

Advancing Target Price and Target Value Design Process in IPD Using BIM and Risk-Sharing Approaches

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The AEC industry has realized the value that can be generated through collaboration and integration. As a result, we are entering into a revolutionary era in history driven by an integrated vision. The results of these ongoing efforts are Integrated Project Delivery (IPD), Building Information Modeling (BIM), and Lean. Associated with lean and IPD are target pricing and target value design, which serve as value-generating solutions. Target price has been used with various contracting techniques such as guaranteed and estimated maximum price. This paper introduces these price contracting mechanisms and highlights their differences with respect to risk allocation. Target costing and target value design are also applicable to other non-traditional delivery approaches in which designers and builders are involved early in the process and work as a team. To identify how the target costing and target value design practices are performed differently in each of these delivery approaches, this study compares the IPD and design-build approaches. The paper concludes with discussing how the practice of IPD and TVD can be further enhanced using contractual strategies and BIM tools and processes to promote value generating efforts.

Keywords: IPD, BIM, Target Cost, Target Value Design

Introduction

Increasing global competition pressured manufacturers into using innovative operational strategies that preserve the desired profitability in their operations. This situation has prompted manufacturers to employ cost management techniques for controlling their processes. To remain in this market with keen competition, manufacturers have to be flexible and responsive to consumers' demands. The most visible consequence of market-driven production and operation is the great variety of products on the market. Therefore, customers benefit from the availability of more and higher quality products on the market at lower prices. The manufacturers that are most responsive to consumer demands are the most profitable. To systematically improve product profitability, manufacturers developed the methodology of target costing (TC) As written (Ballard, 2004).

TC for the first time appeared in the manufacturing industry in the early 1930s and has proven to be a powerful strategic instrument for management and profit planning As written (Cooper and Kaplan, 1999 and Feil, 2004). Since then it has been used in manufacturing most consistently by seven large Japanese manufacturers to achieve cost predictability during new product development so that new products and services both meet market determined price and provide financial returns. Since the 1970s most companies in competitive industries have used some elements of TC As written (Ansari et al., 2006). TC has been implemented in some developed countries since the early 1990s in companies such as Chrysler and Caterpillar As written (Chan et al., 2010 and Cooper, 1997 and Zimina, 2012). Lean, as an optimization tool, emerged and had a revolutionary impact on manufacturing between 1951 and 1961 As written (Cooper, 1997). As the industry struggles to increase the number of successful outcomes and certainty of project delivery in terms of cost, quality, and time, the adoption of TC by the construction industry promises benefits. TC was first successfully applied in construction in 2002 and subsequently, TVD emerged as a design application of TC to foster the practice of value management.

TVD was first implemented by Boldt construction in St. Olaf's Tostrud Fieldhouse and Thedacare's Shawano Clinic Projects and then by Sutter Health in the USA in association with their supply chain As written (Ballard, 2012 and

Zimina, 2012). The term of TVD was formally entered into literature by Macomber and Barberio in 2005 when they used it to refer to target costing in construction As written (Rybkowski, 2012).

By nature, TVD requires close collaboration among designers and builders throughout the design phase. Before proceeding with a project, designers need builders' assistance to determine viable design alternatives, to estimate costs, and to provide value engineering services as the design evolves. TVD involves the concurrent and continuous process of designing to a set target value (cost and quality) and assessing the success at accomplishing the design targets (i.e., cost and quality). To implement value management techniques such as TC and TVD, project stakeholders have adopted a collaborative platform, the emerging Integrated Project Delivery (IPD) approach.

This paper intends to study TC and TVD closely, highlight their differences from other pricing approaches such as traditional pricing and guaranteed maximum price (GMP) and outline the comparative results of IPD vs. Design-Build approaches in implementing value management practices such as TC and TVD. Finally, this paper highlights the current gaps and deficiencies in the TVD process and concludes with recommendations on how IPD, TC, and TVD process can be further enhanced.

Method

This paper conducts a literature review and interviews with IPD/lean experts to shed light on the state-of-the-art TC, TVD, and BIM-assisted cost estimating tools. To address the research questions, we analyzed the information collected through the literature review using a theme-coding technique and developed several open-ended questions based on the current gaps in the literature. We conducted phone interviews with the leaders and founders of IPD and Lean in the industry, recorded the results of conversation and then transcribed and analyzed them. Finally, we performed a gap analysis and suggested how current target price and target value design practices in IPD could be further enhanced to promote value generating efforts.

