to explore the stability of the new Matrix, it was decided that we needed to make a detailed analysis of patents issued since the publication of the Matrix 2003 book. There are, of course, many published case studies that we could have used as the basis for comparing the original and new matrices. The problem with all of them however, is that their publication date precedes that of the new Matrix, and hence may not be viewed as a fair test. The study reported here, therefore, is based on patents published only after July 2003. 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 3). A full description of the method can be found in that article. By way of a summary of the method used, the following points will be helpful to readers of this article:

1) a random set of patents from the US patent database has been selected. The only significant selection criterion used has been that the patents should describe an invention that is 'interesting' in some form or other – this usually meant a solution featuring some kind of 'wow' moment as per the previous, Reference 3, method. Although not a strict definition, this selection criterion effectively meant finding and using mainly Level 3 or 4 inventions as per the original TRIZ definitions. This author made all of the selections in order to ensure consistency. For those familiar with the CREAX newsletter 'patent of the month' feature, it was often candidates for this title that were identified and used. Of course, because the patents are so new there has been no means of relating the strength of any given invention to the financial or business success that it offers to the assignees. It is also worth noting that we have tried to select inventions spanning as broad a range of industries as possible. Specifically this has meant searching out interesting patents from materials, electronics/electrical, chemical/pharmaceutical, software, aerospace and fast moving consumer goods.

2) For each patent, we have identified what aspects of a design the inventor was seeking to improve, what parameters these aspects conflicted with, and how the inventor overcame the conflict. With many inventions, of course, 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 the text from one of the patents analysed:

It is therefore an object of the invention to provide a circuit for driving a laser diode.

It is also an object of the invention to provide a circuit for driving a laser diode which is highly efficient.

It is another object of the invention to provide a circuit for driving a laser diode which has low RF radiation emission.

It is still another object of the invention to provide a circuit for driving a laser diode which is low in cost.

It is yet another object of the invention to provide a circuit for driving a laser diode which has fewer components than conventional circuits.

It is also an object of the invention to provide a circuit for driving a laser diode which does not need to be certified by the FCC.

It is another object of the invention to provide a circuit for driving a laser diode which can be mounted very close to the laser diode.

In this disclosure (actually US6674774, the 99th analysis in the following table of results), we can see that there are several motivating factors behind the invention. In cases like these, the analysis has constructed a hierarchy of factors in order to identify the most significant ones. Thus, in this case, the poor energy usage of the laser generates poor efficiency, which in turn generates heat, which then means that heat management devices have to be fitted and fitting position is restricted, so the cost and complexity goes up. Hence, if the energy usage problem is solved, all of the other problems are also likely to be solved.

With regard to the distillation of Inventive Principles used by an inventor, we have focused on those Principles used to solve the main identified conflict pair. The inventor may have used other Principles to solve other conflicts present in a design, but these have not been recorded here.

Results

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.

1. Weight of moving object
2. Weight of stationary object
3. Length of moving object
4. Length of stationary object
5. Area of moving object
6. Area of stationary object
7. Volume of moving object
8. Volume of stationary object
9. Shape
10. Amount of Substance
11. Amount of Information
12. Duration of action - moving object
13. Duration of action - stationary object
14. Speed
15. Force/Torque
16. Use of energy by moving object
17. Use of energy by stationary object
18. Power
19. Stress/Pressure
20. Strength
21. Stability
22. Temperature
23. Illumination Intensity
24. Function Efficiency
25. Loss of Substance
26. Loss of Time
27. Loss of Energy
28. Loss of Information
29. Noise
30. Harmful Emissions
31. Object Generated Side Effects
32. Adaptability/Versatility
33. Compatibility/Connectability
34. Ease of Operation
35. Reliability
36. Repairability
37. Security
38. Safety/Vulnerabilty
39. Aesthetics
40. Object affected harmful effects
41. Manufacturability
42. Accuracy of manufacturing
43. Automation
44. Productivity
45. System Complexity
46. Device Complexity
47. Ability to Detect/Measure
48. Measurement Precision

