SHOULD PROJECT BUDGETS BE BASED ON WORTH OR COST?

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ABSTRACT

Two opposing objectives drive construction project budgets. Budgets are driven higher by the objective of providing sufficient funds to achieve project goals in conditions of uncertainty, and driven lower by the objective of spending no more than necessary to accomplish project goals. These two risks, running out of money and leaving money on the table, are in tension and finding the balance point between them is a challenge not always met—some might say 'infrequently met'. Projects can and do fail both ways.

In this paper, it is proposed that these two objectives be pursued through two different financial elements rather than a single financial element. The objective of providing sufficient funds to achieve project goals is to be met by specifying as the project budget the most a client is willing and able to spend to achieve the goals of the project. This allowable cost is based on the worth to the client of the asset to be constructed and is the most conservative basis for budget setting consistent with project economic viability. The objective of spending no more than necessary is to be met through shared savings.

KEYWORDS

Lean construction, project budgeting, project cost management, target costing, target value design, value

INTRODUCTION

The question about the proper basis for project budgets has been driven in the lean construction community by the application of product development's target costing to construction projects. Both are projects, but there are two major differences between product development and construction that require adaptation of the target costing process: 1) the role of the customer, and 2) the nature of the product. The customer initiates and structures construction project delivery and construction's products are unique as opposed to objects of repetitive manufacturing. Uniqueness is driven by the fact that the products are produced for a specific customer, not for a type of customer, and by the location in which they are constructed and used. Locations vary in terms of seismic conditions, meteorological conditions, codes, regulations, urban fabric, etc.

In product development's target costing, budgets are set by the producers based on target profitability. In construction, budgets are set by the customers based on what they are willing and able to spend to accomplish their objectives, which may or may not include increased profitability. Product uniqueness poses challenges both to

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accurate estimating of costs and benefits from use of the asset to be constructed (asset worth), and to accurate estimating of cost to procure. Target costing was first successfully applied in construction in 2002 (Ballard and Reiser 2004). Subsequently, target value design began to be used to name target costing in construction. The first process benchmark for target value design was published in 2005 (Ballard 2005).

Construction project budgets have traditionally served two functions that are in tension with one another; namely, to provide sufficient funds to achieve the purpose of the project and also to minimize the project cost. The paper begins with a proposal to divide these two functions between two financial elements rather than only one, relying on the incentive of shared savings to spur innovation and hence reduce the actual cost within the allowable. For the sake of simplicity and brevity, it is assumed that the client is building for their own use. Limitations of this assumption on the applicability of the findings and recommendations are considered in recommendations for future research.

The literature is divided on the proper evaluation of project performance between those who look primarily to the worth of the constructed asset, i.e., to the value delivered to the customer, and those who look primarily to performance against project budget and schedule (Thiry 2009); a division reflecting the contradictory objectives in budget setting (the same could be said for time as for cost). It is argued that the approach proposed in this paper reduces the risk of project failure however evaluated, and that it also reduces the cost of similar projects over time. This proposal is supported by case studies and by reasoned argument.

This reconceptualization of the functions of budgets and the process for budget setting cannot stand alone, but rather entails fundamental changes in project delivery, which are presented in summary form.

A few projects have been completed using an approximation of the recommended approach, and their performance relative to industry norms is evaluated. It is hypothesized that complete conformance to the approach would yield even better results. In any case, more data points are needed in order to increase confidence that this new approach to project delivery is superior to traditional practice.

PROPOSAL TO DIVIDE FUNCTIONS

It is proposed to divide the two functions previously performed by project budgets between the budget, based on allowable cost, and a target cost, which may be based on added value desired by the client, as illustrated in Figure 1, or may be unbounded, with no limit on the amount of cost savings to be shared between client and project team.

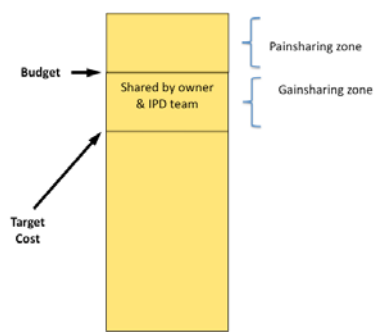

Figure 1: Basic Commercial Model

If the project budget is to perform the function of providing sufficient funds to achieve the 'business' purpose of the project, which is to secure the benefits to be had from use of the constructed asset, it should be set at the maximum amount the client is willing and able to spend to secure those benefits; i.e., the asset's allowable cost (Ballard 2009).

