

TARGET COSTING IN CONSTRUCTION: A COMPARATIVE STUDY

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ABSTRACT

Target costing is an approach for the development of new products in the automobile industry, aimed at reducing their life-cycle costs while ensuring quality, reliability and other client requirements, by examining all possible ideas for cost reduction at the product planning, research and development and prototyping phases. Prior studies have attempted to adapt the manufacturing target costing process to the project-based nature of the construction industry. This paper aims to provide insights for future target costing implementations in the public sector projects. A qualitative comparison of three studies is performed through the lens of a set of target costing influencing factors. Similarities and differences revealed in the comparison suggest that factors related to supplier-base strategy and to the nature of customer are potentially relevant to future target costing implementations in public sector projects.

KEYWORDS

Target Costing, Target Value Design, and Project Delivery.

INTRODUCTION

Construction Industry globally has been viewed as highly inefficient. Most construction projects lack predictability of cost, time and quality standards. Industry experts have proposed innovation at various areas of industry's traditional practices (Banwell 1964; Latham 1994; Egan 2004). In 2012, U.K. Construction Industry highlighted figures of time predictability of 34% (projects, as whole, finished on or before predicted time), Cost Predictability came out to be 61% (final project cost on or below predicted cost). This combined with the negative attitude of the industry due to the recession resulted in only 2.7% industry profitability (Folwell et al. 2012)

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Construction clients have increased level of expectations, this combined with under performance has led to growing dissatisfaction amongst the clients (Santos et al. 2000). Studies have indicated that major obstacles for improving the industrywide performance are fragmented process and confrontational relationship structure in the industry (Egan 2004). Fragmentation and confrontational relationships are due to traditional practices, where the fragmented process and efforts of project professionals aim to deliver the project, which results in inefficiencies at various levels like, confrontational attitude and behaviour amongst the delivery team, reducing the quality and predictability of the product (Building) simultaneously rising its production cost (Latham 1994; Egan 2004). To address this problem, Egan (2004) and Latham (1994) highlighted two strategies; focus the customer, team and process integration in the product development. The focus is required to shift from individual responsibilities and tasks inside respective silos towards the overall need of the project.

Similar solutions can be found in the manufacturing industry highlighting how they manage the process of developing and manufacturing a product, delivering it in set constraints (cost, time, etc.) and managing profit simultaneously. Similarity in manufacturing product development and construction project delivery processes opens an opportunity for target costing in construction (Zimina et al. 2012).

Prior studies have attempted to adapt the manufacturing target costing process to the project-based nature of the construction industry. However, target costing is not a static approach but an adaptive/dynamic one. As target costing adaptation efforts continue, its diffusion across different projects, different types of owners (public and private), and different countries or cultures might face many challenges. However, far too little attention has been paid to environment-specific characteristics, which may influence target costing adoption and consequently success.

Aiming to fill this gap, this paper seeks to analyze similarities and differences between three previous studies in public sector projects in construction by comparing them with a set of target costing influencing factors. The motivation behind the comparison is to provide insights for future target costing applications under these conditions.

The outline of the paper is as follows. First, a brief overview of the target costing manufacturing approach is presented. Then, three studies reporting attempts of adapting target costing in the public sector are briefly summarized. Third, the research method is explained, followed by a qualitative analysis of the three studies through the lens of Cooper and Slagmulder's factors. Finally, the implications and limitations of this paper are discussed in the conclusions.

TARGET COSTING IN MANUFACTURING INDUSTRY

Initiated in Car Manufacturing Industry, Target costing is an overall profit management process which enables to set quality, price, reliability, delivery terms & targets at the time of product planning & development to meet customer's perceived needs and interest. The achievement of these targets is simultaneously attempted in all areas from upstream to downstream processes (Shoten 1996). Target costing approach has been described in the simple equation:

Target Cost = Target Price – Target Profit.

Price and profit are treated as variables determined by various external competitive forces in the market and industry. The target cost is an outcome of the targeted profit over the Target Price. The firm has to manage the cost to meet the external constraints (Ansari et al. 2007). Target costing development can be noted over last 30 years in the Japanese car manufacturing industry. Nissan and Toyota were early adopters of target costing (Nicolini et al. 2000). It was combined with Value engineering and developed as an overall cost management programs in the Japanese industry (Cooper and Slagmulder 1997).