Figure 1: 48 Parameters Featured in Matrix 2003

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

Patent Number	Short Title	Improving Parameter	Worsening Parameter	Classical Matrix	New Matrix	Inventor Used..
US6680961	Curved Waveguide Ring Laser	25	31	10, 1, 34, 29	3, 1, 15, 14, 29, 13, 12, 9	14
US6686564	Food preparation device with smart spring	31	15	35, 28, 1, 40	28, 35, 15, 29, 40, 1, 3, 4	35
US6685962	Gastroretentive controlled release pharmaceutical dosage forms	12	5, 15	3, 17, 19, 2, 16	19, 17, 2, 7, 16, 13, 8, 9, 24, 15	2, 7, 15
US6677073	Non-woven fiber webs	6	41	40, 16	16, 17, 40, 13, 10, 5, 36, 32	10, 5, 17, 40

US6616091	Cable Winding Drum	15	35	3, 35, 13, 21	14, 35, 1, 13, 24, 3, 40	1, 24, 14
US6669134	Take up guide tensioning system	41	15	35, 12	35, 12, 28, 29, 1, 10, 3, 13, 2	10, 3
US6664520	Thermal seat	22	13	19, 18, 36, 40	19, 36, 40, 3, 9, 1	36, 1
US6700055	Self tracking, wide angle, solar concentrators	17	3	-	17, 4, 12, 3, 24, 14	24, 17
US6666666	Multi-chamber positive displacement fluid device	7	5	1, 7 ,4, 17	17, 4, 7, 1, 31, 5…	17, 1
US6682757	Titratable dosage TDD	24	34	(4, 28, 10, 34)	25, 10, 1, 13, 3	1
US6626874	Anticoagulant internally coated needle	31	48	3, 33, 26	4, 17, 26, 10, 37, 34, 24	1, 34, 24
US6654340	Differential OFDM using multiple receiver antennas	47	44	35, 18	2, 28, 10, 35, 25, 5, 18, 26, 37	5
US6674744	Point-to-point data transport over the Internet	14	31	2, 24, 35, 21	35, 21, 2, 24, 33, 28, 11, 16, 34	2
US6663994	Fuel cell graphite foam	24	6	(10, 35, 17, 4)	14, 17, 4, 3, 7, 28, 26	14, 4
US6593017	Hydrogen storage material	2	6	35, 30, 13, 2	17, 14, 3, 35, 30, 4, 9, 40, 13	40
US6587770	Weight estimation method	48	40	28, 24, 22, 26	28, 24, 26, 22, 2, 13, 35…	5, 35
US6701944	Detergent dispenser system	7	5	1, 7 ,4, 17	17, 4, 7, 1, 31, 5…	17, 4
US6703005	Production of a deodorant product	44	22	35, 21, 28, 10	35, 28, 21, 36, 10….	35
US6661345	Alertness monitoring system	38	32	-	30, 13, 15, 28, 17…	28, 15
US6706773	Foam preparation	25	41	15, 34, 33	15, 5, 34, 33, 10…	5, 15

