

VE AND TARGET COSTING IN A STAGE-GATE DESIGN SYSTEM

JAN, K. ALPENBERG,

Dean and Head of Departments
School of Business and Economics,
Linnaeus University

D. PAUL SCARBROUGH, CORRESPONDING AUTHOR

Goodman School of Business,
Brock University
St Catharines, ON, L2S 3A1, Canada
paul.scarbrough@brocku.ca

Abstract

This study describes how Target Costing (TC), which is strongly associated with the Value methodology, was attempted as an addition into a traditional Stage-Gate (SG; Cooper, 1990) product development process. We find conflict between the Stage-Gate method and TC that is consistent with criticisms of SG raised by Sethi and Iqbal (2008). This includes limitations to learning due to truncation of sub-projects without the iterations in TC. We identify the aspects of TC that are in conflict with SG-type design processes, in particular, the lack of effective use of Value Engineering and Quality Function Deployment.

VE AND TARGET COSTING IN A STAGE-GATE DESIGN SYSTEM

Introduction

One design method strongly associated with the Value methodology that is gaining increased attention is Target Costing (see Clifton et al, 2004). Since a product's performance, quality and costs are thought by many to be determined in the design phase (Ansari et al., 1997; Dekker & Smidt, 2003; Olhager, 2013) the TC development process has come to be seen by some as a strategic activity that is critical to the company's survival.

However, the most frequently used traditional product development model in western companies is typified by the stage-gate (SG) approach (Cooper, 1990), which does not include cost at any part of the conceptual process. The stages are linear and sequential, and based on mid-20th century views of the design process derived from the Taylorist vision of the split between thinking vs. doing, transferred into the product development arena as "design vs. production". In this view of product development, design is separated from supplier involvement, and from production involvement, in a series of silos.

Thus we have two contrasting approaches to product development: recursive and multifunctional Target Costing (TC) and linear and siloed Stage-Gate (SG). This study describes how Target Costing is used in the SG product development process at a company we call CEHaul.

The stage-gate approach

The dominant approach in the west for product development is the process called Stage-Gate (Cooper & Kleinschmidt, 1987, 1988). However, there is a growing concern that gate controls are not suitable for all kind of products (Leifer et al, 2000; McDermott and O'Connor, 2002; Veryzer, 1998). Furthermore, it is suggested by Sethi and Iqbal (2008) that rigorous gate control can adversely impact learning in the product development process.

Target Costing process

Our primarily in-depth understanding of the TC process is based on Ansari et al. (1997), and Cooper & Slagmulder (1999), among others.

To achieve the "target cost", engineers, marketers and product developers use VE and QFD analyze the factors that influence a product's cost in order to find ways to reduce cost without reducing the product's function and quality (Ansari et al, 1997). The main method is Value Engineering (VE). TC and VE complement each other, where TC-process identifies the target cost and VE plus QFD identify opportunities for cost reduction (Akau and Mazur, 2003; Afonso et al, 2008; Akhbari et al, 2012; Ansari et al, 1997; Zengin & Ada, 2010).

CASE DESCRIPTION: CEHaul

Construction Equipment Group (CEGroup) is a world-leading manufacturer of construction equipment. The CEHaul division of CEGroup is a leader in the category "articulated haulers", and was the original developer of this category. Articulated haulers are very large vehicles, with an empty weight of over 15,000 kg and a payload of over 20,000 kg. The market for articulated haulers is mature, and products across competitors have become more and more alike.

CEGroup's competitive strategy has been to have the best product on the market. The customers are showing more price sensitivity while asking for additional functions and improved quality.

CEHaul has tried to implement TC twice. We report mainly on the second attempt. CEHaul's first attempt to introduce TC into their already established product development process took place in 2011. The initiative started from the CEGroup CEO who challenged the entire organization to improve the profit on each product through cost reduction without lower quality and functionality.