Cooper and Slagmulder (1997) proposed a generic structure of the TC process divided in three main section: market-driven costing, product-level target costing and component-level of target costing. The market-driven costing plays a key role in determining allowable costs. The product-level target costing disciplines and focuses the creativity of the product designers on achieving the cost aspect of this objective. The component-level of target costing helps discipline and focus the creativity of the suppliers in ways beneficial to the firms. For each one of this section, there are factors that play a critical role in shaping the way a company approached Target Costing.

TARGET COSTING IN THE CONSTRUCTION INDUSTRY

There have been previous attempts of adapting Target Costing in the construction Industry. For the purpose of this paper, only three studies will be discussed. (Nicolini et al. 2000) analysed the application of Target Costing in the UK construction industry and concluded that the main barrier to its adoption in construction derives from the UK commercial and cost management practice. Ballard and Reiser (2004) reported the first successful use in the US construction industry.

Initiatives for fine tuning Target Costing for the construction industry continue. For instance, Jacomit and Granja (2011) proposed a Target Costing framework describing how this approach could be applied in the product development process of public social housing projects in Brazil and concluded that the standardization and replication of the design could be seen as opportunities. On the other hand, the bidding process and the outsourced design were characteristics, which could reduce target costing applicability in this environment.

RESEARCH METHOD

This paper represents a comparative analysis of three studies. These primary studies were considered representatives due to their in-depth description of previous target costing adaptation efforts and because all three studies report attempts of adapting target costing in public sector projects in construction. Cooper and Slagmulder's factors were used as parameters for analysis.

These factors emerged from the original target costing application environment (Japanese manufacturing companies). They help determine the magnitude of the benefits that a company can derive from target costing. The influence level of each factor may differ given the construction industry's peculiarities (one-of-a-kindness, temporary organization and site production), however, these factors could still be considered relevant for making possible a comparison of target costing applications in the construction industry.

While it could be argued that this comparison is based on the authors' subjective assessments, such a comparison could provide insights for future target costing implementation in public sector projects.

TARGET COSTING IMPLEMENTATION IN PUBLIC PROJECTS

UK MINISTRY OF DEFENSE PROJECTS

Target costing application attempt was a collaboration between the Tavistock Institute & Ministry of Defense (MOD). It was an outcome of MOD's attempt to explore alternative procurement methods for avoiding high cost and adversarialism in projects. The aim of the attempt was to develop and demonstrate a systematic approach to the procurement and maintenance of the buildings to achieve improvements in value for money for the client while simultaneously achieving profit for project partners. The attempt consisted of two recreational facilities with swimming pools & gym for army training and estimated capital cost of £10 million & £4 million (Nicolini et al. 2000).

Multi Party Value Engineering (MPVE) was applied in both the projects. The General impression of V.E was that it improved the collaboration, however, there were few setbacks in V.E process were (Nicolini et al. 2000):

- Few parties observed biased behavior from client.
- Dispersed focus (Design v/s process).
- Few team members felt that V.E Process was too bureaucratic.
- Too biased towards the initial designs & individual likings.
- It was observed that too many were involved in the V.E Process.
- V.E was steered by engineering oriented Project Managers instead of strategic cost planners. This led to focus on functionality first & tackled costing/cost reduction later. Justification stated was that complexity of tasks at hand was challenging.

The Overall process for the two pilot projects was based on the basic model of Target costing approach, following the process (Nicolini et al. 2000):

- Developing an option study & a Project Business case
- Understanding the customer requirements & defining product features.
- Costing the project at early stages: product initial cost estimates.
- Collecting & proving TLC (Through Life costing) Data.
- Modelling TLC using the cost model.
- Establishing the cost gap at project and sub-system (Cluster) level
- Finalizing the price negotiations with the suppliers.
- Starting continuous Improvement based cost reduction activities.

The Pilot project surfaced critical issues related to the complexity to adopt through-life and Value Engineering. It also highlighted various limitations due to lack of

durability data related to the construction elements and long term cost computation of the asset. The main barrier to target costing adoption is the existing commercial practices in the UK construction Industry. The understanding of 'cost' varies across various tiers in supply chain as main contractors sublet most of the work as a package, thus additional margins are added to a particular job. The current norm of design and inviting prices from suppliers alien to design development which results in series of 'prices' instead of true cost of the project/product (Nicolini et al. 2000).

US PUBLIC HOSPITAL

Continuous efforts to adapt the target costing manufacturing approach to the US construction industry resulted in a management approach called Target Value Design (TVD). TVD research has been undertaken within the framework of lean project delivery (Ballard 2008). The first successful TVD application in construction was reported by Ballard and Reiser (2004) in a design-build project in the USA. Sutter Health (a healthcare service provider in California/USA) has also pursued TVD application in association with its supply chain (Zimina et al. 2012).

