

Darrell Mann "Hands on Systematic Innovation"

Table of Contents Constructed for the Japanese Edition

[Note: This Table of Contents was constructed for the Japanese Edition on Jan. 26, 2004. Hierarchical numbering system was introduced and some (sub-)section headers were added. The words written in blue were introduced or modified. The page numbers refer to the pages of the first print of the English Edition. See some more detail in the Q&A Document (Part 3).]

Table of Contents

	page
Chapter 1 Introduction: Overview of TRIZ: Toolkit? Method? Philosophy?	9
1.1 TRIZ for Everyone (Even Those Who Don't Want to Spend a Year Learning It) Another Way of Looking at TRIZ; Different User Profiles; The Folly of 'I Am Right; You Are Wrong'; Self-Adapting Systems; Mastery; Overlap; Final Thought	10
1.2 A General Overview of TRIZ TRIZ Basics; The Four Plus One Pillars of TRIZ [Contradictions; Ideality; Functionality; Use of Resources; Thinking in Space, Time and Interface]	17
What Do I Do?; References	20
Chapter 2. Systematic Creativity Process Overview	23
2.1 A Complete Process 'Define' Step; 'Select' Step; 'Solve' Step; 'Evaluate' Step; Innovation Chains	23
2.2 Problem Solving and Opportunity Identification Problems and Opportunities; TRIZ and Opportunity Identification; TRIZ Trends and Opportunity Identification	30
What Do I Do?; References	36
Chapter 3. Psychology of Creativity	39
3.1 The Space Between 'Generic' and 'Specific' Design Solutions The Irreversible Nature of Good Ideas [Case Study 1: Flanged Joint; Case Study 2: Bicycle Seat; Case Study 3: Particle Separator]; Mechanisms of Mind: Pattern Recognition; Use of System Operator/9-Windows; Conclusions	41
3.2 TRIZ Thinking Hats Thinking Modes with 6 Thinking Hats [White Hat (Objective); Red Hat (Intuitive); Black Hat (Negative); Yellow Hat (Positive); Green Hat (Creative); Blue Hat (Process)]; Usage of the Six Thinking Hats in the Systematic Creativity Process; Six Thinking Hats and TRIZ-based Software; Conclusions	48
3.3 Psychological Inertia	55
3.4 Information Structuring – TRIZ and Mind Maps™	57
3.5 Group Psychology	60
What Do I Do?; References; Creativity Text Bibliography	61

Chapter 4. System Operator/9-Windows	63
4.1 System Operator Concept	63
Basics of System Operator Concept ; An Alternative Perspective	
4.2 9-Windows On The World	66
An 'All-Encompassing' Alternative Perspective; Different Perspectives of Space-Time Territory in Different Disciplines	
4.3 Between The Boxes – Changing Perspectives	70
Connections With Smart Little People (SLP) Tool; What Happens If I Apply The Same Viewing Perspectives Change in Different Windows; Standing In The Future And Looking To The Present]	
4.4 Introducing Another Dimension	75
Another Dimension; The Map and The Territory [Common 'Map versus Territory' Differences; Case Study 1: Marks and Spencer – A Middle-Ground Business; Case Study 2: John – The Insensitive Line Manager]	
4.5 Integrating Other Perspectives	80
Co-opetition; Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis; Association/Dissociation; Five Senses (VAKOG); Too Many Windows?	
4.6 Conclusion of System Operator/9-Windows	84
Summary; Final Thought	
What Do I Do?; References	85
Chapter 5. Problem Definition – Problem Explorer	87
5.1 Benefits Analysis	87
Customer, Sponsor, and Problem Solver ; Problem Hierarchy Explorer	
5.2 Identification of Resources	90
5.3 Identification of Constraints	92
5.4 Identification of 'Sore Point'	93
Energy Auditing; Theory of Constraints (TOC); Reliability Problem and Subversion Analysis ; Root Cause Analysis and Root Contradiction Analysis	
5.5 Conclusion of Problem Explorer	96
Two Final Points; And Then?	
5.6 Worked Example of Problem Explorer for a Better Bicycle Seat	97
Sheet 1: Benefits Analysis; Sheet 2: Problem Hierarchy; Sheet 3: Technical Resources; Sheet 4: Knowledge Resources; Sheet 5: Technical Constraints; Sheet 6: Business Constraints; Sheet 7: Sore Point	
References	101
Chapter 6. Problem Definition – Function and Attribute Analysis	103
6.1 Evolution of Function and Attribute Analysis	103
Three Generations of Function and Attribute Analysis ; Attribute Modeling; Time and Space-Based Function Modelling;	
6.2 Function and Attribute Analysis (FAA) for a Simple System	106
Describing Useful Functions ; Describing Harmful, Insufficient, and Excessive Functions ; Describing the Effects of Time	
6.3 Function and Attribute Analysis (FAA) for a Complex System	110
6.4 Function and Attribute Analysis (FAA) for a Time-Based Process System	111
Functions Linked and Function onto a Function; Description of Attributes	
6.5 Optional Enhancements	114

