INNOVATIVE CASES OF TRIZ APPLICATION IN AUTOMOTIVE INDUSTRY

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ABSTRACT

It is becoming increasingly difficult to ignore that cost reduction in product system are not supporting the development of innovation. This contradiction become a great challange for any type of industry, to improve the competitive level. In this research, the focuses on the mechanism of cost reduction using Design To Cost strategy in achieving cost improvment and innovation. The contradiction is solved using Theory of Inventive Problem Solving (TRIZ) that is integrated into Design To Cost Innovation framework. There are two type of cases intorduce in this research that highlight the application and the outcome of TRIZ in Design To Cost framework. From the case studies, the results shows that the magnitude of cost improvement and innovation achieved is more than the application of conventional tools in Design To Cost strategy.This change the limitation of mindset in cost reduction without compromise or trade-off, and open up new possibility of research for cost reduction in processes and services for various application.

KEYWORDS: TRIZ; Innovation; Design To Cost; Automotive; Case study.

INTRODUCTION

In the world of automotive industries, the competition is focus critically on product cost and technology advancement. The biggest challenge is the contradictions to achieve win-win situation for the product manufacturer and the customer. In order to produced cost effective product and at the same time providing the highest satisfaction to the target customer to capture more market share. The conventional approach to balance-up between new technology for customer and the incurred cost from the manufacturer is trade-off. TRIZ methodology is proposed to bring higher value to the customer, by engaging neither trade-off nor compromise. Using other research on Design-To-Cost (DTC) framework integrated with TRIZ [1], cost improvement and reduction able to achieve further compared to conventional approach. This research presents several innovative cases, applying TRIZ in automotive industry to generate innovative solutions.

From the literatures, there are a lot of tools that are currently been used in DTC program [2] [3]. The most commonly tools used are Brainstorming, Value Analysis, Trade-off, Pareto analysis and others [4]. Those tools are applied in a specific phases throughout the DTC process and activities. The common four phases DTC program are 'Prioritization Phase', 'Idea Generation Phase', 'Idea Evaluation Phase' and 'Implementation Phase'. Each of the DTC phase needs a systematic approach to ensure that innovation in product design can be executed while achieving cost reduction. An implementation framework is proposed to synergize the TRIZ methodology as systematic innovation to develop Design-To-Cost-Innovation framework, as showed in Figure 1.

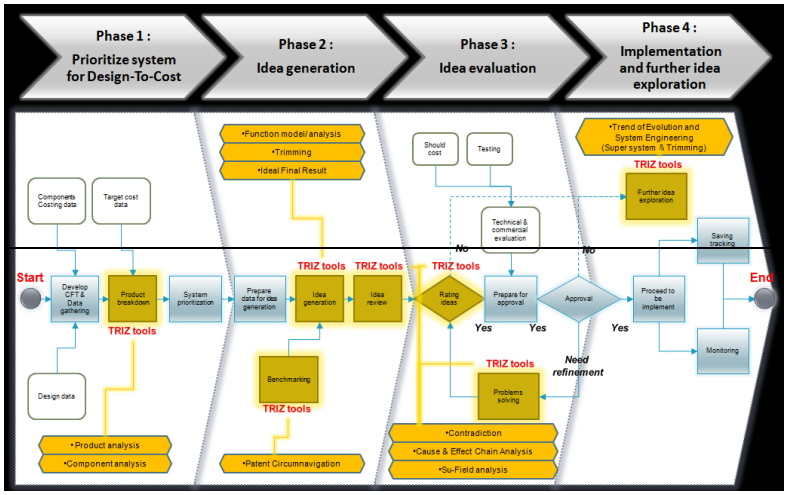

Figure 1. The proposed Design-To-Cost-Innovation (DTCI) Framework [1]

CASE PROJECT FOR DTCI FRAMEWORK USING TRIZ

The implementation of the proposed framework is been executed upon several breakthrough cases in automotive industry. Previously, there is a research on complexity planning for automotive components through this framework [5]. In this study, there will be two more case project presented. The first case project is about pushing the boundary of component optimization using TRIZ to achieved weight and cost reduction. A wiper system is studied to explore the conventional and TRIZ method to provide the best weight reduction idea and concept for the system. The second case project explores new tools from TRIZ called 'Patent Circumvention'. In automotive industry, patent plays a critical role in securing new findings and discovery that brings high impact to product competitiveness [6]. It aims to create opportunity to develop won patent and alongside, cost reduction on benchmarked systems.

An automotive OEM is selected where several case studies are developed by adopting the proposed framework. The company is selected because of their capability in conducting a full cycle product design process. There are 14 case studies developed utilizing the proposed framework, and involving both the OEM itself and several suppliers. The duration of each case study is around 1 to 3 months to be completed at the conceptual level and it takes further 6 to 12 months to actually implement the concept into the product for market. The cost improvement results are captured after the case implementation is completed.

Case project 1: Weight optimization on automotive components

In automotive industry, weight becomes a strong characteristic in automotive design. The weight gave significant impact on engine performance, stability and most important to the customer is fuel consumption. The team from Body equipment section choose wiper bracket component, as shown in Figure 2, as comparison case study to identify the results of conventional optimization process and the DTCI framework. The ultimate goal for this case study is to reduce as much as material has been used to manufacture the component. Therefore it indirectly reflects to the cost reduction outcome on the material consumption related to the bracket design.