Results

Terminologies

As individuals may vary in their understanding of a single terminology, construction management terminology is sometimes used incorrectly and interchangeably. The AEC industry needs a "Construction Wikipedia" that presents a standard definition for the proper use of various terms. It is important that authors provide clear explanations of terms when discussing different topics. For example, although their meanings differ, the terms "cost," "price," and "budget" are often used interchangeably. Below is the definition of the terms used in this article:

- **Budget:** The total amount of money that a client is willing and able to spend on a project As written (Ballard, 2012 & Thomsen, 2012).
- **Cost:** The total sum of expenses incurred by a service provider As written (Walden, 2008).
- **Price:** The amount a customer is willing to pay and the seller is willing to sell for. In a healthy economy the price is higher than cost and involves some profit for the seller. However, in a down economy, because of the low demand the price may be as low as the cost or sometimes even lower As written (Walden, 2008).
- **Value:** Value is defined by the client and it could include various dimensions such as quality, performance, cost, time, and sustainability, etc.
- **Target Cost:** The cost established as a target at the onset of the project based on the project budget and market benchmarking cost (Ballard, 2004). Target cost is aimed at reducing the life-cycle cost of the project while ensuring quality As written (CIMA, 2013).
- **Target Value Design:** An optimization practice and a design process which aims to generate higher value by achieving an established target values including a target cost lower than comparable market benchmarks (Draper, 2012 & Ballard 2012).

- Guaranteed maximum price (GMP). In GMP, the risk of cost overrun is transferred from the owner to the service provider that guarantees the price.
- Estimated Maximum Price (EMP): In EMP contract, the risk of cost overrun is shared by owner, designers, and major contractors (Darrington & Lichtig, 2010).

Target Cost and Target Value Design in an Integrated Project Delivery Approach

Because of the growing complexity, tight schedules, and limited budgets of construction projects, the construction industry is demanding changes in contracting procedures. IPD system with TC and gain-pain share concept has enhanced value for budgeting As written (Chan, 2011). “IPD is a method of project delivery distinguished by a contractual arrangement among a minimum of owner, constructor and design professionals that aligns the business interests of all parties” As written (AIA, 2012, p.2).

Target Cost (TC)

In conjunction with IPD, a new basis of reimbursement is TC As written (Kenig, 2011). TC is a methodology, developed by manufacturers, that systematically improves product profitability As written (Ballard, 2004). Target Cost is not just a cost reduction technique; it is part of a comprehensive strategic profit management system As written (CIMA, 2013). TC is established based on the client’s budget and market benchmarking prices. Benchmarking determines whether or not an allowable cost is adequate for the construction of a desired value. The expected cost provided by the project team is compared with the allowable cost. If the latter is smaller, a conversation about searching for a trade-off between what is wanted, how much it costs, and what can be done to get it begin As written (Zimina, 2012). TC is specifically utilized in situations in which a client working within a limited budget wants to spend the entire budget on adding value. “For instance consider an educational institution is given a donation to build an athletic facility, there is no money available beyond the donation and there is no reason to spend less than the full amount. The objective is to maximize value received from the available funds” As written (Ballard, 2004, p. 239). Once TC is set, the TVD process begins. If a design is to remain within a budget, estimates must be provided continuously through close collaboration among the project participants during the scoping, feasibility study, programming, schematic design, design development and construction document phases to prevent the risk of running above the TC As written (Zimina, 2012 and Haymaker, 2011).

Setting Target Cost

Determination of the TC can be done in several ways:

1. What the project has cost in the past,
2. Estimating a piece of the building and multiplying by the total of the building,
3. How much money the owner is able and willing to spend.

In manufacturing TC development is based on the profitability, but in construction TC begins with the maximum available fund that the customer is able and willing to pay that may or may not include increased profitability As written (Ballard, 2012 and Ballard, 2006). After determining and establishing TC, a worksheet is used to calculate the TC by subtracting the standard profit margin, warranty reserves, and any uncontrollable corporate allocations. If a bid includes non-incurring development costs, these are also subcontracted and then a feasibility study will be run. The target cost is allocated down to lower level assemblies of subsystems in a manner consistent with the structure of teams or individual designer responsibilities As written (Ballard, 2006). Lean suggests setting a TC less than the estimated cost or the available budget, and seeks a collaborative process to deliver the project within that TC.

