

Assessing The Accuracy Of The Contradiction Matrix For Recent Mechanical Inventions

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Introduction

While some parts of the TRIZ community might debate the value of the Contradiction Matrix (Reference 1, 2) as a problem-solving tool, it is undoubtedly an attractive concept to both users and newcomers. A large part of the dis-satisfaction with the Matrix seems actually to stem from the fact that it is out of date rather than conceptually incorrect, and that to update it would require a lot of effort that might be better spent elsewhere.

A previous article (Reference 3) included the following figure as a way of highlighting the extent of the problems associated with the current classic Matrix. Or rather, due to its lack of quantified data, suggested the extent of the problems.

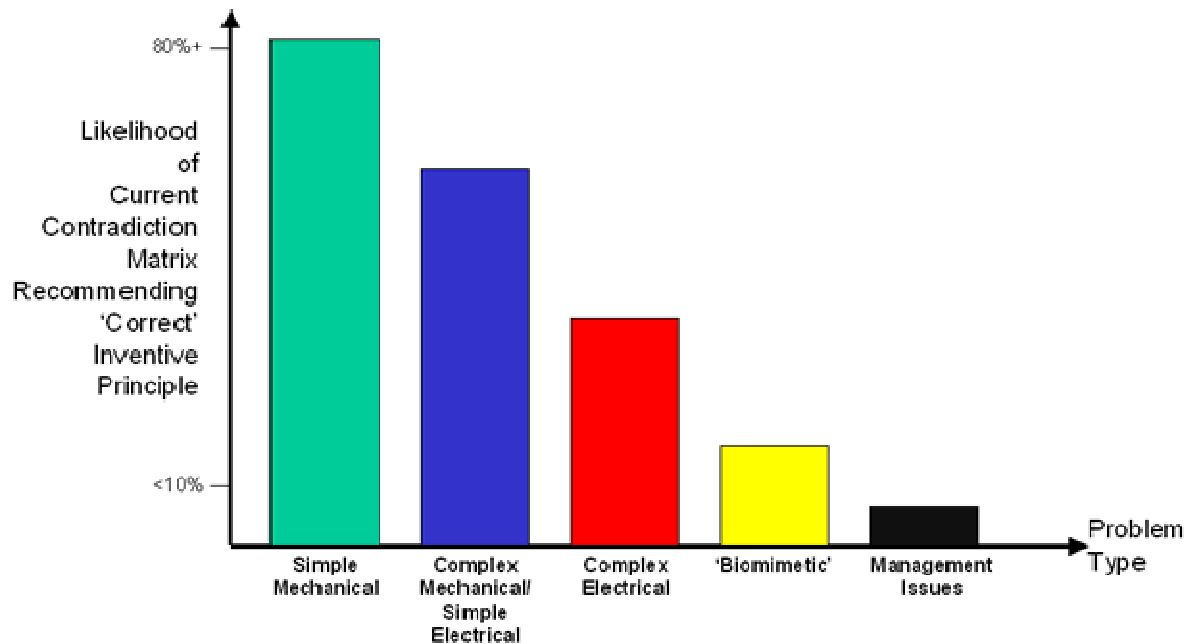
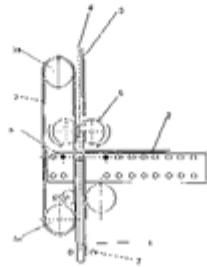


Figure 1: Relative Efficacy of Contradiction Matrix For Different Problem Types

This article reports a brief study conducted by 32 final year engineering and design undergraduates at the University of Bath to calibrate the Matrix against a cluster of recent mechanically-oriented inventions.