External consultants analyzed the products at CEHaul and set up a TC "Workshop" series. According to the CEHaul improvement project chairman and both the project manager and project leaders.

All participants in the second attempt participated in the first, failed, attempt. The second attempt to introduce TC started in the fall of 2013. Even during the second attempt a "TC workshop" was the starting point. The TC-process was only run once (during the "TC-workshop") and was directed by the consultants. In the TC-workshop, employees from different departments were gathered together to put forward improvement ideas and cost reduction ideas. External consultants were used and they

spent 15 weeks onsite at CEHaul together with the sub-project leaders. During this process an articulated hauler was taken apart and studied in order to identify improvement ideas. The work was done in cross-functional teams and a number of new ideas were identified.

Product development process at CE

CEHaul uses the parent company's "Global Development Process," (GDP, see figure 1) for product development. The GDP is based on the concepts in the stage-gate development process (Cooper, 1990).

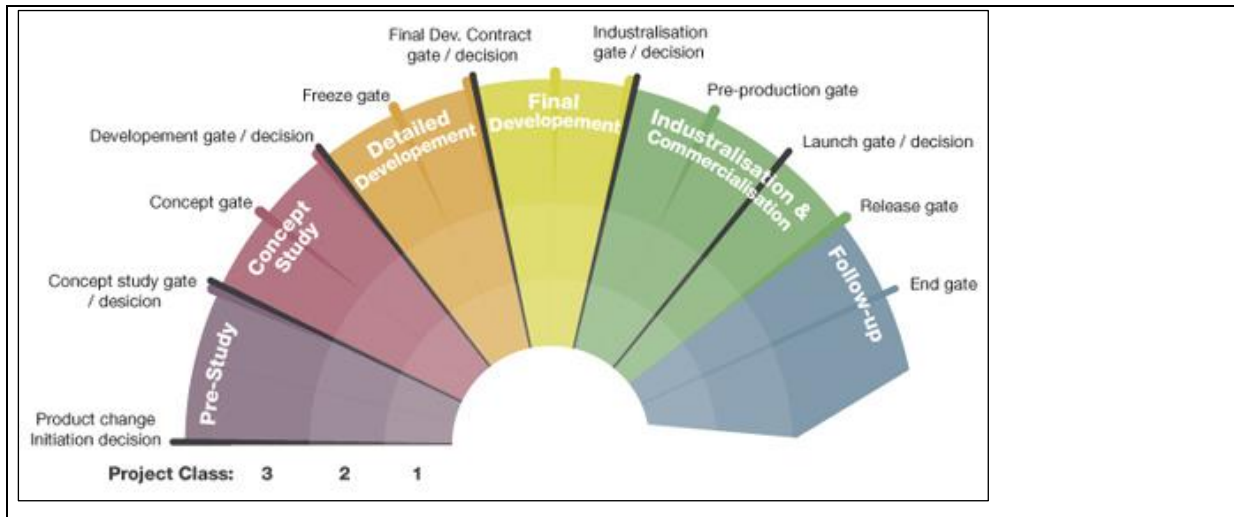


Figure 1. Product development phases at CEHaul

Each phase ends with what is called a "gate". Certain stages also include "gates" within a phase. In these "gates" project management assures that the criteria for the current phase are fulfilled, preparing for the next "gate" as well as updating the project's forecast of final delivery and risks. Additionally, the model assumes a linear, non-recursive process. Below a more detailed description of the different phases is presented.

GDP Pre-study phase

In the first phase, *pre-study*, work with business requirements and opportunities are done and it is seen as a feasibility study. The most promising projects are selected and prepared for the next phase and the others either rejected or worked on. The Product manager pointed out that:

During this phase we start with the requirements, or the definition, which includes what we want, what the cost level is allowed to be, how much it is going to weigh and how profitable it has to be.

