EXAMINATION OF CROSS-FUNCTIONAL ACTIVITIES FACILITATED BY ABSOLUTE VALUE TARGET COSTING AND COMMITTEE ACTIVITIES AT TOYOTA MOTOR CORPORATION

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ABSTRACT

For many years, Toyota Motor Corporation has used variance from current cost as the basis for new part cost target setting. The incremental cost of the added specifi cation is added to the current price of the part to establish a new cost target in variance-based target costing. Then by year 2000, Toyota switched to absolute value target costing that sets the target cost per vehicle by absolute value. The variance-based target costing was reasonable until 1990's in Japan because suppliers of many parts were fixed and expenses other than design cost were relatively stable. However, it does not effectively work at overseas target costing because suppliers who have unique production processes or logistics may change at each model change. In addition to the change of target costing method, during this time, committees related to the cost became active and cross-functional activity was facilitated. Introduction of committee activities brought a change of development structure at Toyota from a matrix organization to three-dimensional structure. These changes in target costing brought about drastic changes as compared to previous few decades. In this article, the meaning and results of committee activity and effects brought by change of target setting method are described, as well as cross-functional activities facilitated by committee activities and absolute value target costing in order to clarify how they have contributed to the evolution of target costing at Toyota.

Keywords: Variance-Based target costing, Absolute value target costing, Committee activity, Three-Dimensional structure, Cross-Functional activity

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INTRODUCTION

Target costing is distinguished from conventional accounting both by its calculation method and administration, and characterized by many unique features from a global viewpoint (Okano [2003]). However target costing seems to become not as interested as it once was since it was reported about ten years ago that Toyota changed target setting method that was one of the unique features of target costing. During this time, committees became active and cross-functional activity increased as result in the change of target setting method and committee output. For this reason, target costing for the latest decade at Toyota seems to be more drastic than those from previous decades.

Article I will describe the meaning and results of committee activity and effects brought by the change of target setting method, as well as cross-functional activities facilitated by committee activities and absolute value target costing method so that Article I can clarify how they contributed to evolution of target costing at Toyota.

Toyota has long employed variance-based target costing method. They switched to the absolute value target costing method by 2000. The differences between variance-based and absolute value target costing methods are clarified and the purposes of the two methods are examined in next section.

The time period in which Toyota changed the target setting methods aligns with the time committee activities picked up. The structure and purposes of the committee activities are described in section 3 as well as their relation to target costing.

In section 4, comparisons are made about variance-based and absolute value target costing methods; i.e. which method is more effective under what circumstances. Changes in target costing, including unintended effects are also discussed in this section which resulted from committee activities and absolute value target costing method.

The final section offers conclusions and remaining challenges.

VARIANCE-BASED / ABSOLUTE VALUE TARGET COSTING

Variance-based Target Costing Method

In the target costing process for a new model, a cost target is set to achieve a profit target taking into account the market price. If only the difference from current model is presented as the cost target instead of absolute value, we call it variance-based target costing method (Hiki [2005]) (Figure 1).

Tanaka [1991] mentions the following advantages of difference-based target costing method which had been a unique feature of Toyota target costing since 1960's.

1. At this stage drawings are not available; estimating only the difference from current model saves work and increases accuracy as opposed to estimating all the cost elements of a part.
2. Cost variance is easily understood.
3. Cost variance caused only by engineering change and volume fluctuation is recognized while cost variance caused by other reasons is excluded.