Method

<p>(12) United States Patent Lutwensen</p> <p>(54) DEVICE FOR APPLYING LABELS TO FLAT MAIL ITEMS</p> <p>(75) Inventor: Frank Lutwensen, Berlin (DE)</p> <p>(73) Assignor: Siemens Aktiengesellschaft, München (DE)</p> <p>(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.</p> <p>(21) Appl. No.: 09/242,070</p> <p>(22) PCT Filed: Aug. 7, 1997</p> <p>(86) PCT No.: PCT/DE97/01680</p> <p>§ 371 Date: Jan. 10, 2000</p> <p>§ 102(e) Date: Jan. 10, 2000</p> <p>(87) PCT Pub. No.: WO98/05559</p> <p>PCT Pub. Date: Feb. 12, 1998</p> <p>(30) Foreign Application Priority Data</p> <p>Aug. 7, 1996 (DE) 296 31 434</p> <p>(51) Int. Cl. ⁷ B32B 3/04, B05C 1/01, B05C 9/02, B05C 9/18, B05C 9/32</p> <p>(52) U.S. Cl. 156/483; 156/363; 156/445; 156/935; 156/517; 156/230; 156/250; 156/318; 33</p> <p>(58) Field of Search 156/230, 240, 156/241, 247, 277, 280, 215, 364, 443, 483, 485, 517, D02, 33, 367, 368, 250, 428/105</p> <p>(50) References Cited</p> <p>U.S. PATENT DOCUMENTS</p> <p>1,854,209 5/1933 Ostratzen</p> <p>4,198,252 3/1980 Ebers</p> <p>4,573,429 * 9/1983 Cynabekow 156/483</p> <p>4,579,454 * 1/1985 Masuda 33/27</p> <p>4,589,945 * 5/1986 Dado 156/487</p> <p>4,639,287 * 1/1987 Sakata 156/361</p>	<p>(10) Patent No.: US 6,230,778 B1</p> <p>(45) Date of Patent: May 15, 2001</p> <p>5,088,712 2/1992 Taguchi</p> <p>5,281,687 4/1993 Nishida</p> <p>5,414,507 5/1994 Hall</p> <p>5,442,766 * 3/1995 Strafinger et al. 428/235</p> <p>FOREIGN PATENT DOCUMENTS</p> <p>7,31,258 4/1992 (JP)</p> <p>11,16,145 10/1961 (DE)</p> <p>11,426 11/1992 (DE)</p> <p>0,044,016 1/1981 (JP)</p> <p>* cited by examiner</p> <p>Primary Examiner: Richard Crispin Assistant Examiner: E. A. Lovings (74) Attorney, Agent, or Firm: Washke; Catherine M. Washke</p> <p>(57) ABSTRACT</p> <p>In a device for applying labels to a flat mail item that is conveyed standing on one edge, having a conveyor for conveying the individual items along a predetermined conveying path, a label conveyor for conveying the individual labels, the device being controlled by a sensor device for determining the position of the front edge of the item, a pressing device for pressing the labels onto the item surface, a label holder, which is disposed in a region in front of the pressing device, with respect to the conveying direction of the item, and into which the labels are conveyed by the label conveyor, the label holder is embodied such that the labels can be moved perpendicularly to the conveying direction and oriented with their adhesive side counter to the conveying direction in the conveying path of the items, as soon as the front edge of an item falls short of a predetermined distance from the label holder, the sensor device controls the conveyor device such that it conveys a label to the label holder, so the front edge of the item impacts the label and the label is moved on both sides in the direction of the item surface, and, simultaneously, in the direction of the pressing device, effecting the release of the label from the label holder and the pressing of the label against the item surface by the pressing device.</p> <p>7 Claims, 8 Drawing Sheets</p>
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The study was conducted by allowing students to select a random set of patents from the US and European patent databases, the only criteria being that the patents should describe an essentially mechanical-based system and that the patent should have been granted in the last ten and preferably five years. No other selection criteria were formally applied, although there was an overall suggested direction towards picking inventions that were 'interesting' in some form or other - this usually meant a solution featuring some kind of 'wow' moment. Each student was tasked with identifying four patents for analysis - and hence the total dataset for analysis comprised over 130 different inventions.

For each patent, the student was required to 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. In broad terms, these elements can be extracted from the background, summary and claims sections of the invention disclosure text. For each patent, the student was required to cut and paste the relevant section of text, show how it mapped onto the terms of the Matrix, and show if/how the inventive step related to one or more of the Inventive Principles. There was no instruction to distill either conflict parameters or Inventive Principles down to a 'best one'; if the inventor solved more than one conflict, or if the conflict was blurred across several parameters, or if more than one Principle was used, the student was asked to record all of the information.

Below is an example of the type of analysis conducted for each patent:

Figure 2: Exemplar Patent - US6,230,788

From the patent text.....

BACKGROUND OF THE INVENTION

The invention relates to a device for applying labels, as defined in the preamble of the independent claim 1.

