Solving Engineering Problems with Systematic Innovative Approach: Acquiring TRIZ as Your Skill

URBAN ENGINEERING DEVELOPMENT SPECIAL INTEREST GROUP

reported by

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Engineers are accustomed to coming up with innovative solutions for various engineering problems. The methods used to solve engineering problems usually require a certain systematic approach or strategy.

The TRIZ is one such method. To introduce IEM members to TRIZ, the Urban Engineering Development Special Interest Group (UEDSIG) organised a 2-hour lecture by Assoc. Prof. Dr Yip Mum Wai, Dean of Faculty of Engineering at Tunku Abdul Rahman University College (TARUC). Prof. Yip is a certified TRIZ instructor and a certified Theory of Open Problem-Solving instructor. He has won many innovation and research competitions and has embarked on several successful ventures in start-up innovative companies. The talk on 5 July, 2017, was attended by IEM members from varied engineering fields.

TRIZ is the acronym for a Russian phrase, *"Teoriya Resheniya Izobretatel'skih Zadatch"* which translates as "Theory of Inventive Problem Solving". It was initially developed by an acclaimed 20th century Russian engineer, scientist and inventor, Genrikh Saulovich Altshuller (15 Oct, 1926 – 24 Sept, 1998).

Dr Yip Mum Wai, Dean of Faculty of Engineering at Tunku Abdul Rahman University College (TARUC)

Russian engineer, scientist and inventor, Genrikh Saulovich Altshuller

Essentially, TRIZ is a method or procedure of systematic problem-solving skills (uncertainty) based on past successful solutions. It is used as a toolset or flowchart to solve possible future problems (uncertainty) in a systematic sequence. Consequently, the TRIZ method reduces wasted or down time by focusing quickly on real solutions in creative and innovative ways. Engineers can then focus on what they do best, that is problem solving and reducing down time in an efficient way. However, engineers should note that this method does not replace or substitute technical knowledge.

TRIZ is based on the study of patterns of problems and solutions. It is a systematic problem-solving method based on logic and data, instead of relying on the intuition of individuals or groups. A key feature

40 Inventive Principles

1. Segmentation
2. Taking Out or Extraction
3. Local Quality
4. Asymmetry
5. Merging or Combination
6. Universality
7. Nested Doll
8. Anti-weight or Counter weight
9. Preliminary anti action/Prior counter action
10. Preliminary action/Prior action
11. Beforehand cushioning/Prior Cushioning
12. Equipotentiality/Remove tension
13. The other way around
14. Spheroidality-Curvature
15. Dynamics
16. Partial or excessive actions
17. Another dimension
18. Mechanical vibratin
19. Periodic action
20. Continuity of useful action
21. Skipping/Hurrying
22. Blessing in Disguise
23. Feedback
24. Intermediary
25. Self-service
26. Copying
27. Cheap/Short Living
28. Mechanics substitution/Another sense
29. Pneumatics and hydraulics/Fluidity
30. Flexible shells and thin films/Thin & flexible
31. Porous Materials/Hotels
32. Colour changes
33. Homogeneity
34. Discarding and recovering
35. Parameter changes
36. Phase transitions
37. Thermal expansion/Relative change
38. Strong oxidants/Enriched Atmosphere
39. Inert Atmosphere/Calmed Atmosphere
40. Composite materials/Composite structure

Figure 1: 40 Inventive Principles

of TRIZ is Inventive Principles. This is a basic, generalised rule that is accepted as fact and works in an exactly the same way consistently, such as Segmentation, Taking Out or Extraction, Local Quality and others. Another key feature is Contradiction Matrix. Contradiction is defined as "improvement in one characteristic of a system results in the degradation of another characteristic".

Segmentation is an inventive principle. It involves dividing an object into independent parts. It makes an object sectional for easy assembly and disassembly. Examples include do-it-yourself furniture, camping test, modular office, 3D puzzles and others.

Another inventive principle is Extraction or Taking Out. This involves separating an interfering part from an object. Examples include an air-conditioning compressor unit, tooth extraction and medical ampoules. Another inventive principle is symmetry. This involves changing the shape of an object from symmetrical to asymmetrical or, if an object is asymmetrical, increasing its degree of symmetry. Examples are chair design, fashion or hairstyles.

There are a total 40 inventive principles in TRIZ which can be used for innovation and problem solving. The 40 inventive principles are shown in Figure 1.

These inventive principles are then used within a contradiction matrix based on the analyses of 2.8 million international patents. It is a systematic method to solve engineering contradictions without trade-off solutions. With this, the user can identify improving and worsening features of the engineering system. An example of contradiction matrix is shown in Figure 2.

Group Photo

The workshop is just an introduction to TRIZ as there are several levels of training and certification for TRIZ. IEM plans to organise an advanced workshop (Level 1) on TRIZ in the near future. Those interested to learn more can refer to future TRIZ related talks/ workshop by IEM or directly contact Malaysia TRIZ Innovation Association (MyTRIZ) at www.mytriz.com.my. ■

Contradiction Matrix

39 Worsening Parameters

39 Improving Parameters

Worsening Feature → / Improving Feature ↓	Speed	Shape	Loss of Time	Reliability	Measurement accuracy	Ease of Operation	Adaptability or versatility	System complexity	Measurement Difficulty	Productivity
Speed	+	35, 15, 18, 34		11, 35, 27, 28	28, 32, 1, 24	32, 28, 13, 12	15, 10, 26	10, 28, 4, 34	3, 34, 27, 16	
Shape	35, 15, 34, 18	+	14, 10, 34, 17	10, 40, 16	28, 32, 1	32, 15, 26	1, 15, 29	16, 29, 1, 28	15, 13, 39	17, 26, 34, 10
Loss of Information	26, 32		24, 26, 28, 32	10, 28, 23		27, 22			35, 33	13, 23, 15
Loss of Time		4, 10, 34, 17	+	10, 30, 4	24, 34, 28, 32	4, 28, 10, 34	35, 28	6, 29	18, 28, 32, 10	
Measurement accuracy	28, 13, 32, 24	6, 28, 32	24, 34, 28, 32	5, 11, 1, 23	+	1, 13, 17, 34	13, 35, 2	27, 35, 10, 34	26, 24, 32, 28	10, 34, 28, 32
Ease of Operation	18, 13, 34	15, 34, 29, 28	4, 28, 10, 34	17, 27, 8, 40	25, 13, 2, 34	+	15, 34, 1, 16	32, 26, 12, 17		15, 1, 28
Ease of repair	34, 9	1, 13, 2, 4	32, 1, 10, 25	11, 10, 1, 16	10, 2, 13	1, 12, 26, 15	7, 1, 4, 16	35, 1, 13, 11		1, 32, 10
Adaptability or versatility	35, 10, 14	15, 37, 1, 8	35, 28	35, 13, 8, 24	35, 5, 1, 10	15, 34, 1, 16	+	15, 29, 37, 28	1	35, 28, 6, 37
System complexity	34, 10, 28	29, 13, 28, 15	6, 29	13, 35, 1	2, 26, 10, 34	27, 9, 26, 24	29, 15, 28, 37	+	15, 10, 37, 28	12, 17, 28
Productivity		14, 10, 34, 40		1, 35, 10, 38	1, 10, 34, 28	1, 28, 7, 10	1, 35, 28, 37	12, 17, 28, 24	35, 18, 27, 2	+

Figure 2: Contradiction Matrix