This phase is the main entry point for TC. Note that any goals must be externally specified in the GDP. TC, on the other hand injects customer demands for both functionality and cost at this stage. Introducing these aspects created friction when the TC initiative was started because they had never been considered at this stage previously.

The *pre-study phase* serves as one of the main phases in order to determine the target cost. A corporate decision by top management has forced all the units in CEHaul to cut costs by a specified percentage. The target for the cost reduction was broken down by assigning each reduction to a different department that deals with various aspects of the product life cycle.

Value Engineering (VE) combined with QFD is the key idea generation tool in Japanese versions of TC. VE is a tool to develop a tight understanding of the value perceived by a customer. The use of VE at CEHaul differs substantially from the normal TC use. An obvious risk for conflict is when they do not use VE, and yet at the same time are afraid of neglecting functionality and quality when they lower cost. However CEHaul does not seem to use VE for these purposes.

GDP Concept phase

In this phase the primary task is to generate the concept which has the potential to satisfy the requirements from the customers. The difficulty in this part of the process is illustrated with the following excerpt from the interview with the Product Manager:

We might have developed a smart concept but if it doesn't 'hit' the product cost the right way, it does not take off. We need the product to be profitable when it is delivered to the customers. The first phase in which we set the requirements is pretty straight forward, but to balance the different concepts along the requirements is where it gets tricky.

The concept phase is divided in two parts with a "gate" between. In order to pass the first gate the concepts have to be defined and "frozen", which includes that it has to be developed, how and where development should occur need to be specified, and there is a quality-and risk analysis.

In the second part of the concept phase, decisions regarding suppliers and manufacturing activities are planned and the timetable is updated. However, there is no actual contact with suppliers at this point, which is a violation of TC.

To reach the target for cost reduction, CEHaul applies a small measure of VE in the concept phase for components and items. Each component and item is assigned its own target cost and together they lead to the cost reduction target. In this step, the cost engineers contribute with special tools such as cost tables. This involves detailed cost information for raw materials, purchased components and processes. However, it is clear that the bulk of the information needed is not available, but is rather in later stages, since suppliers are not part of this analysis. This has negative effects on the CEHaul development process since they must "simulate" the cost reduction possible by suppliers instead of getting help from the actual suppliers.

In this stage we observe the footprints of the TC-process introduced, but since the suppliers are not actively involved in the TC-process, the depth has been limited.

GDP Detail development phase

In the detailed development phase it is assumed that the individual components meet standard requirements. Then, negotiations and agreement with critical suppliers occurs. This after-the-design contact with suppliers is a significant deviation from ideal TC practices.

Several of the interviewees stressed that rather than multiple rework attempts, that projects are 'killed' when the target cost can't be reached quickly. This creates a sense of frustration among employees when projects are canceled without the possibility to continuing to work on them. None of the steps in the TC-process is seen at this stage.

GDP Final development phase

In the *final development phase* the concept is finalized in order to later be able to be implemented.

All interviewees indicated that this is a crucial part of TC, to have control and overview of work as well as clearer accountabilities. Managers pointed out that they learned from past mistakes when the consequences of not allocating responsibilities, objectives and costs, resulted in the improvements failing to materialize. One important lesson from the first, failed, TC attempt is the importance of involving the suppliers in order to let them come up with the best solutions, and thus transfer the cost requirements to them. The Purchasing Coordinator believes there is a gap in the cost structure which he plans to deal with in the future by inviting the suppliers in to discuss additional solutions, however this would still be a level of involvement much lower than in most descriptions of TC.

GDP Industrialization phase

Using the CEHaul standard design method, industrialization is the last phase before production. At this stage they know exactly what it will cost, according to product manager. This is much later than normal TC processes.

Another way that suppliers are involved is that they are able to come up with product reviews. The Manager for Business planning emphasizes:

the importance of listening to suppliers and work together with them as early as possible in projects, which leads to a higher value for the product. At CEHaul this does not happened to any great extent due to lack of time and it represents a major opportunity for development.