Functional Hierarchies; Relationship Matrix; Cause-Effect Mapping What Do I Do?; References	118
Chapter 7. Problem Definition – S-Curve Analysis	121
7.1 S-Curves and System Evolution	122
Labelling of X-Axis; Labelling of Y-Axis; Relative Positioning of S-Curves on Y-axis; S-Curve System/Sub-System Hierarchies; S-Curve System-Function Hierarchy; Final Thoughts on a 'Decline' Phase	
7.2 S-Curves and Problem Definition	128
System at Beginning of S-Curve; System at Mature End of S-Curve; Point of Maximum Complexity	
7.3 Finding Where a System Is On Tts Current S-Curve	130
Technical Focus of Inventions; Design Process; Market and Competition Dynamics	
What Do I Do?; References	134
Chapter 8. Problem Definition – Ideality/Ideal Final Result	137
8.1 Ideality/IFR as a Problem Definition Tool	137
Thinking IFR First [Ideality and IFR References; 'Continuous Improvement' by Current Organization and 'Innovation' by Outsiders; 'Start from the Prize and Work Back' Thinking]; Widening of the Search Space during Stepping Back; Ideal Final Result Problem Definition Questionnaire	
8.2 Case Study Examples	143
Washing Clothes; Planting Seeds; Aerosol Sprays	
8.3 Links to Othe Tools and Additional Thoughts	148
Who's Ideal Final Result? ; IFR as a Function of Time; Links to Trends of Evolution	
What Do I Do? ; References	152
Chapter 9. Select Solve Tool	155
9.1 Identifying Contradictions with the Current S-Curve Position and FAA	156
Case of Limiting Contradiction; Case of Technical Contradiction Coming Clear from FAA; Case of Physical Contradiction Coming Clear from FAA	
9.2 Identifying Insufficient, Excessive, or Missing Actions from FAA	157
Case of Insufficient Actions; Case of Excessive Actions; Case of Missing Actions	
9.3 Identifying the Missing of System, Function, or Problem	158
Case of Missing of Current System and/or Function; Case of No Problem	
9.4 Identifying the Intention of Problem Solving	158
Case of Measurement Problems; Case of Reliability Related Problems; Case of Reducing First Cost; Case of Specifically Searching for a Disruptive Shift; Case of Intending Zero-Risk Innovation	
9.5 Identifying Relationship with Patents	159
Case of Designing Around Someone Else's patent; Case of Strengthening a Patent/Patent Application	
9.6 Identifying the Intention and Situation in a Wider Sense	162
Case of Opportunity Finding; Case of Optimization; Case of Don't Know; Case of No Solution	
9.7 Prioritization of Problems	164
9.8 Summary of Selecting Tool	164
What Do I Do?; References; Optimization Bibliography	165