More recently, The University of California, Berkeley's Project Production Systems Laboratory (P2SL) published a technical report describing the TVD application to the design phase of three hospital projects. For the purpose of this paper, the authors have decided to focus on the UCSF hospital project out of the three projects as other (UK, Brazil) projects in comparison are also public projects.

This TVD project is part of a 3-year research initiative launched in June 2010 by P2SL at the request of member company DPR Construction. The UCSF Medical Center at Mission Bay is a Greenfield integrated hospital complex on a 57-acre biomedical campus (Denerolle 2011).

Although it was not possible to apply all of the TVD principles on the project due to regulatory or legal restrictions, a partial TVD application still provided cost savings. Overall, the project team was able to reduce US\$100 million from the project cost.

BRAZILIAN PUBLIC HOUSING

Jacomit and Granja (2011) investigated target costing applicability within a non-profit low-income housing provider in Brazil. As the housing provider did not apply target costing, the relationship between its environment and target costing was established through a tentative causal model that describes how each chosen environmental characteristic would affect the target costing applicability. The typical project developed by this housing provider corresponds to the repetition of a standard product (five-story building without an elevator) inside a designed area.

In Jacomit and Granja's study, three types of environmental characteristics were identified: (i) characteristics that would raise target costing applicability (design standardization and replication of design) (ii) characteristics that would reduce target costing applicability (bidding process and outsourced design), and (iii) characteristics that drive target costing application (application purpose, decision maker and end-user participation in design).

ANALYSIS

This section aims to analyse the relevance of the Cooper and Slagmulder's factors on the three studies.

INTENSITY OF COMPETITION

It influences how much attention the firm should pay to competitive offerings in the target costing process. As the intensity of competition increases, so does the value of target costing to the firm. The intensity of competition primarily influence the entire target costing process (Cooper and Slagmulder 1997).

DISCUSSION

While the target costing in the manufacturing industry begins with an analysis of the market conditions (customers and competitors), the three primary studies are more internally focused. The three studies have different application purposes. The TVD approach relies on the internal capabilities of an organization to achieve cost predictability. The British initiative also assumed an internal instead of an external one. The British initiative was instigated by the realization of low performance of the UK construction industry. Due to the profitless nature of the Brazilian housing provider, target costing was envisioned as a transformation trigger to increase value by improving project functionality without raising costs. The three projects were not motivated by the intensity of competition. However, the motivation of the projects of achieving cost predictability (US), increasing the industry performance (UK) and providing better value to the customer (Brazil) would have helped in any attempt to address any competition in the construction industry.

NATURE OF CUSTOMER

Degree of Customer Sophistication

It determines how good customers are at detecting differences between the price, quality, and functionality of competitive products. In environments with sophisticated customers, the target costing process will have a strong external orientation because understanding the customers' requirements is critical (Cooper and Slagmulder 1997).

The rate at which customer requirements change

It defines how quickly survival zones (cost, quality and functionality) move over time. Target costing is more beneficial in environments where consumer preferences change rapidly because under such conditions a firm is more likely to launch products that are outside their survival zones (Cooper and Slagmulder 1997).

Degree of understanding of future product requirements

As the degree of understanding increases, it becomes more beneficial to rely on known customer preferences to determine the future location of survival zones. Target costing is less beneficial in environments where the future locations of survival zones are hard to predict (Cooper and Slagmulder 1997).

DISCUSSION

All three projects are public projects, however, the nature of the US and the UK customers differs from the investigated Brazilian customer. The US and the UK customers were highly sophisticated and well aware of their price and quality requirements. In the Brazilian environment, the consumer market was represented by low-income families, which are less sophisticated customers and enjoy less freedom of choice. Unlike manufacturing, the target costing process in the three studies were not market focused. The changes in customer requirements was high in the U.S attempt and due to implementation of Target Value Design the team were able to contain the cost of the project. The UK and Brazilian attempts faced less challenges with respect to changes in client requirements. The client had better understanding of the future requirements in all the three project. However, 'survival zone' application cannot be applied to any of the three attempts due the nature of projects (Public projects).

PRODUCT STRATEGY

Number of Products in the line

The greater the number of different products a firm supports, the higher is the overall level of customer satisfaction. As the number of products in the line increases, so does the effort expended on target costing because new product launches occur more frequently (Cooper and Slagmulder 1997).