Applying labels to flat mail items quickly and reliably poses a problem in the processing of flat mail items, particularly letters, post cards, etc., in mail-processing facilities. An example of this is automatic mail forwarding.

In this instance, mail items are separated out for forwarding addressing, and re-addressed with corresponding, predetermined data stored in a database. A label that covers the old address and, if applicable, a barcode printed on the surface of the mail item, is affixed to these items. The label is then provided with a new barcode and the corresponding, new address. The label is applied in devices that are integrated into automatic letter-distribution systems. The mail volume for such distribution systems varies in format, weight and thickness. In these systems, the items are conveyed at a speed of, for example, 3.6 m/sec, which places stringent requirements on the speed at which the labels must be applied, as well as on the exact positioning of the labels. Furthermore, the handling and especially the transport of the labels to the item surface represent a general problem when the label has a self-adhesive surface.

A device of the above-outlined type is disclosed in U.S. Pat. No. 5,200,007.

It is the object of the present invention to provide a device for applying labels to flat mail items, wherein the supply of the labels to the region of application and the trimming of the labels is performed inexpensively with high advancing speed and accurate positioning.

According to the invention, this object is accomplished by the features of claim 1. Advantageous embodiments of the invention ensue from the dependent claims and the description.

A notable advantage of the invention is a high flexibility in the positioning of the labels on the mail items, and a simple process of supplying the labels to the application region. The conveying speed of the mail items need not be reduced for label application. For the duration of the process of supplying the labels to the application region, and during the application itself, the labels are mechanically held, so no uncontrolled changes in position occur. The labels can be supplied from a simple label strip or a label carrier strip.

etc

...the student is required to pick out the conflicting parameters....

"The mail volume for such distribution systems varies in format, weight and thickness. In these systems, the items are conveyed at a speed of, for example, 3.6 m/sec, which places stringent requirements on the speed at which the labels must be applied, as well as on the exact positioning of the labels. Furthermore, the handling and especially the transport of the labels to the item surface represent a general problem when the label has a self-adhesive surface."

Thing to be improved:-
ADAPTABILITY OR VERSATILITY

Thing that gets worse:-
SPEED

...see what the classic Matrix recommends as its 'top 4 most likely'....

Matrix recommends:-

Parameter Changes, Prior Action, Curvature

...and then pick out the Inventive Principles actually used by the inventor....

Siemens used:-

"...a label conveying and cutting device that is controlled by a sensor device for determining the position of a front edge of the flat mail item..."

Prior Action, Feedback

...and so, in this case, we are able to record a partial match between Matrix and what the inventor used. Thus, in terms of quantifying the 'success' of the classical Matrix, this invention scores one out of two - i.e. two Principles were used; the Matrix suggested one of them.

The total success rate of the Matrix was then calculated by summing all the Principles contained in the Matrix used by each inventor, and dividing that total by the sum of every Principle used in each of the patents under evaluation.

Throughout the exercise - carried out over a period of two weeks - students were also asked to pay attention to either conflict parameters or inventive strategies that did not fit into the existing Matrix/Inventive Principle framework.

Results

The following table summarises the analyses for each of the patents successfully analysed. 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), 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.