Chapter 10. Problem Solving Tools – Technical Contradictions/

	Inventive Principles	167
10.1	Preliminary Examination of the Expressions of 'Eliminate Compromises' and 'Solving Contradictions'	167
	Examination of the Expression of 'Eliminate Compromises'; Graphical Representation of Technical Contradictions	
10.2	The Contradiction Matrix	170
	Concept and Basic Usage of the Contradiction Matrix ; Interpreting the 39 Parameters of the Contradiction Matrix; An Updated Version of the Contradiction Matrix [Matrix 2003]	
10.3	Case Studies of Using the Contradiction Matrix and the Inventive Principles	174
	Pipe Flange Joint; A Comfortable Bicycle Seat; A Better Wrench [Open-End Wrench; Closed-End Wrench] ; Anti Red-Eye Flash Photography [Mechanism of the Red-Eye phenomenon; Using the Matrix to Get Recommended Inventive Principles; Further Problems in the Double Flash Solution; Thinking with the Solution Map; Translating Generic Solutions into Specific Ones with a 3-Stage Strategy; Conclusion of This Case Study] ; A Better Wind-Turbine [Root Contradiction Analysis and the Contradiction Matrix; Effective Use of Patent Search]	
10.4	Contradiction Chains	192
	Two Contradiction Scenarios [Discrete Contradiction Scenario; Continuous Contradiction Scenario; Reconsideration of the Discrete Contradiction Scenario]; How Far Should We Take the Contradiction Chain?	
10.5	What Happens When the Contradiction Matrix Doesn't Work?	196
	Principle Selection Based on Improving Parameter; Principle Selection Based on System Complexity; Different Perspectives (Rearranging the 40 Inventive Principles)	
	What Do I Do? ; References	202
10.6	Inventive Principles	203
	1. Segmentation; 2. Taking Out; 3. Local Quality; 4. Asymmetry; 5. Merging; 6. Universality; 7. "Nested Doll"; 8. Anti-Weigh; 9. Preliminary Anti-Action; 10. Preliminary Action; 11. Beforehand Cushioning; 12. Equipotentiality; 13. "The Other Way Round"; 14. Spheroidality – Curvature; 15. Dynamics; 16. Partial or Excessive Actions; 17. Another Dimension; 18. Mechanical Vibration; 19. Periodic Action; 20. Continuity of Useful Action; 21. Skipping; 22. "Blessing in Disguise" or "Turn Lemons into Lemonade"; 23. Feedback; 24. 'Intermediary'; 25. Self-Service; 26. Copying; 27. Cheap Short-Living Objects; 28. Mechanics Substitution/Another Sense; 29. Pneumatics and Hydraulics; 30. Flexible Shells and Thin Films; 31. Porous Materials; 32. Colour Changes; 33. Homogeneity; 34. Discarding and Recovering; 35. Parameter Changes; 36. Phase Transitions; 37. Thermal Expansion; 38. Strong Oxidants; 39. Inert Atmosphere; 40. Composite Materials	

Chapter 11. Problem Solving Tools – Physical Contradictions **219**

11.1	Four Separation Strategies	219
	Four Questions to Separate Physical Contradictions; How To Use Inventive Principles On the Basis of The Separation Principle; Table of Inventive Principles for Solving Physical Contradictions	
11.2	Case Study 1: Car Wheel Covers	222
	Identification of the Problem and Non-TRIZ Optimization Approach; TRIZ-way of Recognizing Physical Contradiction and Solving through Separation	
11.3	Case Study 2: Bicycle Saddle	224

	Bicycle Saddle Problem Viewed as a Physical Contradiction; Usage of Inventive Principles When the Physical Contradiction Are Separable in Multiple Views; Example of Solutions by Combined Use of Principles: Wrench	
11.4	Case Study 3: Sleeping Policeman Physical Contradiction in the Requirements of Sleeping Policeman; Solutions Combining Separation in Space and Separation in Time; Stronger Solutions Based on the Separation in Conditions	226
11.5	Graphical Representation of Physical Contradictions Graphical Representations of Physical Contradictions and Optimization; Examples of Optimum Search, i.e., Existence of Physical Contradictions; TRIZ Challenge against Physical Contradictions	228
	What Do I Do? ; References	230

Chapter 12. Problem Solving Tools – S-Field Analysis/

	Inventive Standards	233
12.1	Substance-Field Model 'Substance' and 'Filed; Representing Types of Interactions; Classification of S-Filed Models and the Concept of Inventive Standards	233
12.2	S-Filed Model/Inventive Standards – Sequence of Events	235
12.3	Fields	236
12.4	Case Study Examples Case Study 1: Baboons, Mandarins and Ship propellers; Case Study 2: Catalysts; Case Study 3: Pistons and Oil; Case Study 4: Coloured Pencils; Final Thoughts	237
	What Do I Do? ; References	242

12.5 List of Inventive Standards with Examples **244**

A. Incomplete S-Fields; B. Measurement/Detection Problems; C. Harmful Effects [Ca. Modify Existing Substances; Cb. Modify the Field; Cc. Add A New Substance; Cd. Add A New Field; Ce. Add A New Substance AND Field; Cf. Transition to the Sub-System; Cg. Transition to the Super-System]; D. Insufficient/Excessive Relationships [Da. Modify an Existing Substance (Phase Transitions) ; Db. Modify the Field; Dc. Add A New Substance; Dd. Add A New Field; De. Add A New Substance AND Field (Ferro-magnetics); Df. Transition to Sub-System; Dg. Transition to the Super-System]

Chapter 13. Problem Solving Tools – Trends of Evolution **273**

13.1	Trends of Evolution: General Way of Interpreting and Applying It and Two Cases of Exception General Way of Interpreting and Applying Trends of Evolution; Applying the Trend to the Case of Toothbrush; Each Stage of a Trend represents a New S-Curve; Dynamics of Trends of Evolution; Mono-Bi-Poly Trend and Exception in Applying It; Trimming Trend and Exception in Applying It	273
13.2	System Evolution Strategy Evolutionary Potential Radar Plots [Evolutionary Potential Radar Plot for a Hydraulic System Bearing; Evolutionary Potential for Lubrication Systems; Evolutionary Potential for Filtration Systems]; Innovation Timing [When Technology Lags Behind Customer Expectation; When Technology Exceeds Customer Expectation; Case Study – Earth-Moving Equipment; Forecasting Field-Based Earth Movers; Relationship to TRIZ]	279
13.3	Trends As a Problem Solving Tool	292