Frequency of redesign

Increase product functionality is a strategy pursued by many firms in the manufacturing industry. This objective is achieved by rapidly introducing new products, with each new generation incorporating the latest technology. The higher the rate of product introduction, the greater the benefits derived from target costing because the product development budget is higher, and therefore more is at risk (Cooper and Slagmulder 1997).

Degree of Innovation

As the degree of innovation increases, so does the cost of product development. Customer, competitor and supplier information can be invalidated by significant innovations in product design. Target costing is most difficult to apply to revolutionary products (Cooper and Slagmulder 1997).

DISCUSSION

Cooper and Slagmulder (1997) highlighted that the greater the variety of products in a line, the more benefits it could render, since it increases product development priority and further justifies the allocation of funds to the budget. However, in construction, a small variety of products being produced and replicated could, in fact, increase a product's development priority and its budget, reducing the impact of construction peculiarity one-of-a-kindness (Jacomit and Granja 2011).

The Brazilian attempt had low level of redesigning requirements due to the standard and replication nature of the project. It can be observed as client's desire for latest technology/specification (U.K. case), project's design complexity and change in

client's requirements post design development (U.S. case) can lead to higher frequency of redesign.

Due to the nature of the project, the product development budget in the UK and US case were higher than Brazilian attempt. However, U.K & U.S projects demanded high level of innovation. Former due to the integration of Through Life cost (TLC), which required number of efforts to align the through life cost and design needs, and latter due to the project size and its complexity. The U.K. attempt's design development required certain redesigning effort due to TLC and unstructured Multi Party Value Engineering (MPVE) attempt while U.S. attempt faced redesigning requests from the client. It can be drawn that high level of innovation and high level of redesign requirements in a project are highly relevant factors/conditions for target costing implementation.

CHARACTERISTICS OF THE PRODUCT

Product Complexity

It captures the number of components in the product and the number of distinct production steps required to manufacture it, the difficulty of manufacturing the components it contains, and the range of technologies required to produce them. As the complexity of product grows, the benefits of target costing increase (Cooper and Slagmulder 1997).

Magnitude of Up – front investments

Firms that produce products with very low product development cost are often willing to launch numerous products each year with the expectation that only a few will be successful. When up-front investments are small, the benefits of target costing are lower (Cooper and Slagmulder 1997).

Duration of product development

The length of time taken to develop a new product also helps determine the benefits derived from product-level target costing. As the product design cycle increases in length, the target costing system typically becomes more complex (Cooper and Slagmulder 1997).

DISCUSSION

All three studied projects differ in terms of complexity. While the TVD practice is mostly pursued in large highly complex healthcare projects, the Brazilian initiative investigated target costing applicability in a standard product. The UK initiative was a complex, high investment upfront attempt with a reasonable standard product with high level of specification requirements. All three attempts have high magnitude of up-front investment with US attempt having the longer product development time.

SUPPLIER-BASE STRATEGY

Degree of horizontal integration

It captures the percentage of the total cost of the firm's products are sourced externally. When a greater percentage of the product is externally sourced, the potential savings are greater because target costs can be developed for each of the

externally acquired component and can be used to create pressure on suppliers to reduce price.

Power over major suppliers

It helps establish the ability of the firm to legislate selling prices to its suppliers. The more power the firm has over its suppliers, the more benefits it can derive from target costing by using it to create cost pressure on its suppliers.

Nature of supplier relation

It deals with the degree of cooperation the firm can expect from its suppliers and in particular the amount of design and cost information sharing. As supplier relations become more cooperative, the target costing process in general and the component-level step, in particular, become richer and more beneficial.

DISCUSSION

All of the three studied initiatives were public sector projects in which procurement restrictions usually prevent early collaboration among key project stakeholders during the early stages of product development. UK commercial and cost management practice were pointed out as the main barrier to the adoption of a fully-fledged version of target costing. Large contractors often operate without a complete understanding of costs through the supply chain (Nicolini et al. 2000).

The Brazilian initiative highlighted that the bidding process reduces cost reduction opportunities associated with the supply chain. Despite low bid based selections have traditionally been used in the public sector, the US initiative used a multi-criteria contractor selection (best value selection) to establish incentives to increase contractor alignment with owner needs. All the attempts highlights that supplier based strategy is highly important in the implementation of target costing. Table 1 summarizes the comparison results.