	process					
US6708115	Vehicle speedometer	48	45	27, 35, 10, 34	3, 35, 10, 27, 1, 13, 28	28, 10, 35
US6708080	Agricultural product dispenser	25	47	35, 18, 10, 13	28, 24, 3, 17, 10, 35, 13…	35, 24, 10
US6706077	Hair Coloring Composition	13	41	35, 10	35, 10, 40, 5, 13, 2	5, 40, 35, 10
US6695476	Bag with extensible handles	34	10	12, 35	35, 1, 13…	1
US6695341	Containment impact protection system	38	5	(17, 2, 18, 39)	17, 15, 13, 4, 30, 14, 3	15, 30
US6683126	Difficult-to-wet surface	25	45, 21	35, 10, 28, 24, 2, 14, 30, 40	28, 5, 2, 10, 24, 4, 31, 1, 30, 19…	1, 31
US6662574	Rapid fluid cooling	13	22	19, 18, 36, 40	19, 24, 35, 40, 36, 15, 16	15, 24
US6661967	Variable temperature vaporizer	25	22	21, 36, 39, 31	36, 37, 21, 39, 31, 24, 2	37, 39
US6699013	Cooling Fan	24	32	(35, 28)	15, 19, 3, 28, 4	15
US6732497	Cigarette packing machine	14	33, 29	(2, 24, 35, 21)	3, 7, 19, 14, 6….	14
US6677258	Breathable composite sheet	25	31	10, 1, 34, 29	3, 1, 15, 14, 13, 12, 9	3, 1, 13, 12, 35
US6657021	Nozzle with variable level	10	19	10, 36, 14, 3	40, 9, 35, 14, 17, 3, 13, 4	35, 7, 17
US6729842	Reduced seal rubbing	31	36	-	1, 24, 27, 17, 30, 12, 40	17, 24
US6729136	Liquid metal/ nitrogen power plant	30	16	(2, 35, 6)	35, 28, 10, 3…	35
US6730379	Shoe sole	32	25	15, 10, 2, 13	13, 10, 3, 15, 19, 40, 24	40
US6731772	Cushion cover for earphones	19	32	35	15, 35, 17, 13, 3, 30, 31	31

US6730879	Self-cleaning oven	18	13	16	38, 35, 10, 4, 28, 19, 16	19
US6730913	Active night vision system	23	4	-	14, 17, 32, 35, 24, 19, 1	19
US6725493	Toothbrush	24	5	(15, 26, 17, 30)	15, 30, 17, 3, 4, 35, 14	15, 17, 30, 3
US6725490	Toothbrush	24	45	(6, 29)	2, 15, 19, 28, 35, 30, 4, 17	17, 4
US6727211	Multiphase bar	39	14	(21, 22, 35, 28)	15, 3, 14, 19, 26	3
US6727403	Absorbent article	13	4	1, 40, 35	40, 35, 1, 9, 17…	35, 1
US6726947	Customized fresh-brewed coffee	32	41	1, 13, 31	10,13, 29, 31…	10
US6726761	High temperature emissivity paint	23	22	32, 35, 19	19, 35, 32, 1, 40, 28…	35
US6726052	Collapsible fluid transport tank	21	10	15, 32, 35	5, 24, 31, 40, 35, 15, 39, 13	7, 35
US6727618	Bearingless switched reluctance motor	15	21	35, 10, 21	35, 10, 24, 21, 1, 13, 12…	1
US6728289	Non-planar micro-optical structures	41	9	1, 28, 13, 27	29, 13, 1, 16, 28, 30, 24, 27, 35	1, 27, 35
US6727517	3D integrated circuits	4	41	15, 17, 27	17, 3, 15, 13, 4, 31, 10	10, 4
US6733766	Personal care composition	32	21	35, 30, 14	35, 40, 4, 14…..	40, 35
US6733452	Ultrasound imaging method	29	32	-	28, 10, 1, 15, 3, 25	15, 3
US6735985	Method of impressing a twist on a fiber	11	6	(2, 18, 40, 4)	32, 2, 3, 24, 17, 28	17
US6718972	Dose metering system	10	19	10, 36, 14, 3	40, 9, 35, 14, 17, 3, 13, 4, 36	14, 15, 3, 17, 4
US6729351	Metering valve	48	10	2, 6, 32	2, 13, 1,	1