13.4	Usage of Trends in Combination	294
13.5	Trends in Reverse? The Law of Non-Uniform Evolution; Market Anomalies	296
13.6	Trends Reference	300
	What Do I DO?; References	301
13.7	List of Trends of Evolution	303
	1. Adaptive Materials (Smart Materials); 2. Space Segmentation; 3. Surface Segmentation; 4. Object Segmentation; 5. Evolution Macro to Nano Scale (and Beyond) (Space/Time); 6. Webs and Fibres; 7. Decreasing Density; 8. Increasing Asymmetry (To match External Asymmetries); 9. Boundary Breakdown; 10. Geometric Evolution (Linear); 11. Geometric Evolution (Volumetric); 12. Dynamization; 13. Action Co-ordination; 14. Rythm Co-ordination; 15. (Matching to External) Non-Linearities; 16. Mono-Bi-Poly (Similar); 17. Mono-Bi-Poly (Various); 18. Mono-Bi-Poly (Increasing Differences); 19. Reduced Damping; 20. Increasing Use of Senses; 21. Increasing Use of Colour; 22. Increasing Transparency; 23. Customer Purchase Focus; 24. Market Evolution; 25. Design point; 26. Degrees of Freedom; 27. Trimming; 28. Controllability; 29. Reducing Human Involvement; 30. Design Methodology; 31. Reducing Number of Energy Conversions (Tending to Zero)	
 Chapter 14. Problem Solving Tools – Resources		335
14.1	Resource Identification Triggers Resources in the Environment; Low-Cost Resources; Manufacture Process Type Resources; Materials Resources ; Special Properties/Modifications Resources; Resources Associated with Humans	335
14.2	'Unexpected' Resources and Turning Harm into Good Tales of the Unexpected – Wind Turbine in a Garden ; Turning Harm into Good	341
	What Do I Do?; References	343
 Chapter 15. Problem Solving Tools – Knowledge/Effects		345
15.1	Database of Physical, Chemical and Biological Effects (Classified by Function)	345
15.2	Database of Attribute Altering Effects (Classified by Attribute Type)	351
15.3	Patent Search Strategies Example of Patent Search– Hand-Pump for a Liquid Soap	354
 Chapter 16. Problem Solving Tools – Algorithm for Inventive Problem		
	Solving (ARIZ)	357
16.1	ARIZ – Background	357
16.2	ARIZ Process – Within a 'Systematic Creativity' Setting Step a) Define the mini-problem; Step b) Define the Problem Space and Interval; Step c) Define a Technical Contradiction; Step d) Define the Physical Contradiction; Step e) Define the Ideal Final Result Outcome; Step f) Define the X-Component; Step g) Analysis of Resources; Step h) Modification of Resources; Step i) Use Principles for Eliminating Physical Contradictions; Step j) Use Principles for Eliminating Technical Contradictions; Step k) Use Knowledge/Effects; Step l) No Solution?; Summary	358
16.3	ARIZ – Case Study Example: Human Powered Aircraft	362