Table 1. Comparison of three studies

Factors	UK Ministry of Defense projects	US Public Hospital	Brazilian Public Housing
Intensity of competition		not applicable in this context	
Nature of customer			
Degree of Customer Sophistication	High	High	Low
The rate at which customer requirements change	Low	High	Low
Degree of understanding of future product requirements	High	High	Medium
Product Strategy			
Number of Products in the line		not applicable in construction domain	
Frequency of redesign	High	High	Low
Degree of Innovation	High	High	Low
Characteristics of the product			
Product Complexity	Medium	High	Low
Magnitude of Up – front investments	Medium	High	Medium
Duration of product development	Medium	High	Medium
Supplier-base strategy			
Degree of horizontal integration	Medium	Medium	Low
Power over major suppliers	High	Medium	Low
Nature of supplier relation	Hybrid	Collaborative	Adversarial

CONCLUSION

Any target costing adaptation for the construction industry is likely to manifest itself in different ways given the uniqueness and site-based nature of the projects and industry. The inferences derived from the qualitative comparison of the three studies cannot be generalized on a larger scale and only few simplified conclusions can be drawn.

The main lesson learnt from the comparison was that the three factors related to supplier-base strategy (Degree of horizontal integration, Power over major suppliers and Nature of supplier relation) are potentially relevant to future target costing implementation in public sector projects. While Design-Bid-Build is still the delivery method most frequently used in the construction industry, public owners can take a more proactive approach to ensure the level of supply chain integration needed for target costing application.

Cooper and Slagmulder (1997) pose six key questions that organizations should ask in deciding if the direction of their organization is supportive of target costing. The question of whether supplier relations are becoming more critical to the survival of the company focuses on how supplier relations are changing. As the level of outsourcing in the construction industry increases, the role of supplier relations become more critical in the target costing process.

It can also be highlighted that factors related to the nature of customer (Degree of Customer Sophistication, rate at which customer requirements change and Degree of understanding of future product requirements) are also relevant to target costing implementation. Customer knowledge about required product, their change requirements would influence the implementation of target costing. However, public projects are not under the competitive market hence the future product requirement factor is not highly relevant to target costing implementations in public sector projects.

Similarly, factors under Product Strategy are also relevant except number of product in the line. It has been noted that Frequency of redesign and Degree of innovation also act as a highly relevant factor for target costing implementation.

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REFERENCES

- Ansari, S., Bell, J. and Okano, H. (2007). "Target Costing: Uncharted Research Territory". In: Handbook of Management Accounting Research. s.l.:Elsevier Ltd..
- Ballard, G. and Reiser, P. (2004). "The St. Olaf College Fieldhouse Project: A Case Study in Designing to Target Cost." Proceedings of the 12th Annual Conference of the International Group for Lean Construction, Elsinore, Denmark.
- Ballard, G. (2008). "Lean Project Delivery. An Update." *Lean Construction Journal* pp. 1-19.
- Banwell, H., (1964). "The Placing and Management of Contracts for Building and civil Engineering work". London: HMSO.
- Cooper, R. and Slagmulder, R. (1997). "Target Costing and Value Engineering" The IMA Foundation for Applied Research, Inc.
- Denerolle, S. (2011). "Technical Report: The Application of Target Value Design to The Design Phase of 3 Hospital Projects." Retrieved from www.targetvaluedesign.org/publication
- Egan, S. J. (2004). "Rethinking Construction" London: Construction Task force.
- Folwell, K., Sharp, G., Souza, J., Wilen, A., Bentley, D., Davis, R. and Hutchinson, V. (2012). "UK Industry Performance Report" London: Construction Excellence.
- Jacomit, A.M. and Granja, A.D. (2011) "An investigation into the adoption of target costing on Brazilian public social housing projects." *Architectural Engineering and Design Management*, 7 (2) 113-127.
- Latham, M. (1994). *Constructing the Team: The Final Report of the government/Industry review of procurement & contractual arrangements in the UK Construction Industry*, London: HMSO.
- Nicolini, D., Tomkins, C., Holti, R., Oldman, A. and Smalley, M. (2000) "Can Target Costing be Applied in the Construction Industry?: Evidence from Two Case Studies." *British Journal of Management*, 11 (4) 303-324.
- Office, C. (2011). "Government construction strategy", s.l.: Cabinet office.
- Santos, A., Powell, J. and Formoso, C.T. (2000). "Setting stretch targets for driving continuous improvement in construction: Analyses of Brazilian and UK Practices." *Work Study*, Volume 49, pp. 50-58.
- Shoten, M. (1996). "The Future Directions of Target Cost Management Research, The Report of the Special Committee on Target Cost Management" s.l.: Japanese Accounting Association.
- Zimina, D., Ballard, G. & Pasquire, C., (2012) "Using collaboration and lean approach to reduce construction cost." *Construction Management Economics*, 30(5), pp. 383-398.