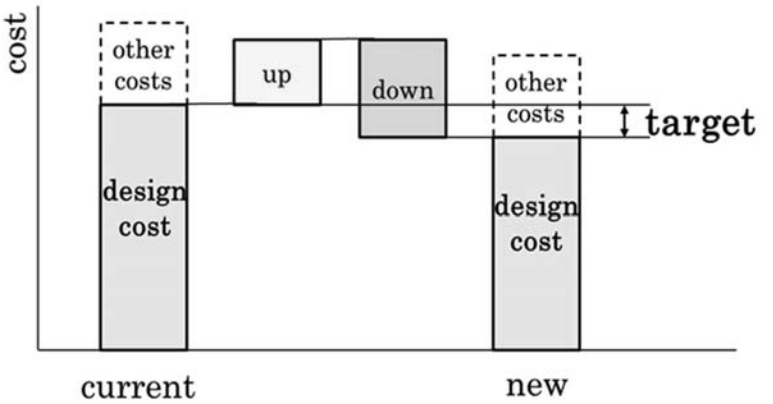

Figure 1: Variance-based Target

Hiki [2005] mentions that the third advantage above may be the most important. The cost variance caused by volume fluctuation mainly affects amortized tooling cost. Amortized tooling cost is usually smaller than piece cost. Any variance is caused by engineering change. It is an essential point that only engineering cost is grasped under the difference-based target costing, which includes both merits and demerits. This is to be discussed later.

Absolute Value Target Costing Method

On the other hand absolute value target costing method sets the target cost per vehicle by absolute value, not by difference from current vehicle (Figure 2). It also urges us to calculate 'should-be cost' for part by part target without referring current cost. The advantages of absolute value target costing method are;

1. Since whole part cost is covered, the expenditures other than design cost are required to reduce and, as a result, a bigger cost reduction is expected;
2. It can be applied to overseas projects where suppliers and/or processes are often different from current model.

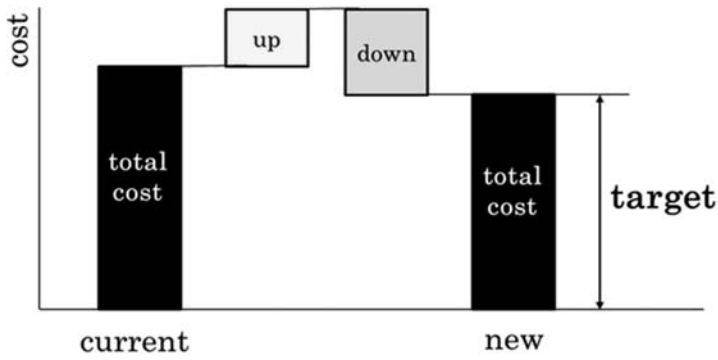

Figure 2: Absolute value target

Below the target setting ways based on absolute value target costing method are described both for vehicle and part.

Target Cost Per Vehicle

Profit targets are set in advance and are stipulated in the medium-term management plan. In order to achieve the overall company profit target, Toyota sets individual improvement target for each vehicle. Once the profit target for the vehicle is set and the estimated retail price is fixed, the remainder is the target cost for the vehicle.

Targets for plant cost, logistics cost, design cost, and so on are given so that the total of those targets satisfy the vehicle cost target. Design cost target is distributed among design departments (Figure 3).

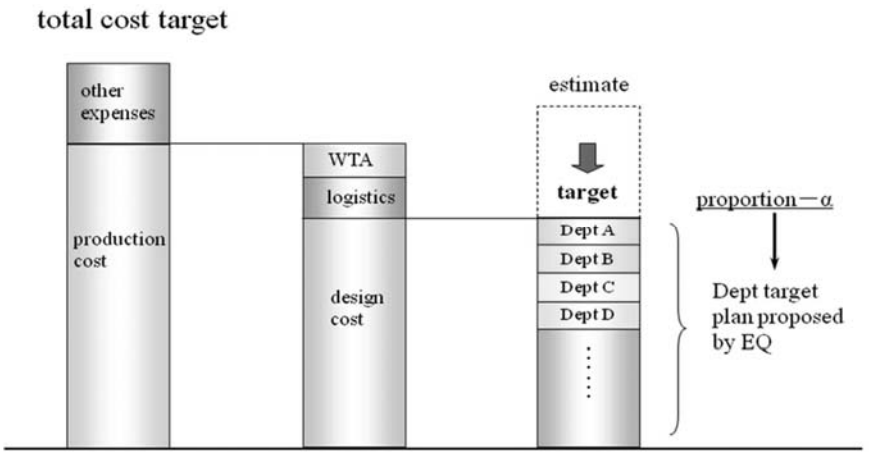

Figure 3: Target distribution among design departments

Target Cost Per Part

On the other hand, each design department calculates proper target per part. Toyota has two ways to make this calculation (Fig. 4). The first one is utilizing the 'CC graph' showing CVI (Customer Value Index) on the x-axis and cost on the y-axis. A coordinate on the graph is determined by CVI, calculated based on the part's specification or qualitative value to the customer and piece price. They plot coordinates of the Toyota vehicles of a part using a CVI defined for each component, and subtract the lowest line passing through the origin. The definition of lowest line is a straight line connecting the origin and the coordinate that makes the slope minimum. A designer calculates CVI of the part he/she is going to design, and determines the target cost of the part by plotting the coordinate on the least expensive line.