Step a) Define the mini-problem; Step b) Define the Problem Space and Interval; Step c) Define a Technical Contradiction; Step d) Define the Physical Contradiction; Step e) Define the Ideal Final Result Outcome; Step f) Define the X-Component; Step g) Analysis of Resources; Step h) Modification of Resources; Step i) Use Principles for Eliminating Physical Contradictions; Step j) Use Principles for Eliminating Technical Contradictions; Step k) Use Knowledge/Effects; Step l) No Solution?	367
What Do I Do?; References	367
Chapter 17. Problem Solving Tools – Trimming	369
17.1 Trimming Tool	369
Seven Questions for the Trial of Trimming a Component ; Trimming Sequence	
17.2 Trimming Rules	372
Function Capturing; Law of System Completeness; Coupled Functional Requirements	
17.3 Trimming Case Study Examples	376
Case Study 1 – Paper Stapler ; Case Study 2 – Time-Based Problems	
What Do I Do?; References	382
Chapter 18. Problem Solving Tools – Ideality/ideal Final Result	385
18.1 Structured Thinking Questionnaire	385
18.2 'Self' Solution Trigger Tool – 'Self-X' Patents	386
'Self-Cleaning' Filters – Difference between Conventional Thinking and TRIZ-Based Ideal Thinking ; Another Example – 'Self-Cleaning' Oven ; 'Self-X' Patents; 'Self' and Your Problem	
18.3 Resources and System Hierarchy Tool	393
What Do I Do?	395
Chapter 19. Problem Solving – Psychological Inertia Tools	397
19.1 9-Windows/System Operator	397
19.2 Smart Little People	399
Basic Process of the Smart Little People Modelling ; Case Study – Reducing the Size of a Diffuser ; Other Examples	
19.3 Size-Time-Interface-Cost (STIC) Tool	403
8 Questions of the STIC Tool ; Case Study – Taking-off and Landing of an Aircraft	
19.4 Why-What's Stopping Analysis Tool	405
'Why-What's Stopping' Tool for Solution Generation; Case Study – Home Delivery Pizzas ; Summary	
What Do I Do?; References; Bibliography	408
Chapter 20. Problem Solving Tools – Subversion Analysis	
	for Improving Reliability
	411
20.1 Basics of the Reliability Concept	411
Problems in the Designs for Reliability ; Measures of Reliability – Failure Rate and Reliability ; Origin of the Reliability Problems – Benefit vs. Cost ; Problem of the Ambiguity in the Safety Factor	
20.2 Reliability Contradictions	415

	Unknowable Nature of Reliability Numbers ; Approach of Improving Reliability by Identifying Root Contradictions ; Improving Reliability by use of Contradiction Matrix and Invention Principles	
20.3	Design for Reliability Constant Failure-Rate Model and Bath-Tub Curve Model ; System Analysis ; Fault Tree Analysis (FTA) ; Failure Mode, Effects and Criticality Analysis (FMECA/FMEA) ; Limitations of FMEA and FTA ; Application of Artificial Intelligence ; Adding In the TRIZ Parts ('Subversion Analysis') [Basic Idea of Subversion Analysis ; Subversion Analysis supported by the S-Field Model ; Case Study – Leakage of an Hydraulic Coupling] ; Now What? [Summary of Various Design Methods for Reliability ; Overcoming the Reliability Limit by a Paradigm Shift in the Design Methodology] ; Someone, Somewhere Already Solved Something Like Your Problem	416
20.4	The Future Importance of Design for Reliability	426
	What Do I Do?; References	427
Chapter 21. Solution Evaluation		429
21.1	Select the 'Best' Solution Simple Multi-Criteria Decision Analysis (MCDA) [Basic Process of MCDA ; Example of MCDA Analysis]; Ratio-Scaling MCDA [Basic Process of Ratio-Scaling MCDA ; Example of Ratio-Scaling MCDA Analysis]; Sensitivity Analysis ; Robustness Analysis	429
21.2	Good Enough? Axiomatic Design ; 'The Next Contradiction' ; Resource Assessment ; Combinations	435
	What Do I Do?; References	437
Chapter 22. Into The Future		439
22.1	TRIZ and 'Systematic Creativity'	439
22.2	Evolving TRIZ	440
22.3	Evolving 'Systematic Creativity' TRIZ and Function Analysis/Value Engineering (VE) ; TRIZ and QFD and Robust Design (Taguchi Method) ; TRIZ and Design for Manufacturing and Assembly (DFMA) ; TRIZ and Axiomatic Design (AD) ; TRIZ and Viable System Model (VSM) ; TRIZ and Multi-Criteria Decision Analysis (MCDA) ; TRIZ and Six Sigma ; TRIZ and Theory of Constraints (TOC) ; TRIZ and De Bono ; TRIZ and Neuro-Linguistic Programming (NLP) ; TRIZ and Kansei Engineering	441
22.4	Further Ahead	446
	What Do I Do?; References	447
Appendix A. 'Define' Pack		449
	1. Benefit Analysis (Project and its benefits) ; 2. Problem Hierarchy (What is the Problem?) ; 3. Functional Analysis (What is the Current System?) ; 4. Past and Future (How does Time Affect the System?) ; 5. Technical Resources (Function, Substance, Field) ; 6. Knowledge Resources (Sponsor, Customer, and Team) ; 7. Technical Constraints (Function, Specification, Process, Tools) ; 8. Business Constraints (Time, Cost, Risk, Skills) ; 9. Sore Point (What are the Things That are Stopping Us?) ; 10. Sore Point (What Aspects?) ; 11. Sore Point (Where/When are the Bottlenecks/Contradictions?) ; 12. Ideality (Ideal Final Result) ; 13. S-Curve (How Mature Is the Current System?)	