According to the Product Manager, CEHaul involves suppliers in several steps, however, there is ambiguity regarding cooperation because it is performed by both "cost engineers" and "supplier development". Furthermore, the selection of suppliers inhibits their possibilities for further cost reduction. According the Project leader:

there is a lack of structure in the purchasing process which limits the improvement possibilities. There is no point in making use of temporary vendors that offer better price or solution to a prototype when they can't be used on a long term basis, which increases costs when they are going into production and have switched to existing suppliers.

The greatest potential, according the Project Leader, is therefore closer cooperation with suppliers, clearer division of responsibilities and greater flexibility in sourcing and selection of suppliers.

Interaction between GDP Product Development Process and Target Costing

The Chairman explains that CEHaul developed its own tools for cost reductions in the development process. They use VE when they want to take a closer look at a feature. However, they are not active with it since it's a lot about working with suppliers, fixed costs, economies of scale, etc., which the project manager express as:

There are tools, such as VE, [but] we have proprietary methods on this where we compare. We buy a lot from within the group and know the majority of the costs. We have special engineers who can appreciate how realistic it is. It is, of course, lots of tools, I'm not so impressed by them, for me it's more the orderliness, persistence that matters. (Project manager, CEHaul)

Furthermore, when asked about the use of QFD, the Chairman pointed out that CEHaul is using it in some way:

There are people who know QFD and can work with it. If you do it on a machine, at the level that we work, is the enormous and complicated. The matrixes become huge and difficult to handle in practice.

(Chairman, CEHaul)

Cost control

The introduction of TC at CEHaul was seen as a critical step by the top managers, to maintain the profitability of the company. Previous experience of cost reduction attempts were not good, and had created a negative attitude among members of the organization This was expressed explicitly in the following way:

Cost reduction is seen by [CEHaul] members as a sign of inferior product and it can take time to accept and understand [that this is not the case] (Project Leader).

The corporate culture is an important element in performance management that enables desirable behavior, and weak corporate culture can thus be seen as a cause of the lower acceptance of VE. At CEHaul, a clash of cultures took place when the company went from being an engineering-driven to a cost-driven organization according to one of the Project Leaders. This is also one of the main reasons to why VE was a difficult part of implementing TC. The explicit customer and cost focus of VE, dropped into the pre-existing cultural friction created by the move to traditional cost reduction.

According to the Project Leader:

...it is hard to change ways of thinking overnight, from only constructing what is the "best solution" to designing the "best solution and at the same time the most cost effective" solution.

The absence of a supportive organization, structure and processes for TC may be explained by prior experience with temporary cost reduction activities, according the Chairman. Furthermore, it has been difficult for the managers to incorporate TC in their existing culture and to create desirable behavior. According to one of the project leaders:

In order to create acceptance for TC and avoid negative effects and unexpected results, knowledge about TC needs to increase all through CEHaul and it needs to be seen in a long-term perspective.

Although, according to one of the project leaders, TC has contributed to a better understanding among employees and its activities have been incorporated as an integral part of the work of the product development process. If they fail to continue implementing the deeper ideas in TC, and if they revert to the previous way of working, it is likely that they will encounter the same problem again.

Value Engineering - VE

When TC was adopted in the product development process at CEHaul, VE was the first tool they started to use according to one of the project leaders. To reduce cost and at the same time maintain quality and functions in order to increase the value of the product was the attraction with VE. The project leader pointed out that CEHaul used VE:

... for analyzing the features of products, processes and services and achieve them for the lowest possible total cost of ownership.

The value index was not used for selection of components for cost reduction. Instead, they used the percentage of cost per component of the total cost. According to the project leader:

... the components that carried the greatest cost percentage and at the same time showed high complexity and risk to change was chosen first.

At CEHaul, there were also a list of components that shouldn't be neglected, which were components which needed cost reduction in order to improve the overall profitability for CEHaul. It is clear that this has influenced the company's creativity and previous experience to use detailed cost information by cost engineers.