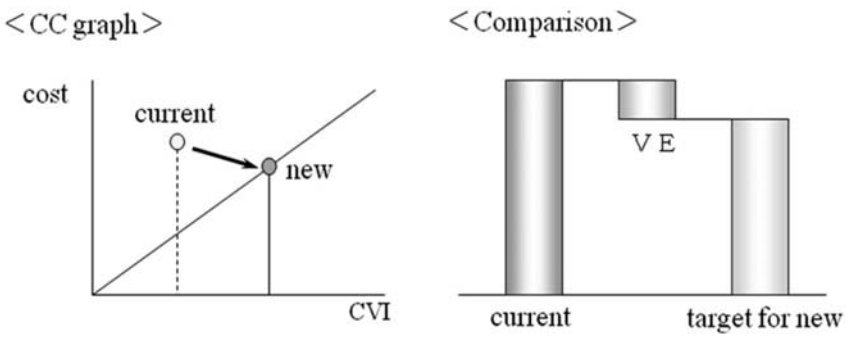

Figure 4: Target setting ways of part cost

For parts where CVI is difficult to define, another way to calculate target cost is to show the difference from current part. Using a waterfall graph, we start with the current cost. The cost changes based on reduction ideas implemented or the specifications added based on the design. The final bar on the right side is the cost target for that part.

Target setting with CC graph is based on absolute value target costing method and target setting by difference from current part is based on variance-based target costing method. Toyota is still partially using variance-based target costing method after they switched to absolute value target costing.

Agreement between a department target and part targets

The cost target for a design department as mentioned in Figure. 3 does not correspond with the total of part cost targets for the department as mentioned in Figure 4 because the ideas of target setting are different from each other. A department target calculated by using overall vehicle target profit and estimated retail price as basic points is usually more challenging than the total of part targets set individually. Since the conflict cannot be left unsolved, negotiations are required for agreement. A department target based on the company profit target tends to be prioritized, and then the part targets must be reset so that they meet the department target.

COMMITTEE ACTIVITY

Committee activity is closely related to absolute value target costing. The placement of committee activity in Toyota development organization is explained first in this section, followed by main committee activities.

Toyota Development Organization

Toyota development organization forms a matrix structure which contains project-based chief engineers and function-based divisions such as Design, Production Engineering, Purchasing, Logistics and so on. Design division includes departments such as Body, Chassis, Electronics, Engine and so on. Figure 5 shows the matrix structure formed by project-based and function-based design fields.

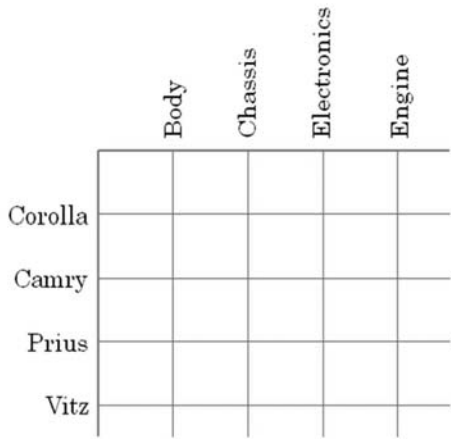

Figure 5: Matrix structure

However Toyota development structure cannot be explained fully by two-dimensional matrix because it also has committee activity which embraces both the vertical and horizontal axes. Ongoing committee activities which cost are related to RR-CI, corporate-wide VA, and part standardization and so on.

Each committee is administered by a director as chairman and cross-functional secretariat. Most committee activities often last a few years to

address a particular issue. The part of standardization committee, which has been in place for ten years plus, is an exceptional instance. When we recognize these activities as the third axis, the Toyota structure can be shown as a three-dimensional structure like Figure 6.