Estimated Maximum Price (EMP) and Pain/Gain Sharing

The pain/gain share concept associated with the EMP method can be an effective means of motivating contractors to achieve better value by aligning their financial objectives with the overall objectives of the project As written (Bower, 2002) & (Darrington & Lichtig, 2010). Any savings below or overruns above the TC are shared by all of

the project parties with a pre-determined share ratio according to the contract conditions As written (Chan, 2011). The concept of pain/gain sharing confirms that involved parties in the project are under contractual obligation.

Figure 1 illustrates the risk allocation versus risk sharing approach in Guaranteed Maximum Price (GMP) and Estimated Maximum Price (EMP) contract, respectively. In GMP, the risk of cost overrun is allocated to the CM/GC. Comparatively, in EMP contract, the risk of cost overrun is first shared by the project team to the extent of their at-risk fee and beyond that it will be owner’s risk.



Figure 1: TC with GMP vs. TC with EMP

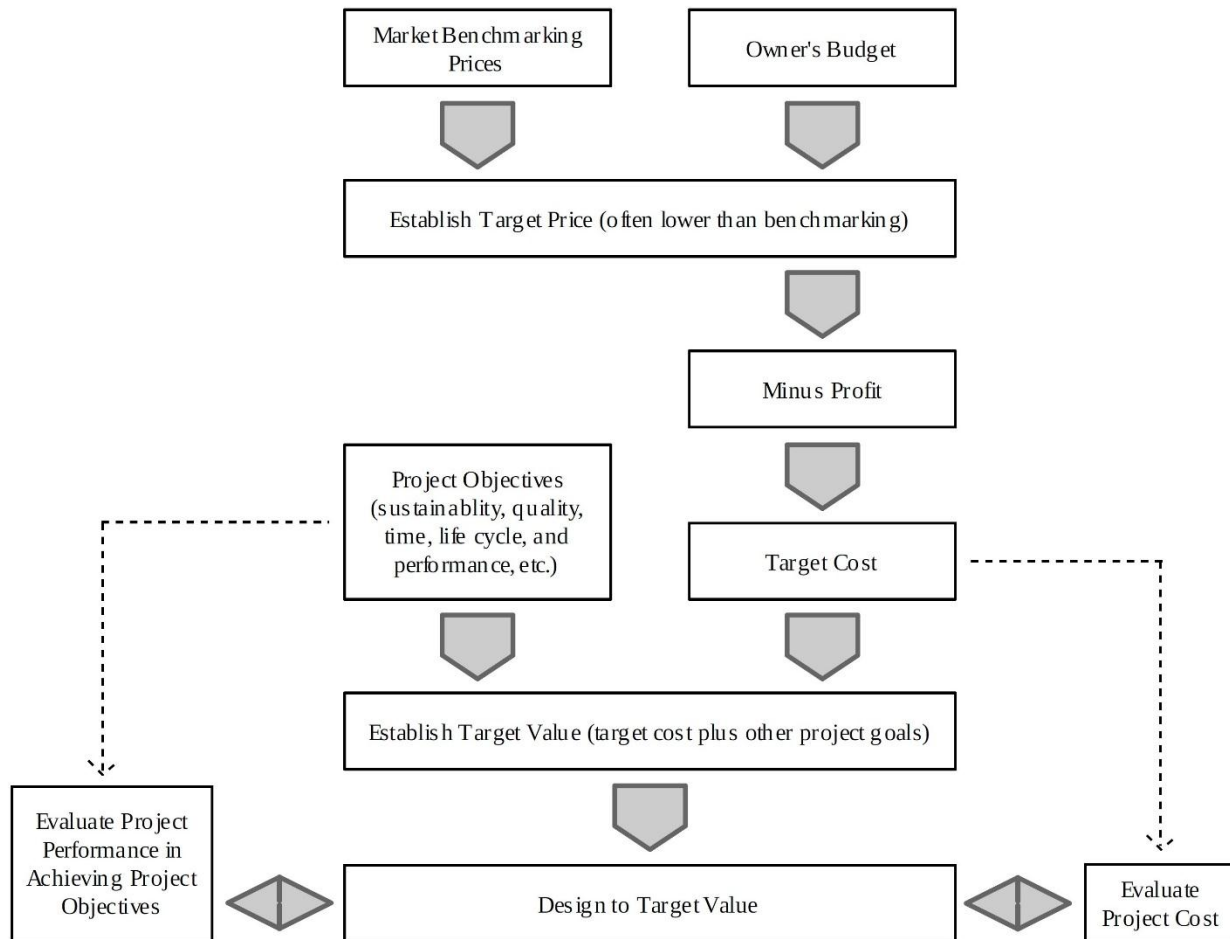


Figure 2: TC Setting and TVD Process

Target Value Design (TVD)

Target Value Design is a newly merged value engineering based approach implemented in Lean practices and IPD projects. The goal of TVD is to achieve the greatest value on behalf of the owner. It involves an optimization process that seeks to achieve more than the owner thought was possible for less than the originally conceptualized target cost. Unlike the traditional process, where estimating follows a design phase, in TVD practice, cost and value drives design As written (Draper, 2012). Real time estimating is constantly performed and no item or alternative goes further than a week without being estimated. In IPD approach, the shared financial risk and reward model and the colocation of the team enhances collaboration between design and construction team, and thus provides an excellent platform for implementing TVD.