Patent Number	Short Title	Improving Parameter	Worsening Parameter	Matrix Recommendation	Inventor Used..
4923041	Liquid Friction Coupling Blade	10	13 3	35,10,21 17,19,9,36	35, 17, 4
4966257	Shock Absorbing Damper	10	5	19,10,15	15
5473723	Optical Fibre Sheath	33	24	4,10,27,22	3
5485307	Binoculars	35	12	15,37,1,8	1
5485359	Remote control Holder	18	19	32,1,19	25
5485360	Miniature Flashlight	11	13 31	35,33,2,40 2,33,27,18	24,23
5493544	Noble Metal Watch Case	26 2	14	14,35,34,10 28,2,27,10	2,35
5493551	Disk Loading Apparatus	33	36	32,26,12,17	17
5493578	Ash Melting Furnace	26	22	7,18,25	25
5493580	Recycling Filter Dust	23	22	35,27,2,31	1,35,31
5540495	Injection Assembly	8	36 10	1,31 2,18,37	31,17
5543179	Head Treatment Device	30	14	35,18,37,1	16,10, 1
5543179	Evaluating Pummelled Glass	37	18	2,24,26	32,23
5544090	Removal of Entities from Textiles	30	15 26	22,15,33,28 35,33,29,31	29,23, 1
5568961	Tubular Seat Frame	14	1	1,8,15,40	1,15
5569009	Loosening Prevention Screw	27	36	13,35,1	1
5569282	Retractable Surgical Knife	31	33	-	7
5570342	Disk Cartridge	5	36	14,1,13	1
5650591	Waterproof Casing	31	17	22,35,2,24	31
5650983	PCB Magnetic Head	8 2	24	- 10,15,35	5
5650990	Mini-Disc Tray	10 19	13	35,10,21 19,13,17,24	15
5651055	Digital Secretary	33 38	24	4,10,27,22 35,33	10,28
5666803	Vectored Thrust Compressor	31 12	36 32	19, 1, 31 1,32,17,28	1,17
5666937	Repeat-Fire Pellet Rifle	27	36 7	1,13,35 3,10,14,24	10,13
5667294	Strip Sport Light	33	35	15,34,1,16	15,1
5668542	Aircraft Cockpit Display	31 33	36	1,19,31 12,17,26,32	1,32

5680467	Hearing Aid	28	13	32,35,13	35
5680468	Automotive Speaker Equalisation	16	33	1	1
5694827	Cushioned Unloading Cycle for Truck	15	9	3,35,5	3,35,5
5724415	Coin Deflector for Telephone	7	5	1,7,4,17	17
5724478	Liquid Heater Assembly	22	6	17,7,30,18	1,17
5724625	Belt_Driven Shutters	9	11	6,18,38,40	6,1
5724663	Carphone Connected to Audio Unit	31 33	35	- 15,34,1,16	5
5746360	Coat Hanger Bag	7	31	17,2,40,1	2,30
5772623	Easy Removal Bandage	33	31 15	- 29,3,8,25	3,17,5
5790028	Anti-Robbery Handbag	27 24	36 21	13,35,1 10,19	10,24
5810078	Control of Vehicle Interiors	17	28	3,10,19,35	10
5815984	Casement Window Operator	33	13 10	32,35,30 28,13,35	13,24,4
5824184	Peel-off Backing for Adhesive Tape	33	3	1,17,13,12	3
5899166	Boat Hull Protector	33	7	1,16,35,15	35,30
5900705	Bicycle Motor Control	33	31	-	13,5
5900819	Drowsy Driver Detector	30	33 3	2,25,28,39 17,1,39,4	1,5,35
5900821	Rain Sensor System	32	35	2,13,15	2
5924704	Foot Supporting Roller	15	36 27	10,4,29,15 11,2,13	15
5992588	Suitcase	10	3	17,19,9,36	17
5999869	Electric Power Steering	31	15	15,22,33,31	23
6003407	Motorcycle Toe-Shift Seal	27	36	13,35,1	7,24
6050219	Animal Milking Apparatus	15	25	20,10,28,18	20,23
6053646	Ergonomic Computer Input Device	31 10	9	35,28,3,21 1,28,3,25	28
6053805	Dust Free Sander	26	36	13,35,1	13,3,5
6065555	Power Assisted Wheelbarrow	19	22	12,22,15,24	23
6084576	User Friendly Keyboard	33	5	1,17,13,16	1,13
6098208	Protective Baseball Pads	5	1	2,17,29,4	14,30
6099018	Snowboard Binding	31	12	35,1	1,17