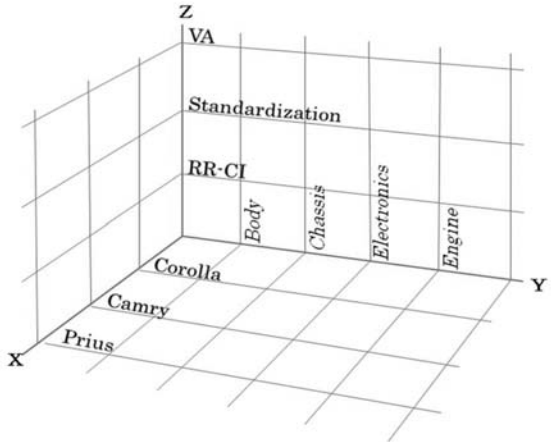

Figure 6: Three-dimensional structure

Project-basis activities appear if you cut a Y-Z section. Each project involves all design fields and participates in various committee activities. For example, the section of Corolla shows that each design department such as Body, Chassis, Electronics, or Engine participates in various committee activities such as RR-CI, corporate-wide VA, and standardization's part and so on. These activities are performed not only by Corolla but also by other projects like Camry, Prius, or Vitz.

Part basis activities appear if you cut an X-Z section. Each design department participates in various committee activities for each project. For example, the section of Body department shows that various committee activities such as RR-CI, corporate-wide VA, and part standardization and so on are performed in order to incorporate the fruits into each project such as Corolla, Camry, Prius, or Vitz. These activities are performed not only by Body but also by other departments like Chassis, Electronics, or Engine.

Committee activities appear if you cut an X-Y section. Each committee activity involves all design departments and projects. For example, the

section of RR-CI shows that the committee activity is performed by each design department such as Body, Chassis, Electronics, and Engine and so on in order to incorporate the fruits into each project such as Corolla, Camry, Prius, Vitz and so on. These activities are performed not only by RR-CI but also by other various committee activities like corporate-wide VA or part standardization.

Committee activity is not a personnel structure or a development mechanism based on the traditional chief engineer system. It is the mildest system among the three axes. However the activity plays an essential role in development and target costing by specifying a theme and methods and by mobilizing organizational expertise.

To summarize, the functional axis is personnel structure that is organized by role. The project axis is development mechanism based on chief engineer system, and committee axis is the means of target achievement. If it is limited to cost, functional axis is cross-vehicle cost improvement activity performed by each division such as Purchasing, Design, or Production Engineering, project axis is the target costing activity itself, and committee axis is a device to promote cost reduction.

Various Committee Activities

In 1996, NBC Committee started and triggered adoption of absolute value target costing. The range of the activity was extended to total cost and all functions of the company. It evolved into an advanced activity called EQ Committee in 1998. 'E' in EQ is a code name of the first generation of Corolla. 'Q' in EQ stands for quality. Therefore EQ means Corolla quality. Its concept was to execute target costing under careful consideration of marketability for Corolla.

However each committee was for a single project. In 2000, CCC21 started as the first activity to reduce cost for all projects and for all functions. It was succeeded by VI in 2005, urgent VA in 2008 and RR-CI in 2010. Those activities were based on absolute value target costing. The details are described below:

CCC21 (Construction of Cost Competitiveness for the 21st Century)

CCC21 started in July, 2000. It was called 'quadrinity' activity because Design, Production Engineering, Purchasing and suppliers worked together to reduce cost by 30% or one trillion yen in three years. 173 parts became subjects of the activity. The goal was not to reduce cost from current part but to achieve the world's lowest absolute cost. The aforesaid CC graph was introduced to set targets and benchmark competitors thoroughly.

An activity for in-house parts was also facilitated from 2002 under the slogan "BT2 (Break-Through Toyota)." The target was 30% reduction in three years again.

At the end of the activity in 2005, the cost in outsourced and in-house parts reduced by one trillion yen. Through the period of CCC21 activity, however, design attributes were not improved so much compared to the results from Purchasing and Suppliers or Production Engineering.