Various value engineering techniques, such as functional analysis can be implemented in TVD process. “Functional analysis is concerned with improving profits by attempting to reduce costs and/or by improving products by adding new features in a cost effective way that are so attractive to customers that profits actually increase” (CIMA, 2013). While functional analysis is mostly focused on cost and profit, TVD aims to achieve broader arrays of project goals besides cost, such as quality, sustainability, life cycle performance, etc. TVD describes the continuous process of design and its evaluation to achieve or exceed the value defined by the client while keeping the project within or under the target cost. Figure 2 illustrate the process of establishing target cost and target value design.

IPD vs. Design-Build: Implementation of Target Value Design and Target Cost

TVD can be implemented in various project delivery methods; however, it is best suited to IPD, as it requires a close collaboration between the designer, the builder, and the *owner*. TVD is also applicable to other integrated approaches such as design-build and CM at-Risk. Following is the comparative result of IPD versus design-build with respect to application of TC and TVD. According to Ballard the key points of comparison can be summarized into three categories: 1. how target price is set socially and quantitatively, 2. how TVD process is managed, and 3. how commercial interests are aligned.

Setting Target Price in IPD vs. Design-Build

In an IPD project, the TC is established collaboratively by owner, designers, and builders based on the owner’s budget, program requirements, market benchmarking, and feasibility study. TC in IPD process has the collective buy-in from all parties As said (Ballard, 2012).

In contrast, the target price in the Design-Build approach is usually established by the Owner without the Design-Builders’ involvement and through some types of competition considering both price and quality As said (Ballard, 2012).

Target Value Design Process in IPD vs. Design-Build

TVD in IPD fosters innovation, especially when the TC is aggressive and the team is financially incentivized to meet or exceed TC. Throughout the TVD process in IPD, the owner, the designer, and the builder work collaboratively and make collective decisions when assessing different design alternatives and adjusting target cost in order to achieve or exceed the desired value. The project team’s involvement in developing project goals/criteria and the owner’s involvement during the design development promotes team’s understanding of the project requirement and owner’s desires and project constraints As written (Ballard, 2012).

Comparatively, in design-build, the owner is not involved in the decision making process once the contract is awarded. The design-builder would exercise the sole control on the design/construction process and value management decision making. The owner sets the project criteria, without any input from the design-builder, and the design-builder decides on “how” to design, build and manage the process to stay within Target Price and value without much input from the owner As said (Cohen, 2012) & (Ballard, 2012). The design-build process is generally

not transparent to the owner. Design-build offers a better delivery solution for less sophisticated owners, who do not want to be actively involved in the project.

Alignment of Commercial Interests in IPD vs. Design-Build

Throughout the TVD process within IPD, the client is the member of the core IPD team. The owner, the architect, and the contractors are bound together through a tri-party contract and their individuals' success is tied to the project success through shared risks and rewards provision. As a result, the commercial interests of key players are aligned. In contrast, in design-build, the risk of cost overrun is shifted from the owner to the design-builder, and thus the parties' interests are not completely aligned As said (Ballrad, 2012).

BIM-assisted Cost Estimating Tools

Cost estimation is essential to the processes in the construction industry and its accuracy is critical for project success. Traditionally cost estimating for building projects starts with quantification which is time consuming and human error during this process is unavoidable As written (Sabol, 2008). Processes within estimating, such as quantity survey and pricing, may be automated by using existing BIM software in combination with existing estimating software As written (Sattineni, 2011). "BIM has proven to offer great advantages over traditional estimating methods As written" (Nassar, 2012, p.171). The "Innovaya" system provides a visual model of all the objects that have been imported from the BIM model and allows estimators to use it for their needs without having to learn all of the features contained within a given BIM tool As written (Eastman, 2011).