6099150	Bicycle Brake Light	33	15	29,3,8,25	40
6099658	Pool Cleaner	9	31	2,24,35,21	24
6157887	Brake System	36	32	27,26,1,13	26,1,28
6166359	Induction Heating for Pipe Welds	17	22	21,17,35,38	1,28
6176374	Sensitive Component Container	11	14	9,18,3,40	9,3
6179727	Dual Radius Putter	35	36	15,29,37,28	4,20
6182299	Baseball Chest Protector	14	33 17	2,28,32,40 30,10,40	2,3, 40
6203313	Reconfigurable Candle	35	14	35,3,32,6	1,35
6204482	Cooling a Toaster Oven	17 22	31	22,35,2,24 21,17,35,38	1,30
6220333	Bar Code Stencil	24	27	10,28,23	17,28,13
6213258	Auto-Compensating Drum Brake	4 16	8	35,8,2,14 35,34,38	1,15,35
6216864	Golf Club Holder	31	36	19,1,31	31,1,35
6223658	Weighted Paintball	31	35	-	1,30
6227989	Line Marking System	16 33	31	1,17,40,33 2,25,28,39	17,10, 24,31
6239337	Shoulder Rest for Musical Instrument	35	31	-	35
6256886	Device for Cutting Vegetation	31 1	36	19,1,31 26,30,36,34	15,28
6257009	Ice Dispenser	39	17 23	35,21,28,10 28,10,35,23	35,23
6260276	Adjustable Length Clipper	35	36	15,29,37,28	15,6
6272687	Needle-Proof Gloves	14	33	32,40,25,2	3,40,15
6279720	Coin Handling Mechanism	27	30	2,27,35,40	2
6283549	Adjustable Office Chair	35	13	35,30,14	14,4
6290148	Fuel Injection Nozzle Delay	38	36	15,24,10	24,10
6290196	Holding Device for Surgical Instrument	3	7	7,17,4,35	3,7, 17
6293565	Roller Hockey Skate	9 35	31	2,21,24,35 -	17,14,3
6296160	Clothes Hanger	31 33	36	19,1,31 32,26,12,17	8,5
6298993	Diaper Bag	33 12	35 7	15,34,1,16 14,4,15,22	1,2
6299550	Golf Ball	3	9	13,4,8	13
6303074	Rotor for Molten Metal Pumping	7	5 19	1,7,4,17 35	17

6305305	Kneeboard	3	10	17,10,4	17
6306040	Telescopic Baton	7	36	26,1	1,15
H1947	Expandable Police Baton	33 14	3	1,17,13,12 1,15,8,35	1,7,17
GB2303376	Pigment Ink	13	26	15,32,35	35,24
GB2303439	Gas Turbine Combustor	13	35	35,30,34,2	35
GB2303469	Vehicle Speed Limiter	24 31	36	- 19,1,31	19
GB2303510	Radar Wheel Detector	30	27 21	27,34,2,40 19,22,31,2	19,28
GB2307485	Bubble Generator	15	10	2,16,19	4,18
GB2309876	Ultraviolet Water Treatment	36	30	22,19,29,40	2
GB2312704	Lifting Offshore Platforms	1	30	22,21,27,39	22
GB2315973	Plant Watering System	23	17	21,36,39,31	31
GB2315980	Sports Shoe	12	8	7,2,35	2,35
GB2315994	Rainwater Collection for Automobiles	26	7	15,20,29	25
GB2316044	Vehicle Wheel Trim	10	33	1,28,3,25	1,15
GB2350145	Escape Ladder Assembly	33	35	15,34,1,16	15
GB2350268	Packet Data Transmission	24	27	10,28,23	10
WO 01/13760	Hyperaemia Comb	7	5	1,7,4,17	17,4
WO 01/70445	Airbag Deployment Trim Piece	28	3	5,16,26,28	5,26

Of the patents analysed, the net effectiveness of the Matrix was calculated as 48%. In other words, in 48% of inventive problem situations, the Matrix in its current form would have enabled the inventor to reach the eventually patented solution.

Conclusions

The classical TRIZ Contradiction Matrix was assembled from primarily mechanically biased patents from twenty or more years ago. While the sample here is of a significantly smaller size than the original analysis, it is nevertheless sufficient to allow some statistical comparison to be made. The 48% success rate, although lower than some estimates (higher than others, however) should give us at least some confidence that the Matrix is still relevant for mechanical problems. The most significant shifts in thinking appear to come through increased use of Principle 23, Feedback, and to a lesser extent 25, Self-Service - and these now appear to be somewhat under-represented in the classic Matrix. Conversely, while the Matrix suggests Principle 22, Blessing In Disguise relatively frequently, the patents analysed suggest it has rarely been utilized. In terms of the 39 parameters contained in the Matrix, it was evident throughout the monitoring of the patents that parameter 31 'Object Generated Harmful Effects' was used in a relatively high number of cases. The parameter has to be used to wrap up a wide variety of issues (safety, noise,

environmental harm, etc), which would ideally be handled by introducing more parameters into the Matrix.