VI (Value Innovation)

It started in May, 2005. The activity pursued cost reduction of 300 billion yen or more per year (Kim, [2007]) by drastic improvement of design attributes (size, mass, and number of component parts). Design philosophies were reviewed from the beginning of development. Unlike CCC21, VI was led by Research and Development (R&D). It differed from the previous activity in which all 173 parts were reviewed separately. Instead, VI categorized multiple items into a system according to functions or layouts, such as engine system or safety device system. It allowed Design to simplify components. As for body shell design, major 100 parts (90% in mass) of a body shell were given targets for yield ratio and number of process for an optimal design (Yamakawa & Hosoda, [2008]).

RR-CI (RyohinRenka - Cost Innovation)

It started in January, 2010. The idea is similar to CCC21 in which Toyota aimed to achieve the world's lowest cost together with suppliers. CC graph is used for evaluation of cost again. Through this activity, Toyota declared an aim for good product and good price. It implies that the company is conscious of CVI more than it was at CCC21.

Urgent VA, corporate-wide VA

Toyota started urgent VA activity in April, 2008 after an interval of 15 years. The purpose was to avoid a fall in profits by cost reduction of vehicles in production. The company foresaw that net earnings would be reduced by nearly 30% because of material cost increase and exchange rate fluctuation (Ikehara [2008]). In fact, Toyota went into the red through the economic downturn precipitated by the Lehman Brothers bankruptcy. However, urgent VA activity contributed to reduce the deficit. After the first fiscal year for limited vehicles, the range of activity was expanded to most vehicles in fiscal 2009. In fiscal 2010, urgent VA was renamed corporate-wide VA, and was declared to be a constant movement.

Committee Activities and Absolute Value Target Costing

Figure 7 shows the history of committee activities and absolute value target costing. It is found that committee activity is closely related to absolute value target costing. Committee activity in corporate-wide functions deals with all expenses under absolute value target costing.

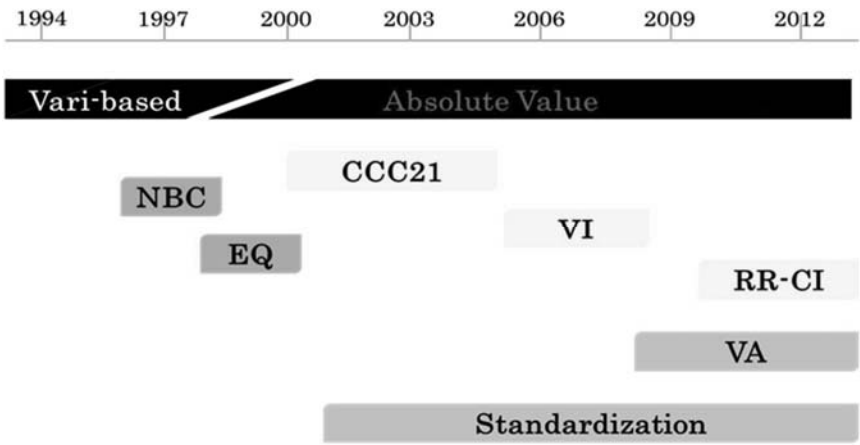

Figure 7: History of committee activities and absolute value target costing

TARGET COSTING METHODS AND COMMITTEE ACTIVITIES

The Background of Introducing Absolute Value Target Costing

Toyota was in need of a global target costing method. Assembly plants moved overseas one after another, and many parts needed to be purchased locally. The conventional method separated the cost calculations into pre and post mass-production stages. Each calculation rotated isolated PDCA (plan-do-check-action) cycle (Okano [2002]). Toyota's overseas subsidiaries have limited products, and profitability of each vehicle directly influences whether or not they survive. A gap in cost concepts between pre and post launch makes larger impact on overseas subsidiaries than it does on headquarters or domestic subsidiaries. Meanwhile, competition in Japan was intensified in 90's after the economy bubble burst. Hence, Toyota needed something beyond the variance-based target costing method.

The activities described above supported the company to adapt from variance-based costing method to absolute target costing method (Okano [2003]). At that time, a challenging cost target could not be achieved only by

the improvement of drawings anymore. Also, other fixed conditions started to influence profitability. The new target costing method brought expansion of its coverage to the expenses that had not been discussed before, such as purchasing negotiation, process efficiency, sales cost and general expenses.