VE was used to develop ideas for cost reduction through creativity and brainstorming. At CEHaul this was done during the "workshop" that was arranged by consultants and which during several rounds of cross-functional team work led to the activities that could be reduced, eliminated, combined, replaced by a substitute, reclassified or improved. Another activity in which VE was used was to test and implement promising ideas which required determination. This was done in CEHaul by compiling the ideas in Excel and "wash" through the validation process. In addition to a validation process, leaders also attended together with technical specialists with long experience in order to ensure that the ideas were feasible. An important criteria for the selection of the sub-projects was "pay-back time" for the projects.

When a project does not meet the specifications in terms of function, quality or price of a "gate" during the development phase, CEHaul decide if they'll use outsourcing of the component or "kill" the project.

Quality Function Deployment QFD

None of the respondents at CEHaul mentioned QFD as one of their tools. The Chairman believes that:

the QFD-matrixes are much more difficult to manage in practice because they quickly become extensive and complicated.

However, he described the "system engineering" as a similar tool that they use as:

...it can be seen as an equivalent to QFD because it is a way to derive requirements for features.

Furthermore, the Chairman pointed out that:

it is important not to hang onto the technology early, but to focus on the functionality and what the customer requires. Thus there is flexibility to change technology while the function remains.

However, it is clear that the manager's at CEHaul does not believe QFD is appropriate for their product and uses its own corresponding tools with a different title.

CONCLUSIONS

The introduction of TC was seen by some participants as a critical step to maintain the profitability of the company in the face of market changes, however not all participants agreed. To some participants it seemed like just another tool thrown to them by corporate management. Additionally, many of the participants associate cost reduction with inferior products and do not accept cost reduction as a design goal for CEHaul.

In the table below, the four TC-activities and how they are used in the different phases of the product development process at CE is shown

Stage-gate phases	TC-process at CEHaul			
	Identify need for cost reduction	Set the cost reduction target (gap)	Break down the cost reduction target in detail	Reduce the gap
Requirements	n/a	Yes	Yes	Yes
Concept	n/a	Yes	Yes	Yes
Detail development	n/a	No	No	No
Final development	n/a	No	No	No
Industrialization	n/a	No	No	No

Table 2 – TC stages in the Product development process at CEHaul

At CEHaul, TC is not used in cost discussions with suppliers. CEHaul instead uses a traditional adversarial bidding process to takes quotes from other suppliers that can offer better price or solution to a prototype. Thus, no benefit from collaboration is received by suppliers. They take the full responsibility for the cost requirements, and at the same time they waste time and resources in the process. This appears to be the reverse of the TC general approach, and more consistent with traditional western approaches.

CEHaul attempts to use TC as if it were some sort of free-standing dynamic capability within a stage-gate process. However, since VE is not used, except sporadically, there are no formal ways to identify and solve problems, but rather it rests on individual members' spontaneous insight. Thus, improvements did not come from a persistent dynamic capability, but fortuitously. The use of VE is weak, it is seen only in the initial training "workshop", and only to a very small degree in the rest of the work. Since VE is the key tool in most versions of TC, this is surprising. QFD is not used, which is related to the lack of use of VE. However the customer-voice aspect of QFD may be identified in some existing tools. Overall the lack of VE means that its role in development of dynamic capabilities is missing.

It is interesting that several interviewees appeared to resist using VE, feeling that it was too intense, in effect. The degree of intellectual application demanded by VE is significant, and is caused by the recursive development of new perspectives on the problem. In many ways it can be seen a precursor to a dynamic capability.

When the TC-attempts where initiated several meetings were held in order to identify and solve problems, but the methods (such as VE) never became institutionalized, which is to say, that they did not become dynamic capabilities.

