Hands on Systematic Innovation **G. Hyland**
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Mr. Mann, former Rolls Royce chief engineer and University of Bath industrial fellow for systematic innovation research, leads management consulting companies Blackswan and Systematic Innovation. He has given courses to over 3000 on systematic innovation and is amongst the most widely published in the field (600+ papers & articles).

Primary/secondary sources reference 23 chapters, e.g. Perception+ Software www.systematic-innovation.com, Savransky S. "Engineering of Creativity" CRC Press 2000, Altshuller G. "To Find an Idea" Nauka Moscow 1985.

The book is one volume of a two part series – the first gives a macro view (Business and Management) whilst this focuses on "Technical Systems". The text is formatted into six sections 1) introduction, 2) problem definition, 3) tool selection, 4) problem solving tools, 5) solution evaluation, and 6) future directions. TRIZ (Teoriya Resheniya Izobreatatelskikh Zadatch) comprises 1500manyrs of research into a significant portion of the world's most successful solutions from the sciences, math, engineering and the systematic analysis of successful patents from around the world, together with the study of the internal, psychological aspects of human creativity. The pillars deduced are – contradictions, ideality, functionality, resources, and space/time/interface. Systematic innovation may evolve further by including Game & Chaos Theories, Spiral Dynamics, Fourth Turning, Pattern Language, Cybernetics and General Periodicity. Generally 10% of the audience find the system is not for them, 50% like it, 35% learn piece-by-piece as the situation demands, and 5% are bitten by the TRIZ virus which can lead to burnout. Teamwork is vital e.g. adding significantly to the solution space – if 10 people are asked to scribe 10 connecting words each, duplication is ~5%, i.e. >90 connected words are generated. Different styles of thinking are appropriate for each of the four phases, and sub-phases; thus one should mix the team and use appropriately.

Today's problem can become tomorrow's opportunity and 90% of a problem is defining what it is. The Key is 3 of 5 approaches described – problem explorer, function & attribution analysis (FAA), and S-curve analysis. 1) Problem Explorer works by benefit analysis, parameter-identification (resources, constraints, sore-point), and hierarchy. Energy auditing, theory of constraints (TOC), subversion and root cause analysis (RCA) can supplement. 2) FAA is attribute, time & space based function modeling. 3) S-curve graphs describe product/technology life-cycles (conception, birth, infancy/growth, maturity, retirement). Curves map against time, the number of inventions & competitors, and invention focus (make it work, work properly, performance, efficiency, reliability, cost – looking for the point of maximum complexity).

A matrix mapping analysis (p177) of solution tool choice narrows the space from 11 (one per chapter) to a more manageable 6 approaches. Unfortunately no insight is given in "problem/opportunity-situation" frequency generally or in specific subject matter domains (e.g. mechanical, electrical, chemical fields). The Key solution methodologies, formulaic by nature, are in order – knowledge, physical contradictions, technical contradictions, trends, IFR (ideal final result) and S-fields. e.g. for a measurement problem one should use 1st S-fields, 2nd IFR, 3rd knowledge and 4th technical contradictions.

The gist in solution generation is – stand tall by standing on the shoulders of others who went before, i.e. don't re-invent the wheel. 1) Knowledge – the most obvious and important, is a database of functional effects, combined with a database of attribute altering effects, and patent search strategies. The functional effects (physical, chemical, biological) are organized by primary function vs. solid, liquid, gas & field. Attribute altering effects are organized by attribute vs. means of – changing, increasing, decreasing, stabilizing, and measuring. 2) Physical Contradictions – focus on when, where, if, and transitions to an alternative system. 3) Technical Contradictions – map 39 basic "parameters", to be improved vs. those which get worse, with the intersection containing Inventive Principles used to solve specific problems. e.g. the top-8 of the 40 principles are segmentation, preliminary action, the other way round, dynamics, periodic action, blessing in disguise, self-service and parameter changes. 4) Trends (of Evolution) – are monolithic solid -> hollow structure -> structure with multiple hollows -> capillary/porous structure -> porous structure with active elements. Two exceptions are mono-bi-poly trend & trimming. The 37 trend lines collate into 3

groups – 13 space, 6 time, 18 interface related. 5) IFR(/Ideality) – uses structured thinking, "self" solution trigger tool, and connection to resources & system hierarchy tools. 6) S-field models – decompose system function minimally into 2 substances & 1 field using a guide of relevant inventive standards to problem solve.

Once generated, solution evaluation includes MCDA (multi-criteria decision analysis) and ratio-scaling to generate a first cut conclusion about different answers. This is then refined using sensitivity and robustness analysis. It is important to go around the systematic creativity process at least twice to identify whether the solution is good enough using axiomatic design, next contradictions, resource assignment and combinations.

Though interesting examples are given they are not convincing, never-mind compelling. Disappointingly the same systematic rigorosity applied throughout falls down when ranking "solution-creation" methodologies. Text can be too long to get the key points across, and simultaneously not illustrative enough – a writer's paradox to be sure. A smaller tighter book would be better – "introduction, 3 key problem definitions, tool choice matrix, 6 key solving methods, evaluation" for half the size covering ~85% of what's used in practice. A separate volume – worked soup-to-nuts examples taking 10-20 problems to final conclusions demonstrating "How" the answers were arrived at.

Overall – recommended with reservation: gives a "feeling", but no panacea. TRIZ can only be learnt by practice.