With an absolute value of a part cost, it is able to compare data of expenses in design and production stages and to clarify how much they contribute. We can also compare cost and performance of headquarters and overseas subsidiaries.

Absolute Value Target Costing and Committee Activity

As mentioned above, the beginning of a series of committee activities was NBC Committee in 1996. It was followed by EQ Committee in 1998. These committees facilitated target costing for a single project under matrix development structure. The three-dimensional structure was formed in 2000 when CCC21 Committee started as a corporate-wide activity.

It is now meaningless to grasp part cost only by variance of drawings. All departments such as Design, Product Engineering, Purchasing and Sales must act cross-functionally. In 1999, USA became the first country where Toyota adopted target costing abroad. In foreign countries, expenses other than design cost fluctuate more frequently than those in Japan. It is partly because suppliers of many parts are not fixed. Also, the best material or the best process may differ from Japan. Therefore, variance-based target costing did not fit well abroad. NBC and EQ committees were limited to domestic activity for specific vehicles, but CCC21 involved several overseas affiliates. The absolute value target costing method became a corporate-wide agreement quickly. The success of committees such as EQ, which began under the slogan ‘no exception is allowed,’ helped Toyota to accept the new method relatively easily. Also, overseas target costing welcomed the method because the company already foresaw that the variance-based target costing would not work globally.

Transition of Target Costing Method and Merits/Demerits of the Methods

As mentioned at the outset, the variance-based target costing method has its merits. It saves work, secures accuracy and elucidates cost variance or efforts by designers. It also has its demerits. Efforts by other divisions are not facilitated as target costing, and current cost is eligible only in Japan (Table 1).The variance-based target costing was reasonable until 1990's in Japan because suppliers of many parts were fixed and expenses other than design cost were relatively stable. However, it does not effectively work at overseas target costing because suppliers who have unique production processes or logistics may change at each model change. The headquarters in Japan also needed to grasp absolute value to enhance improvements in processes and purchasing.

Table 1: Merit/demerit of target costing methods

		variance-based (– 2000)	absolute value (1998 –)
coverage		design cost	total cost
target	vehicle	variance from current	absolute value
	part	mainly variance from current (absolute value for new technology)	mainly absolute value (difference from current for non-CVI parts)
estimate		mainly variance from current (absolute value for new technology)	absolute value
advantage		1. saves work and accurate 2. easy to grasp variance 3. easy to see design efforts	1. all expenses are evaluated 2. interactive activity is expected
concern		1. difficult to prompt other divisions to strive 2. difficult to introduce overseas	1. may count on other divisions 2. cost increase may be accepted if CVI increases

Committee activities triggered absolute value target costing method to solve the problems above. The new method allowed Toyota to evaluate all expenses and act interactively. However, it could result in situations that designers and buyers shifted the responsibility onto each other. The following section shows recent movements and problems at Toyota.

Separation of a Designer's Attempt

A question arose whether or not to separate designers' and buyers' attempts. Under variance-based target costing method, only designers were responsible for cost reduction. Buyers negotiated prices, but their efforts had never been recognized as an activity of target costing.

Some claim that things were better in those days and designers became lazy under absolute value target costing. According to their opinions, designers expect buyers to negotiate prices to achieve cost reduction even if their drawings exceed budgets. In fact, design activity was not as evident as purchasing activity at CCC21. Designers' activities were notable

when VI committee gave them a specific mission. It seems natural for the management to think that Designer's attempts should be systematically separated. After practicing absolute value target costing for more than ten years, however, interactive movements has formed an intricate structure. Most of activities about target costing, including designers and buyers, are now cross-functional.

It is almost impossible to define who takes the credit for an achievement. An example is a design competition in which multiple candidate suppliers present a quotation at sourcing. Some say that it should be classified as an improvement in buyers who actually lead the event. However, it is designers who prepare drawings and judge suppliers' cost reduction proposals if their ideas maintain the quality of a vehicle.

Another example is Value Engineering (VE). Buyers facilitate ideas from suppliers and assess cost reduction. However, designers are in charge of everything about changes in drawings. Buyers negotiate prices but often ask designers if claims from suppliers are adequate. On the other hand, designers draw, but ideas often come from suppliers, and it is buyers who facilitate the activity of suppliers. Therefore, it is virtually impossible to separate performances between Buyer and Designer. Current RR-CI Committee is premised on interactive activities of designers and buyers.