The existing SG-system has not allowed the dynamic capabilities to develop and this has limited the ability to adopt the dynamic capability laden, iterative and multifunctional nature of the TC-process and benefit from the potential in TC.

In this study we find that there is conflict between the Stage-Gate method and TC that is consistent with criticisms of SG raised by Sethi and Iqbal (2008). This includes limitations to learning due to truncation of sub-projects without the iterations in TC. Additionally, we support Sethi and Iqbal's finding that the extremely rigorous gate-evaluation process reduces flexibility in the development system and become a barrier for new initiatives i.e. TC. We connect their observations with the

concept of dynamic capabilities to make our analysis more granular and point more precisely to the aspects of TC that are in conflict with SG-type design processes.

Acknowledgements

We would like to thank Jeton Alku and Judita Rashiti for help with data collection and employees at CHHaul for their time. We also would like to thank discussants at the APMAA-conference in Bali, Indonesia, 2015 for valuable comments on an earlier version of this paper.

References

- Akao, Y and Mazur, G (2003). The leading edge in QFD: past, present and the future. *International Journal of Quality and Reliability Management*. Vol. 20.
- Akhbari, M, Alpenberg, J, Scarbrough, P. D. & Wennberg, E. (2012). *Target Costing as a Dynamic Capability in Swedish Publicly Traded Companies*. Paper presented at the 8th APMAA, Asia-Pacific Management Accounting Association Annual Conference, Xiamen, China.
- Ansari, S. L., Bell, J. E., Cypher, J. H., Dears, P. H., Dutton, J. J., Ferguson, M. D., Hallin K., Marx, C. A., Ross, C. G. & Zampino P. A. (1997). *Target Costing – The Next frontier in strategic Cost Management*. McGraw-Hill, USA.
- Afonso, P., Nunes, M., Paisana, A. & Braga, A. (2008). The influence of time-to- market and target costing in the new product development success. *International Journal of Production Economics*, 115, 559-568.
- Cooper, R. (1990). Stage-gate - systems: a new tool for managing new products. *Business Horizons*, 3, 44–55.
- Cooper, R. & Kleinschmidt, E.J. (1987). Success Factors in Product Innovation. *Industrial Marketing Management*, 16(3), 215-223.
- Cooper, R. & Kleinschmidt, E.J. (1988). Resource Allocation in the New Product Process. *Industrial Marketing Management*, 17(3), 249-262.
- Cooper, R. & Slagmulder, R. (1997). *Target Costing and Value Engineering*. Institute of Management Accountants. Montvale, New Jersey.
- Cooper, R. & Slagmulder, R. (1999). Develop Profitable New Products with Target Costing. *Sloan Management Review*. 23-33.
- Dekker, H & Smidt, P. (2003). A survey on the adoption and use in Dutch firms of target costing. *International Journal of Production Economics*, 84, 293-305.
- Leifer, R., McDermott, C.M., Colarelli O'Connor, G., Peters, L., Rice, M. and Veryzer, R.W. (2000), *Radical Innovation*. Boston: Harvard Business School Press, MA.
- McDermott, C.M. and Colarelli O'Connor, G. (2002). Managing Radical Innovation: An Overview of Emergent Strategy Issues. *Journal of Product Innovation Management*, 19 (November), 424–38.
- Olhager, J. (2013). *Produktionsekonomi – Principer och verktyg/metoder för utformning, styrning och utveckling av industriell produktion*. Studentlitteratur AB, Lund.
- Sethi, R. & Iqbal Z. (2008). Stage-Gate Controls, Learning Failure, and Adverse Effect on Novel New Products. *Journal of Marketing*, 72 (1), 118-134.
- Veryzer, R.W. Jr. (1998). Discontinuous Innovation and the New Product Development Process. *Journal of Product Innovation Management*, 15 (July), 304–321.
- Zengin, Y. & Ada, E. (2010). Cost management through product design: target costing approach. *International Journal of Production Research*, 48, 5593- 5611.