



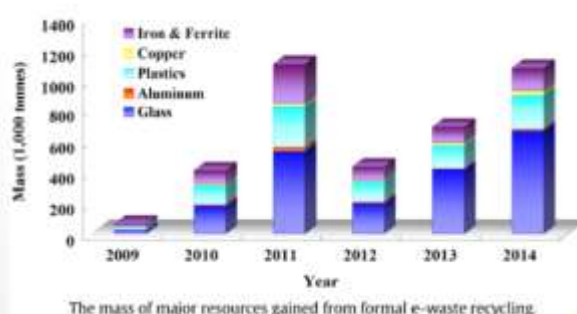
Report for eETD Technical Talk - Introduction to E-Waste & Theory of Inventive Problem Solving (TRIZ)

by Ir. Dr Lee Choo Yong

Ir. Dr Lee Choo Yong is currently a committee member in Electronic Engineering Technical Division (eETD) and IEM Penang Branch.

IEM eETD organized evening talk on Introduction to E-Waste & Theory of Inventive Problem Solving (TRIZ) delivered by Ir. Bhuvendhraa Rudrusamy and Dr. Yeap Gik Hong respectively. The talk started at 6:00pm, 12 members attended the talk.

Ir. Bhuvendhraa started his talk with introduction of pollutions, ecosystem and e-waste, e-waste refers to thrown away electronic devices, typical e-waste are computer, mobile phone and television. The e-waste increases as life span of electronic devices becoming shorter, as technology grow rapidly, electronic devices become obsolete faster, typical example is smart phone. As electronic devices usually contain 1000 over substance, some of them are harmful to human and environment. Ir. Bhuvendhraa shared typical e-waste recycle process comprises disassembly, dismantling, separation, crushing and smelting and recyclable materials from e-waste.



E-waste and recyclable materials from e-waste

Ir. Bhuvendhraa then mentioned about hazardous substances of e-waste such as polychlorinated biphenyls (PCBs), americium, toner dust, arsenic, barium, lead, cadmium etc and their implications to human and environment. For instance, metals like lead and cadmium will result in neurotoxicity and dysfunction of hematopoietic, asthma, cough and wheeze. Ir. Bhuvendhraa also shared e-waste management, regulation under purview of Department of Environment (DOE) and challenges with the floor. It is forecasted that 1.11 million metric tons of e-waste will be produced in 2020. At the end of the talk, Ir. Bhuvendhraa emphasized that everyone has obligation to reduce e-waste and shared about collection centers as listed in DOE website <http://www.doe.gov.my/household-ewaste/> for proper household e-waste disposal.

Dr. Yeap introduced Theory of Inventive Problem Solving (TRIZ) by sharing a table design example and also deployment of TRIZ in Malaysia. The compromise curve was used to explain constraint of conventional compromise problem solving strategy. After that, Dr. Yeap introduced TRIZ, the Russian acronym for Theory of Inventive Problem Solving. It is a systematic problem solving method based on logic and data, not intuition or spontaneous creativity of individuals or groups. It is based on the study

of patterns of problems and solutions. TRIZ provides repeatability, predictability, and reliability due to its structure and algorithmic approach which improves individual or team's ability to solve problems.



Compromise curve which shows limitation in problem solving

Up to date, there are more than 2.8 million patents have been analysed and investigated. Dr. Yeap shared key discoveries based on worldwide patent analysis.

- Problems and solutions were repeated across industries & sciences → 40 inventive principles for solving problems
- Patterns of technical evolution were repeated across industries & sciences → technology trends to evolve a product to the next generation
- Innovations used scientific effects outside the field from where the original problem was found → scientific effects can be used to solve problems in unique ways

The 40 inventive principles are as follow:-

TRIZ tool - 40 Inventive Principles

<ol style="list-style-type: none"> 1. Segmentation 2. Taking Out 3. Local Quality 4. Asymmetry 5. Merging 6. Universality 7. Nested Doll 8. Anti-weight 9. Preliminary anti action 10. Preliminary action 11. Beforehand cushioning 12. Equipotentiality 13. The other way around 14. Curvature 15. Dynamization 16. Partial or excessive actions 17. Another dimension 18. Mechanical vibration 19. Periodic action 20. Continuity of useful action 	<ol style="list-style-type: none"> 21. Skipping 22. Blessing in Disguise 23. Feedback 24. Intermediary 25. Self-service 26. Copying 27. Cheap short -living objects 28. Mechanics substitution 29. Pneumatics and hydraulics 30. Flexible shells and thin films 31. Porous Materials 32. Color 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
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Dr. Yeap then further elaborated a few principles such as segmentation, nested doll and dynamization as examples. The 40 Inventive Principles are not only applicable in the field of engineering but also management as well as computing.

