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Contradiction Matrix Applied to Value Analysis Value Engineering (VAVE)

Ainul Farahin Binti Abdullah*,
Kulliyyah of Material and Manufacturing Engineering, International Islamic University Malaysia, Selangor, Malaysia.
Email: farahin828@gmail.com
Erry Yulian Triblas Adesta,
Kulliyyah of Material and Manufacturing Engineering, International Islamic University Malaysia, Selangor, Malaysia.
Email: eadesta@iium.edu.my

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Abstract:

This paper presents one of the tools used in Theory of Inventive Problem Solving (TRIZ) methodology; Contradiction Matrix and its implementation during New Product Development (NPD) phase structured by the Value Study. A comparison has been made between TRIZ matrix with Value Study matrices and discussed to achieve product optimization. Finally, results obtained are discussed.

Keywords: *Contradiction Matrix, Theory of Inventive Problem Solving (TRIZ), Value Analysis Value Engineering (VAVE)*

I. INTRODUCTION

A New Product Development (NPD) phase is a stage-gate product development process used by many companies in order to encourage rapid product development and to cull out the least promising projects before large sums of money are committed. The application of NPD is based from the engineering design process which consists of 7 main phases; conceptual design, embodiment design, detail design, planning for manufacture, planning for distribution, planning for use and planning for retirement [1]. Figure 1 below shows the flow summary of the 7 phases.

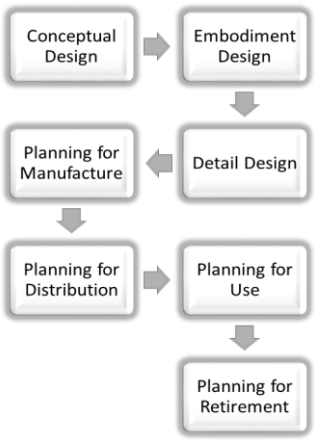

Fig. 1. Summary of the Engineering Design Process for NPD

Previous study shows integration has been made between NPD and Value Study; Value Analysis (VA) and Value Engineering (VE) [2]. VAVE has proven its ability to verify the worth of a particular product and process through the application on series of tools governs by the Job Plan. However, it is found that a new integration within these methodologies with the one been applied within the Theory of Inventive Problem Solving (TRIZ) may further enhance the verification process and lower the design risk. This would then give the opportunity to improve the design value without compromising with the harmful may present.

II. JOB PLAN

Job Plan consist of three main phases; Pre-workshop, Workshop and Post-Workshop. While Pre-workshop phase assign to prepare for the foundation of the studies and Post- workshop responsible for the follow up action plan, the Workshop phase involve six other sub-phases; information gathering phase, function and analysis phase, creative phase, evaluation phase, development phase and presentation phase [3]. A new integration is found within the Workshop phase of Job Plan where new tool can be introduced from TRIZ;

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Contradiction Matrix. Figure 2 shows the summary of Job Plan different stages.

Fig. 2. VAVE Standard Job Plan Cycle. [3]

III. CONTRADICTION MATRIX

Contradiction Matrix is one of the two methods in applying the Inventive Principle in TRIZ. This tool introduced to solve the Engineering Contradiction Model of Problem by defining the key of problem for choosing the
accurate Specific Inventive Principle. Contradiction Matrix will result in an improvement for one characteristic of a system with degradation of another characteristic or parameter [4]. Figure 3 shows how this matrix can reflect the two or more component parameters in a positive-negative interaction.

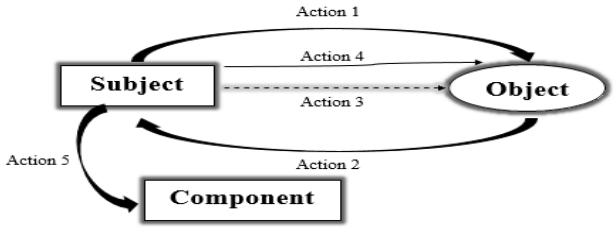

Fig. 3. Engineering Contradiction with positive and negative interaction between components.

IV. ADVANTAGES

The advantages of Contradiction Matrix are as follows:

- Facilitate the use of 40 Inventive Principle
- Identify System Parameters in solving the specific problem.
- Construct 39 x 39 matrix which comprise of worsen parameter at the x-axis and improve parameters at the y-axis to improve the contradiction.
- Point out the functions view rather than component view.
- Improve the Engineering System.
- Improve individual and team's ability to solve problem without require any special knowledge.

V. LIMITATION

The Contradiction Matrix in TRIZ is developed by Genrich Altshuller and his colleagues which based from the study of patterns, problems and solutions [4]. However, there is still possibility of getting no ideal solution for the required set of Inventive Principle base from the matrix. If this happen, study need to be proceed with the remaining 40 Inventive Principle. Figure 4 shows the structure of TRIZ tools.