					37…	
US6732716	Metering valve	30	12	15, 22, 33, 31	1, 10, 21, 3, 36, 18, 15	1, 15
US6684781	Printer	42	32	-	35, 7, 13, 1, 4, 17, 12	17, 7
US6728594	Central control system for tuning cigarette manufacture	42	40	26, 28, 10, 36	10, 28, 9, 23, 2, 24, 33, 35	23
US6684917	Volumetric metering of small quantity of powder	48	10	2, 6, 32	2, 13, 1, 37, 6, 24	1, 24, 31
US6699434	Metering valve	45	10	13, 3, 27, 10	2, 10, 13, 3, 35, 31, 24	10, 31, 24
US6673994	Synthetic drumstick with microcellular structure	20	2	40, 26, 27, 1	40, 31, 2, 1, 17, 26, 35, 3	31, 35
US6719293	Corrosion resistant gasket	21	22	35, 1, 32	35, 40, 3, 1, 24, 18	40, 35
US6734404	Heating elements with reduced magnetic field emissions	22	31	22, 35, 2, 24	35, 2, 25, 22, 10, 3, 12, 20	1, 25
US6720362	Perforated foams	29	20	(15, 35, 22, 2)	3, 35, 26, 40, 4, 28, 30, 10	10, 3
US6734512	Electrostatic actuator	15	42	28, 29, 37, 36	28, 29, 5, 37, 36, 12, 13, 17, 25	17, 13, 12
US6739132	Thermal micro-actuator	3	41	1, 29, 17	1, 24, 4, 10, 29…	1
US6734000	Nanoporous silicon support	41	10	35, 23, 1, 24	25, 16, 1, 31, 24, 30, 27…	31, 24
US6740094	Shape memory polymer actuator	10	9	35, 14	35, 7, 14, 3, 31, 38	35, 14
US6732808	Fire-extinguisher	12	45	10, 4, 29, 15	5, 10, 15, 4, 2…	10, 4
US6740250	Fire suppressant	38	30	(3, 24, 39, 1)	1, 35, 24, 39, 19, 13	24, 35
US6741314	Liquid crystal	6	4	26, 7, 9,	17, 14, 3,	17, 3, 7

	display			39	4, 7, 9…	
US6741816	Tone reproduction control method	42	22, 40	26, 19, 28, 10, 36	26, 10, 3, 28, 24, 9, 19, 2, 23	26, 23
US6723148	Moldable twist-lock snap-fit	41	24	(35, 28, 34, 4)	1, 10, 15, 16, 3, 6, 25	10, 15
US6741767	Piezoelectric optical relay	9	18	4, 6, 2	4, 6, 2, 30, 1, 3, 14, 7	3, 7
US6716485	Intumescent ablative composition	38	41, 2	(3, 10, 8, 28)	30, 31, 13, 10, 3, 12, 36, 18, 40, 1	1, 10
US6715716	Economy aircraft sleeper seat	32	8	-	24, 15, 31, 16, 1, 3, 35, 7, 30	31, 15, 1, 7
US6718752	Jet engine exhaust nozzle	29	27	(21, 35, 2, 22)	3, 15, 9, 31, 35…	35, 15
US6712346	Helical compression spring	15	7	15, 9, 12, 37	12, 15, 9, 35, 37, 14, 4	14
US6736419	Suspension system	21	15	10, 35, 21, 16	24, 21, 10, 16, 1, 35, 17	24, 1, 35
US6675734	Fluid containment vessel	21	1	21, 35, 2, 39	40, 35, 31, 5, 2, 39, 17, 24, 8	40, 31, 5, 17
US6726213	Bi-directional rotatable face seal	25	32	15, 10, 2	2, 15, 28, 27, 12, 3	3, 12
US6700384	Detecting leakage in power supply	38	47	(22, 19, 29, 40)	28, 32, 37, 17, 3, 13, 26	37
US6703748	Brushless DC motor and refrigerant compressor	41	4	15, 17, 27	13, 17, 14, 15, 4, 29, 2…	4, 17
US6727018	Battery having a film-type casing	17	38	(10, 36, 23)	24, 3, 16, 30, 26, 39, 25	30, 24, 3
US6735818	Vacuum cleaner	41	20	1, 3, 10, 32	3, 35, 1, 24, 33, 10, 30	10
US6740281	3-D articles of indeterminate axial length	41	9	1, 28, 13, 27	29, 13, 1, 16, 28, 30, 24…	1, 13, 29
US6740752	Chitosan particle	12	21	13, 3, 35	35, 24, 40, 13, 3,	35, 24, 19