Principle #1: Segmentation

- Divide an object into independent parts
- Make an object sectional – for easy assembly and disassembly
- Increase the degree of an object's segmentation or fragmentation
- Transition to micro-level



Furniture



Camping Tent



Lego blocks

e.g. Break into small teams. Virtual office. Modular office. Divide a difficult problem into smaller segments for better focus. Market segmentation

e.g. Distributed computing e.g. client server computing (BitTorrent peer-to-peer model), front-end (UI) back-end (data). Segment large files into small data packets (e.g. IP packets in internet)

Principle #7: Nested doll

- Place one object inside another, place each object, in turn, inside the other
- Make one part pass through a cavity in the other



Matryoshka Dolls



Stacking cups



Tripod stand



Luggage bags



Antenna of a car which can be retracted or extended

e.g. Store-in-store. Profit centres inside an organization. ATM work for multiple banks

e.g. Create Powerpoint presentation from Word. Cascading menu with main menu having submenus which have further submenus

Principle #15: Dynamization

- Allow for the characteristics of an object, external environment, or process to change to be optimal or to find an optimal operating condition
- If an object is rigid or inflexible, make it movable or adaptive
- Divide an object into parts capable of movement relative to each other



Expandable Table



Bicycle Chain

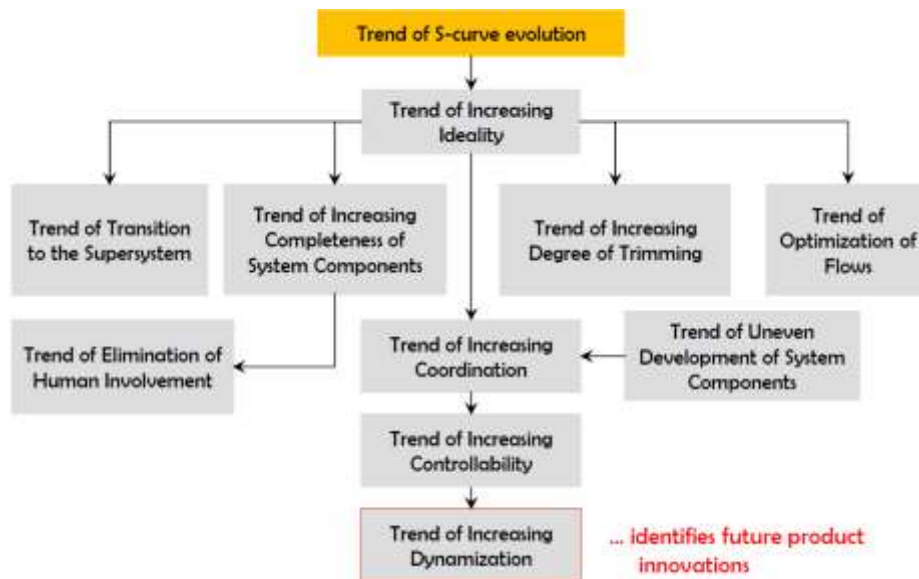


Flexible vehicle for rough terrain

e.g. Mobilize people from different organization to work on problem/project. Flexible shift pattern. Temporary workers. Job rotation to higher skilled job or different module/equipment/scope. Customer Response Team. Continuous Process Improvement

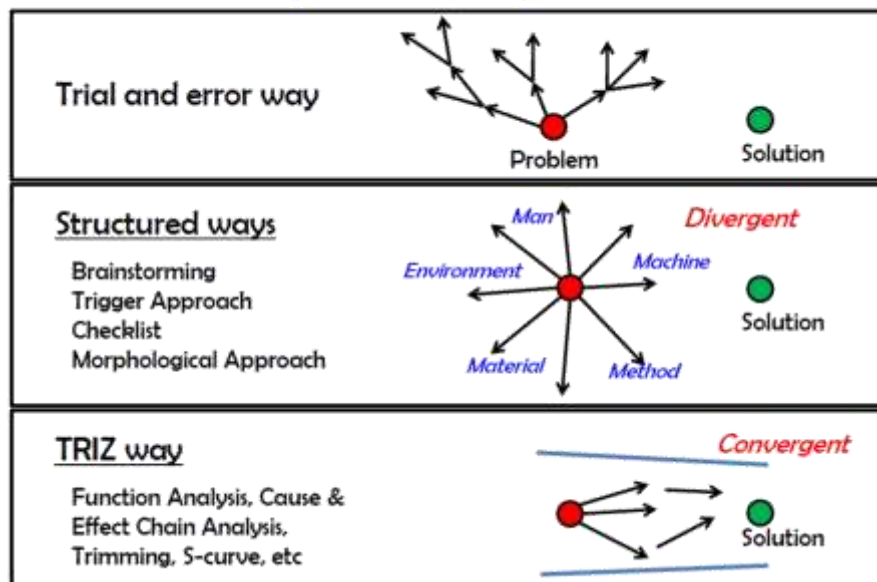
e.g. Movies and animation compared to static images. Animated buttons which show animation when mouse is moved over it. Banners that run across a web page

As for the technological trends, there are 9 trends all together that can that can be used to forecast innovation roadmap as follow:



Dr. Yeap then used the examples of removing the core from bell pepper, removing the shell from cedar nuts and braking artificial diamond that using generic solution of "slowly raise pressure and suddenly reduce it" to explain how innovations used scientific effects outside the field from where the original problem was found. Finally, Dr. Yeap concluded that TRIZ provides very structured methodologies through various tools which accelerate time to problem solving and solution innovation. Comparisons have been made to the conventional trial and error way, structured way and TRIZ way to solve problems to reach the conclusion.

Ways to solve a problem



At the end of the talk, IEM Penang branch chairman Ir. Ting Chek Choon expressed gratitude to speakers and participants and presented certificates of appreciation to Ir. Bhuvendhraa Rudrusamy and Dr. Yeap Gik Hong. A group photo was also taken at the wrap-up session.



Left - IEM Penang branch chairman Ir. Ting Chek Choon presenting certificate of appreciation to Ir. Bhuvendhraa Rudrusamy. Right - Ir. Ting presenting certificate of appreciation to Dr. Yeap Gik Hong.



Group photo at the wrap-up session