The Relationship between Committee Activity and Product Development

Chief engineer system is Toyota's most significant feature of a product development structure and its source of international competitiveness. However, it 'was not purposely introduced to build the advantage in international competition,' but rather 'rooted as aviation engineers transferred from the aircraft industry along with the system (Fujimoto [1997]).'

The dawn of matrix organization was contingent, and so as the introduction of the third axis, or committee activities. Toyota has experienced three major events: introduction of absolute value target costing, start of committee activities, and overseas transfer of target costing. It is difficult to affirm which caused others. It is more appropriate to say that

changes in circumstances provoked global cost reduction activities without sanctuaries; thus all the three events were the results.

Committee activities were temporary trials at the beginning. Toyota later recognized their importance, and has conducted a number of committees for cost reduction since CCC21. Committee activities have now become the third axis. It was not planned from the beginning but realized contingently.

The Interaction of Design and Purchasing is also contingent. Toyota has already practiced an activity called SE (simultaneous engineering) for Design and Product Engineering. SE activity has operated under a system called the 'rugby method.' Under this method, pre-process and post-process proceed with slightly offset positions. Compared to the 'baton pass method' which was once favoured in Europe and North America, it is effective to enhance interactive activities. As committee activities and absolute value target costing were introduced, Design and Purchasing also adopted the method. Under CCC21's'quadrinity'activity of Design, Product Engineering, Purchasing and Suppliers, Design made the most of information from other three divisions.

Imagine a designer with an idea of an aluminium-like panel with in-mold decoration. S/he may abandon the thought if s/he does not know a supplier who can mold high quality panels by molded-in colour. However, if a buyer informs the designer that there is such a supplier, the designer will be thrilled by the idea that s/he can design a more complicated shape with a lower cost.

Introduction of committee activity and absolute value target costing encouraged interactive activity between Design and Purchasing. As a result, design activities became unable to evaluate separately from others. Unexpectedly, these events made variance-based target costing method unsuitable for Toyota.

Effects of Absolute Value Target Costing and Committee Activity on Target Costing

Under absolute value target costing method, not only manufacturing cost but also logistics cost and miscellaneous expenses are now given targets

under target costing. As for manufacturing cost, all activities of Design, Product Engineering, Purchasing and Suppliers have been evaluated since CCC21's 'quadrinity' movement. Drastic cost reduction has been achieved, and committees remain active in Toyota.

Figure 8 shows an image of cost reduction effect brought by introduction of absolute value target costing and committee activity. Evaluated expenses and responsible departments were expanded by introduction of absolute value target costing. Every division was required to deliver good results. It enhanced vigorous activities and successful performances of committees. Toyota became internationally competitive because of these wide, deep cost reduction strategies. So to speak, introduction of absolute value target costing resulted in wider range of activities and the starting of committee promoted deeper activities.

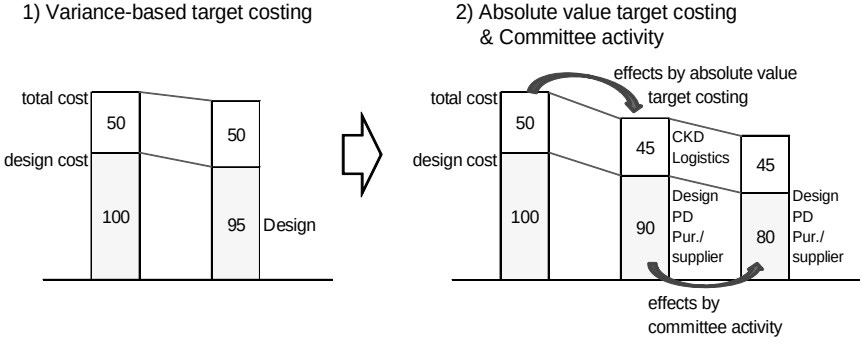

Figure 8: Image of effects by absolute value target costing and committee activity

CONCLUSIONS

Toyota has employed variance-based target costing method since the beginning of target costing. Absolute value target costing method was introduced by 2000. The variance-based target costing method was reasonable until 1990's in Japan because suppliers of many parts were fixed and expenses other than design cost were relatively stable. Targets were set according to changes in a design, and it was able to estimate the cost even if a drawing was not complete. Difference in cost between

old and new models was evident and fully depended on designers' ideas. However, variance-based target costing method did not effectively work at overseas target costing because suppliers might change at each model change, which had unique production processes or logistics. Divisions in Japan also needed to grasp absolute value to enhance improvements in processes and purchasing.