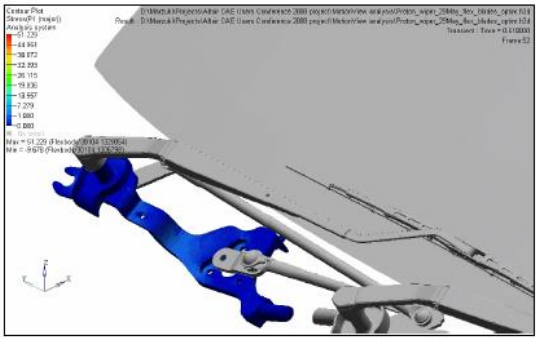

Figure 2. The wiper bracket in wiper system for automotive.

The team starts with optimizing the wiper bracket using special and expensive Computer Aided Engineering (CAE) software to assist them on identifying the area that has high potential to be discarded through stress-strain flow coloured mapping analysis. Then the engineer redesign the bracket by taking out some portion of the component and run back the analysis to validate the modified component. The component is fabricated as prototype and the data of weight reduction is measured.

The same team member has been trained and certified with TRIZ level 1 to ensure they have the competency to use certain type of tools such as contradiction matrix. The team starts to identify the contradiction parameters based from the function of the wiper bracket. While focusing to reduce the weight of stationary object, the affected parameters are force, strength, stability, reliability and ease to manufacture. The contradiction matrix shows the recommended inventive principles to the engineers to develop a better concept of wiper bracket with better weight reduction. After analysing the solution and adopt it into the wiper design, the new wiper bracket is fabricated as prototype and the weight is measured, similar as previously done.

The inventive principles analysis is done based on cost impact and total concept feasibility level evaluated by the experts. Figure 3 shows there are four inventive principles that have low cost impact and high feasibility to develop. The evaluation matrix filtered the recommended inventive principles specifically related to project scope and budget. Those recommended concept is been discuss and review in detail by the designers.

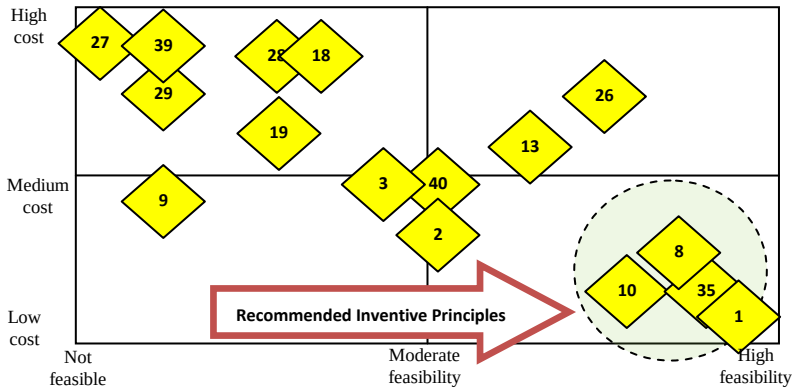

Figure 3. Analysis of inventive principles on technical & commercial evaluation matrix.

The new design is created based from the concept of inventive principles called segmentation and change parameters. In detail design features, the designer changed the body of wiper bracket into three parts, which the main body is hollow type shaft and both mountings are smaller and use lightweight material, such as alloy.with both product is developed until prototype level, the comaprison can be simutaed to identify the outcome of this project case. Figure 4 shows the physical design for both wiper bracket to be analysed.

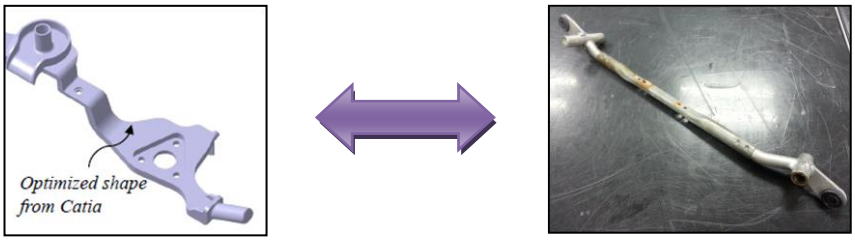

Figure 4. The optimized design concept is modified with adopted Inventive Principles

As shown in Table 1, the result achieved by current optimization method is 22.1% weight reduction against existing design. Meanwhile, optimization method using TRIZ achieved 75.3% of weight reduction against existing design. This clearly shows that TRIZ give higher impact in component weight optimization than existing method.

Table 1. Weight improvement and optimization design and TRIZ design solution.

Level of bracket design	Weight improvement (kg)	% of weight reduction
Current design	1.504	-
Optimized design	1.172	22.1%
Adopting TRIZ optimized design	0.371	75.3%

Case project 2: Patent development with cost reduction

As all know patent brings new level of competitiveness, especially in automotive industry. Innovative Benchmarking may open up new possibility to create another innovation. This can be achieved using Patent Circumvention. However, in the real situation things maybe more difficult when cost reduction is also a part of the target, which is normally people compromise for the long term goal. DTCI is used to explore this situation and to demonstrate how the results are achieved, and later comparison is made to the normal patent development process.