VI. STRUCTURE OF TRIZ TOOLS

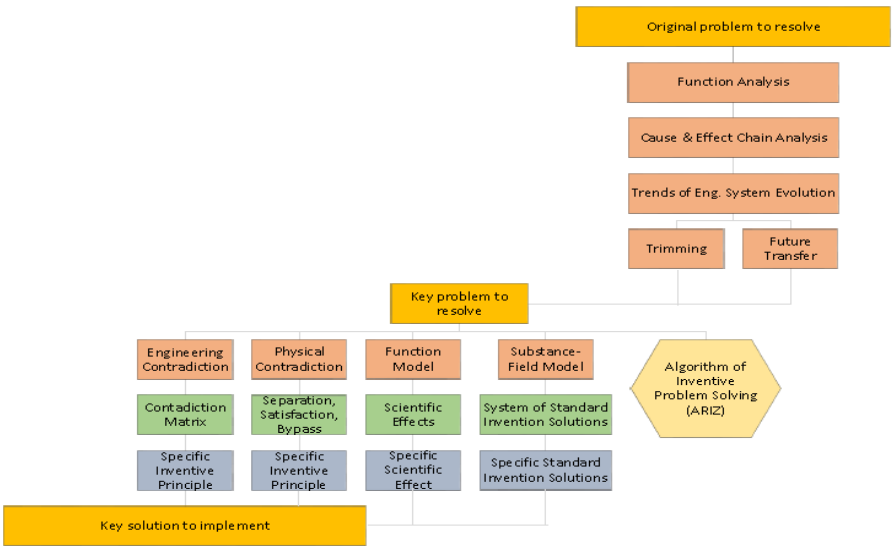

Fig. 4. Structure of TRIZ tools. [4]

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VII. VAVE ENHANCEMENT

Previous research shows several matrices within Value Study for the verification purposes mostly to achieve the target costing in VA. Figure 5 shows the detail of those matrices; Performance Score and Improvement Potential Index before conclude the Cost Benefits of the particular product or process from the previous study. While in VE, the matrices are limited to only Morphological Chart and Pugh Chart for the concept generation and selection. The technical analysis in VE is only base on the benchmarking activity within the team members which then would only depend on their knowledge, experience and skills.

The weakness in VE analysis is found to be enhanced using the contradiction matrix, where benchmarking activity can be structured and guided within the 39 System Parameters especially for the complex problems. Figure 6 listed the 39 parameters for the general solutions selection from the general problem identified earlier.

(a)

Item	A	B	C	D	E		
Weight	3	3	2	3	4	Sum	Rank
Model							
1	1*3	1*3	2*2	1*3	1*4	17	2
2	2*3	2*3	2*2	2*3	2*4	30	1

(b)

	Performance Score a	Cost (Rm) b	Value Score a/b
Model			
1	17	6.50	2.62
2	30	6.50	4.62

(c)

Cost of part before VAVE	RM 8.00
Cost of part after VAVE	RM 6.50
Savings per part	RM 1.50
Value improvement	23.08%
Expected annual savings	RM 81,000.00

Fig. 5. (a) Performance Score, (b) Improvement Potential Index and (c) Cost Benefits for VE base on the previous study of Vehicle Outer Door Handle.

1. Weight of moving object
2. Weight of nonmoving object
3. Length of moving object
4. Length of nonmoving object
5. Area of moving object
6. Area of nonmoving object
7. Volume of moving object
8. Volume of nonmoving object
9. Speed
10. Force
11. Tension, pressure, stress
12. Shape
13. Stability of object
14. Strength
15. Durability of moving object
16. Durability of nonmoving object
17. Temperature
18. Brightness
19. Energy spent by moving object
20. Energy spent by nonmoving object
21. Power
22. Waste of energy
23. Waste of substance
24. Loss of information
25. Waste of time
26. Amount of substance
27. Reliability
28. Accuracy of measurement
29. Accuracy of manufacturing
30. Harmful factors acting on object
31. Harmful side effects
32. Manufacturability
33. Convenience of use
34. Repairability
35. Adaptability
36. Complexity of device
37. Complexity of control
38. Level of automation
39. Productivity

Fig. 6. 39 System Parameters.

VIII. CONCLUSION

In conclusion, Contradiction Matrix may be used to enhance product value while maintaining its intended functions for solving particular problems without scarifying any project requirements for safety, quality, operations, maintenance or environment. TRIZ matrix propose better structured and systematic problem solving approach within VE analysis. The integration would benefit Value Study to have better analysis both in term of technical view from VE and costing view from VA.

Details case study can be made on integrating the different tools within TRIZ and VAVE in various industry such as automotive or any other for the different product and process application.

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AUTHORS PROFILE

Ainul Farahin Binti Abdullah has obtained the master's degree in manufacturing engineering at the International Islamic University Malaysia, Malaysia (2017). She has been involved in creativity and innovation as the Production and Project Engineer, concentrating in the area of Value Analysis Value Engineering and TRIZ. She is a Graduate Engineer under Board of Engineers Malaysia (BEM) and certified TRIZ Practitioner.

Dr. Erry Yulian Triblas Adesta Manufacturing Systems Engineering at the Department of Manufacturing and Materials Engineering, Kulliyyah (Faculty) of Engineering, International Islamic University Malaysia. He is also Chartered Engineer (CEng) of Engineering Council (UK) as well as a Member of the Institution of Mechanical Engineers (MIMechE) (UK). Professor Adesta is immediate past Dean of Kulliyyah (Faculty) of Engineering.