	process				33, 12, 19	
US6652524	Fixator	32	15	15, 17, 20	35, 15, 17, 14, 6, 7, 13	15, 17
US6706043	Bone anchoring assembly	13	31	22	35, 14, 40, 3 ,39, 13, 33	3, 33
US6736820	Bone screw	4	3	-	3, 1, 4, 19, 17, 35	3, 17, 4
US6744848	Low-dose 3D imaging	47	9	27, 13, 1, 39	13, 28, 3, 1, 17, 26,	1, 17
US6744976	Hot airflow generation device	22	8	35, 6, 4	35, 40, 31, 3, 4, 6, 30	31, 30
US6743841	Heat-resistant composition	22	10	3, 17, 30, 39	30, 31, 3, 35, 39…	35
US6743932	Polymerization catalyst	21	41	35, 19	25, 35, 24, 3, 15, 5, 19	35, 24, 5
US6744371	Sensing device for detecting wetness	47	6	2, 39, 30, 16	26, 28, 2, 17, 39, 32….	17
US6744038	Methods of separating particles	47	8	2, 18, 26, 31	28, 26, 2, 24, 13, 31, 32, 4	28, 4
US6743936	Composites made using functionalized nanoparticles	21	20	17, 9 ,15	40, 17, 9, 35, 14, 4, 5	40, 35
US6745201	Poly vectoral reverse navigation	47	11	(3, 27, 29, 18)	19, 3, 32, 7, 10, 13, 25, 4	10, 7, 13
US6744209	Microwave oven	18	29	(18, 2, 35)	24, 28, 13, 3, 14, 39, 5, 25	5, 13
US6742351	Ice-making machine	12	24	(28, 27, 3, 18)	13, 1, 19, 12, 3…	1, 19
US6674774	Chopped laser driver	29	17	(19, 18, 22)	19, 23, 28, 4, 24, 14, 9…	4, 19, 23
US6675030	Blood glucose monitoring system	48	32	13, 35, 2	35, 2, 10, 13, 24, 6, 1	10, 6

Figure 2: Comparison Of Classical and New Matrix

Summarised Results

The 100 patents included in the analysis used a total of 206 Inventive Principles. This represents an average of just over 2 Principles per invention.

For the 100 patents included in the analysis, the original Matrix predicted 55 of these Principles. This represents an accuracy rating of just under 27%. This is a rather disappointing result when compared to the rating of almost 50% recorded during the Reference 3 investigation.

The new Matrix identified 198 of the 206 recorded Inventive Principles. This represents an accuracy rating of 96%.

Conclusions

Any attempted validation of a tool conducted by the author of that tool is inevitably going to face criticisms of bias. It would undoubtedly have been preferable if the work had been conducted by a completely independent party. Alas there have thus far been no volunteers to conduct such work. The offer, of course, remains one that is open to all.

From the perspective of the author, the objective of the research described here has been to make a genuine attempt to gauge the dynamics of the world of invention. Answers to questions like 'how often might we need to publish updates to the Matrix?' have an important impact on the future direction and focus of our research activities. The findings reported here suggest that the Matrix of 2003 is still very good at predicting the inventive steps used by inventors of patents granted in 2004.

The results for the original Matrix are somewhat more disappointing than was anticipated. It is difficult to establish the precise reasons for the poor result. It is possible to suggest that the decision at the beginning of this analysis to select a balance of patents from different disciplines was a contributory factor. This decision meant that the proportion of 'mechanical' inventions considered was rather low. The analysis conducted for Reference 3, on the other hand – which obtained a much better result (48% compared to 27% here) – was conducted by mechanical engineers on mechanically focused inventions. Perhaps it is fair to conclude that because the world was a much more 'mechanical' place in 1973 when the original Matrix was last updated, it contains an inevitable bias towards mechanical devices, and therefore would understandably be less good at predicting what Principles non-mechanical inventions are likely to use.

References

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