A team that specialized in automotive power-train and transmission is exploring the patent on cylinder deactivation system. There are four types on patents related to cylinder deactivation system benchmarked by the team. Those are patent filed by Bentley, Audi (Cylinder on demand), Bosch and Volkswagen. The activity really requires strong teamwork between the group of designers and the group from legal unit, from the very beginning of the project. For the mechanism of the selected system, patent circumvention process used trim out and for secondary problem is solved using Technical Contradiction. Figure 5 shows the process of TRIZ application for patent circumvention.

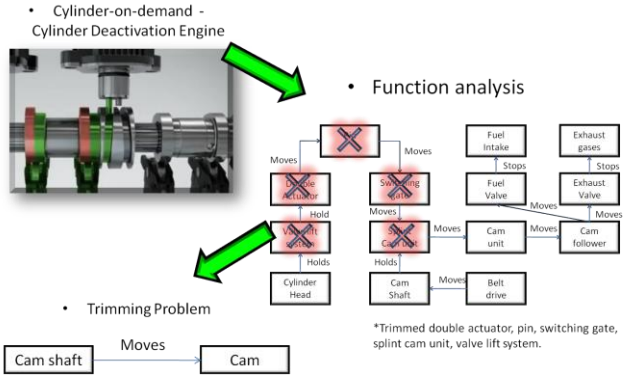

Figure 5. Function analysis and trimming process for patent circumvention.

Using the feasible concept generated, new system of cylinder deactivation is created, as shown in Figure 6. However, the concepts need to be refined further in term of technical ground and also legal perspective. This creates patentable solution that different from others competing patents.

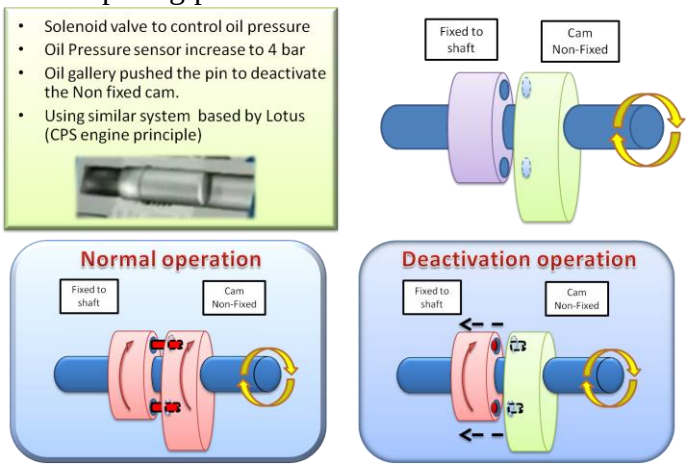

Figure 6. New patent developed using patent circumvention approach with low development cost.

RESULTS AND DISCUSSIONS

The result from both case projects shows that the application of TRIZ methodology in DTC generates significant impact to cost reduction in the automotive components and enhanced the innovation level of existing system [7]. The application of TRIZ in the DTC program achieved effective cost saving through product or component design improvement. TRIZ methods change the thinking process to extract more innovative ideas

and expand new inventions that produces significant impact on cost reduction.

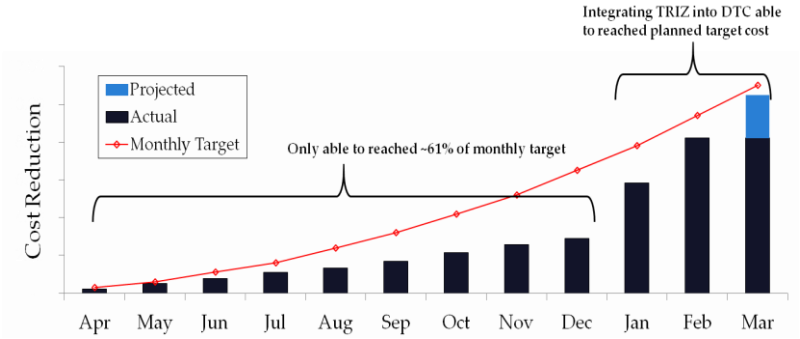

Figure 7. The cost improvement results through DTCI framework in automotive industry

In the same financial year (2011/2012), the organization really shows significant results in cost reduction performance, as shown in Figure 7. Those initiatives continue, adopting the proposed framework and eventually achieved further cost reduction in the following financial year.

CONCLUSIONS

This project cases has explained the central importance of DTCI framework that adopt TRIZ to enhance the result of cost improvement through innovation. The present study was designed to determine the effect of adopting TRIZ in cost strategy and compare to any existing available methods. One of the more significant findings to emerge from this study is that all limitations and contradiction in reducing cost at product design level can be solved using DTCI. The results of this research support the idea that the cost reduction achievement can be enhanced better using TRIZ method [7]. The findings of this study have a number of important implications for future practice beyond product design, for example process design or service design in cost reduction initiatives.

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