The classical Matrix, of course, should not be interpreted as saying that the Principles used or usable to solve a given contradiction type are limited to the ones published - merely that these are the 'most likely'. If the Matrix recommends any three or four Principles for a given contradiction, it does not preclude the achievement of a strong solution from one of the other 36 or 37 Principles. The results of this study are suggesting that, for mechanically oriented problems, the Matrix recommendations will be 'right' just under half of the time. We should continue, therefore, to use the Matrix as a 'useful start point' rather than as a definitive end.

Final Thoughts

If TRIZ is about finding win-win solutions and maximizing the utilization of resources, the idea of using students to help update the TRIZ methodology appears to offer a very good match. The activity conducted by this batch of students served to familiarize them with searching patents, observing the way patents are written, understanding contradictions, familiarizing themselves with the Inventive Principles, in addition to providing the TRIZ community with some hopefully useful data.

It would be good to extend this type of analysis to patents from non-mechanical areas in the future. The author is happy to pass on teaching and assignment instruction data for anyone wishing to attempt a similar exercise with students elsewhere.

Meanwhile, CREAX nv in Belgium is in the process of systematically analyzing and codifying patents for contradictions, trends of evolution, inventive standards and knowledge/effects content, starting from the present day and working back in numerical order, patent-by-patent back to the time when systematic analysis previously stopped. The fruits of this updating activity will gradually be published via www.creax.com. Anyone wishing to find out more about this work, or wishing to participate in some way should get in touch with the author.

Acknowledgements

The author would like to thank all of the students for participating in the exercise; without their efforts, this article literally would not have been possible.

References

1. Domb, E., 'Contradiction Matrix', TRIZ Journal, September 1998.
2. Salamatov, Y., 'TRIZ: The Right Solution At The Right Time', Insytec BV, Netherlands, 1999.
3. Mann, D.L., 'The Space Between Generic and Specific Solution', TRIZ Journal, August 2001.

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. 3) Mann, D.L., "Assessing The Accuracy Of The Contradiction Matrix For Recent Mechanical Inventions"™, TRIZ Journal, February 2002. ©2004, D.L.Mann, all rights reserved. Related Interests. See below for downloads of the Contradiction Matrix and 40 Inventive Principles. Our TRIZ training courses help you get results fast. Oxford TRIZ Innovation Bank. Oxford Creativity has developed Oxford TRIZ and its simple processes to apply these concept lists to your most difficult problems, making these wonderful tools easy to understand and use by everybody. Contradiction Matrix. Once we understand the conflict in our requirements then we can use TRIZ processes for uncovering contradictions and the tools for solving them. A contradiction is a simple clash of solutions. Either we want opposite solutions, or by introducing a new solution, i.e. an improving change to one feature in a system, another feature in our system has got worse... 2. New versions of the Contradiction Matrix and the 40 principles, based on studies of business cases and business texts, are now being developed (23) Other TRIZ software which uses the inventive principles (24) as well as the patterns of innovation for business situations has been available for some time DTC (Distance-Time -Cost) Operator The DTC operator (25) is a problem analysis. Assessing The Accuracy Of The Contradiction Matrix For Recent Mechanical Inventions. TRIZ Journal, February Gennady Retseptor. 40 Inventive Principles in Quality Management. Assessing The Accuracy Of The Contradiction Matrix For Recent Mechanical Inventions Darrell Mann Industrial Fellow, University of Bath Bath, BA2 7AY, UK. While some parts of the TRIZ community might debate the value of the Contradiction Matrix (Reference 1, 2) as a problem-solving tool, it is undoubtedly an attractive concept to both users and newcomers. A large part of the dis-satisfaction with the Matrix seems actually to stem from the fact that it is out of date rather than conceptually incorrect, and that to update it would require a lot of effort that might be better spent elsewhere. Figure 1: Relative Efficacy of Contradiction Matrix For Different Problem Types. 2002. Assessing The Accuracy Of The Contradiction Matrix For Recent Mechanical Inventions. <http://www.triz-journal.com>, 2002. Engineering of creativity. CRC Press, Boca Raton, 2000. The Analysis and Think of The Chinese Inventive Patent. Journal of Information, 2000. The Innovation Algorithm:TRIZ, systematic innovation and technical creativity. G. S. Altshuller, Lev A. Shulyak, Steven Rodman. Engineering. 1999.