There are some 5D BIM based work flow software such as "Vico" that supports data from other software including Revit, Tekla, MS Excel, etc. Vico can use the quantity take off data and define time and cost. It is also an effective tool in project control phase As written (Vico Software, 2013).

Discussion

This research closely studied TC and TVD concept. It highlights how TC and TVD are established and managed, and outlines the benefits and application of these value management techniques. In addition, it comparatively demonstrates the application of TC and TVD in an IPD approach versus a design-build approach. Following the results outlined in previous sections, a table is developed which presents the influential factors such as owner's characteristics and budget condition which leads to the selection of an alternative delivery method (Table 1).

TC with EMP contract and TVD have been utilized in IPD approach to increase value to the owner and reduce waste. The value is defined collectively by the core IPD team, which usually involves *owner*, designer, and key builders. Owner's value is defined by different criteria, such as quality, cost, time, and sustainability etc. Unfortunately, cost is often measured by design and construction cost and does not include facility operation cost. Respectively, designers and contractors are not incentivized to look for solutions which would reduce operational cost but instead increases the construction cost to a less extent. The operation cost is as important as initial cost, if not more. For instance in the Gates Computer Science Building of Stanford University, the present value of its 30-year life cycle including maintenance, operations and utility costs are as much as the initial project cost As written (Guideline for Life Cycle Cost Analysis, 2005).

Best practices consider life cycle cost as opposed to just design and construction cost. It is up to the owners to define life cycle cost as one of the target value criteria in order to ensure that the team is not incentivized to reduce design and construction cost in the expense of increased operation cost.

Owner's active involvement in the project and decision making process throughout design and construction will increase the likelihood of project success in achieving the target value. In this respect the IPD model, which by nature requires increased owner involvement in the process, is superior to Design-Build and CM at-Risk business model. Contractually, DB and CM at-Risk do not require as much owner's involvement as the IPD model does.

Table 1: Selection Criteria Leading to the Choice of Design-Build or IPD Approach

TC/TVD	Select Design-Build, if:	Select Integrated Project Delivery (IPD), if:
Setting Target Price	<ol style="list-style-type: none"> 1. Owner's budget is a fixed known amount; or 2. Owner does not need Architect's or Contractor' assistance in feasibility study or benchmarking 	<ol style="list-style-type: none"> 1. Owner's budget is flexible based on the forecasted project price and market study; or 2. If Owner would like to have Architect's and Contractor's input in developing project goals and criteria, establishing target cost and target value and also to have their buy-in 3. Open accounting
Target Value Design	<ol style="list-style-type: none"> 1. Owners would not like to be involved in design & construction process and decision making process 	<ol style="list-style-type: none"> 1. Owners would like to be involved in design and construction process 2. Owners would like to have joint control over design and construction 3. Innovative design & value generating solutions

Furthermore, the involvement of the project team in establishing target values will increase the likelihood of project success in achieving those set values because of the team's buy-in to those goals and their increased sense of ownership. The early involvement of project team and the jointly developed project goals and criteria in the IPD approach differentiates it from the DB model and makes IPD a more reliable approach to achieve the established target value.

Additionally, the shared risks and reward model specific to IPD ties individual's success to project success. As a result project participants' interest and business goals are aligned. The project team are more likely to collaborate with each other and the owner for the best interest of the project, as they have skin in the game and profit at risk.

This paper recommends that the target value includes operational cost in addition to project initial cost. It suggests that the IPD core team should also involve the future facility manager. This way, the owner would highly benefit from the involvement of the facility managers when developing the project goals and criteria, establishing the target operational cost and developing the incentive plan. Respectively, the financial shared risks and rewards model should incentivize the project team on achieving target design and construction value as well as target operational value.

This research also proposes expanding the capacity of BIM process and tools to support TVD process. The as-built BIM model must include the as-built cost information and their detailed cost breakdown. The as-built BIM database of the past projects would be a useful source of information for setting a target price for future projects and also for identifying the price range for sub-system while having access to building information at the same time. This especially would be useful when setting the TC for different sub-system and developing designs criteria. The stored cost information and the virtual model in the BIM database provides a significant value to the core IPD team in establishing the target value.

Even though this paper attempted to provide a comparative analysis between, IPD and design-build, with respect to implementation of target cost and target value design, it is important to note that these business models are not mutually exclusive systems. Both DB and IPD could in fact be employed on the same project. While overall delivery method is important in structuring the relationships between the owner, designers, and builders, the language of the contract(s) between the parties will legally control the dynamic of the team. In addition, the informal relationships of the parties may also blur the distinctions between "IPD" and "design-build".

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