In addition to transformation of target costing method, during this time, committees related to the cost became active. Introduction of committee activities made Toyota's development structure change from a matrix organization to three-dimensional structure.

Such circumstances urged Toyota to introduce absolute value target costing. The new method and committee activities altered product development at Toyota. They enhanced interactions among multiple departments such as Design and Purchasing.

Both of variance-based and absolute value target costing methods have advantages and disadvantages. A company should choose a method considering whether its cost fluctuation mostly depends on design changes or not. Absolute value target costing is superior to the other for Toyota, regarding its interactive production development system.

REMAINING CHALLENGES

Toyota values cross-functional activities and keeps absolute value target costing method to enhance the interactions. However, there are two issues to be watched carefully.

First, designers and buyers could shift the responsibility onto each other. As described above, some claim that designers became lazy under absolute value target costing. According to their opinions, designers expect buyers to negotiate prices to achieve cost reduction even if their drawings exceed budgets. This problem has not been solved yet because designer's efforts cannot be evaluated alone under absolute value target costing.

Another problem with absolute value targeting costing is that part cost target is mainly set by CC graphs. At CC graphs, a target is expressed by a line of the first quadrant passing through the origin. If CVI increases and coordinate stays on the target line, it is a success. However, it does not mean that actual cost of new parts is always less expensive than old ones (Case 2 of Figure 9). The fixed vehicle cost target may suppress expenses as a whole, but some parts would cost unnecessarily due to unwanted function for customers. Toyota is now counting on chief engineers' insights to detect such problems, but is it the best? We must watch carefully how Toyota is going to solve these dilemmas in the future.

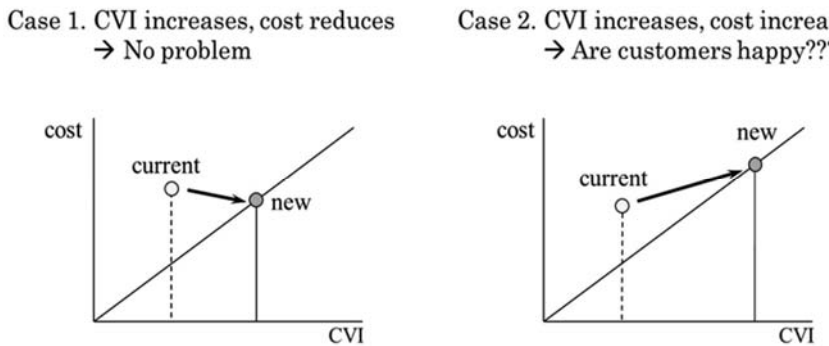

Figure 9: Possible problem on CVI graph

Notes:

Amortized tooling cost: Tooling investment divided by production volume through the model life.

Piece cost: Part cost per piece excluding amortized tooling cost.

CVI (Customer Value Index): Value for customer is defined per part. The value of visible parts such as steering wheel or audio is easily defined but Toyota also defines the value of invisible parts. For example the CVI of instrument panel reinforcement that hangs steering wheel is the product of dimensions and mass for resonant frequency that directly relates to reduction of steering vibration.

NBC Committee: NBC stands for New Basic Car, which was the name of the first Vitz/Yaris at development stage.

EQ Committee: EQ Planning & Development Dept. is the namesake of EQ committee.

Yield ratio: It generally means the proportion of gained product to charged material.
RyohinRenka - Cost Innovation: "Ryohin" means good product and "Renka" means good price in Japanese.
In-mold decoration: It is a molding technology which enables to decorate a part in an injection mold by transferred foil.
Molded-in colour: It is a technology that raw material of plastics is colored. It may achieve metal-like surface by molding plastics that high gloss material is compounded.

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