The recommended process for determining the allowable cost for a project is shown in Figure 2. What the client is willing to spend is a function both of his estimate of those net benefits (net the costs to use the asset; such as maintenance, staffing, etc.) and required return on investment.

The amount a client is willing to spend may be reduced by funding constraints, determining the allowable cost: what the client is willing and able to spend to obtain use of the asset to be constructed. The next step is to compare the allowable cost to the market cost estimated from programmatic data (conceptual estimating) and expressed as an interval estimate. If the upper end of the interval estimate for the market cost is below the allowable cost, unless the client chooses to change what's wanted, the budget is provisionally set equal to the market cost. If the market cost is above the allowable cost, the feasibility of the project is doubtful.

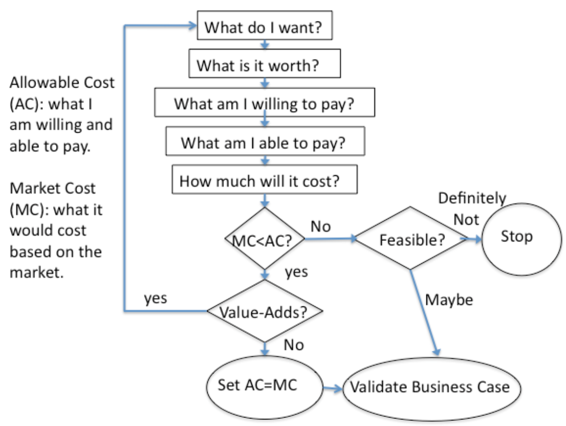

Figure 2: Determining the project budget

If feasibility is considered impossible, the project is stopped. If not, the client assembles the key members of the team that will design and construct the project to validate the project business case. The project funding decision is made by the client based on the team's validation report[2] (Ballard 2009).

2ND FUNCTION: LIMIT THE COST TO ACQUIRE

How then should a client secure the second function of traditional project budgets; namely, to limit the cost to acquire, without increasing the risk that the project will

2 Key members of the team that will design and construct the project if it is funded are engaged by the client to validate the project business case, answering the question 'Can you have what you want within your conditions of satisfaction for time, cost, location, etc.?'. Validation is most effective when it begins by asking about client purpose and presuppositions, revealing the consequences of client desires, and exploring alternative means to achieve their purposes (Ballard 2009).

fail to achieve its purpose? One possibility is to shift cost risk by securing fixed price contracts to design-construct or construct-only. The probability that actual costs at project completion will be within the budget (allowable cost) is a function of the gap between the budget and the sum of fixed prices, on the one hand, and the level of project complexity and uncertainty on the other. There is some interdependency between these two variables. The more complex and uncertain the project, the more likely the gap will be reduced, as bidders buffer their own risks of commercial failure. And the more complex and uncertain the project, the more likely it is that claims will increase the actual cost beyond the sum of fixed prices. Further, the incentive for the contractor is to reduce their cost in order to increase their profit (or reduce their loss), which may lead to reducing the fitness for purpose of the constructed asset. Consequently, it appears reasonable to assume that fixed price contracting is a reliable strategy for limiting the cost to acquire only for relatively certain and simple projects; interestingly, the projects where cost risk is low to non-existent.

It can also be argued that switching procurement strategies based on market conditions interrupts the continuous improvement process, resulting in industry performance that has stubbornly remained the same year on year. In a buyer's market, the buyers beat up the suppliers. In a supplier's market, suppliers beat up buyers. When there is continuity of players from project to project, collaborating for the long term, gains can accumulate. A case in point is the Boldt Company's performance on Thedacare projects. According to Morton and Ballard (2009), the cost for similar projects was reduced on average 1% per year for 9 years. This suggests the importance of alliances that span multiple projects as a means for promoting and preserving gains.

A more robust and reliable method to reduce the cost to acquire below the allowable cost is shared savings. Figure 1 shows a target cost set below the project budget (allowable cost). This defines the range over which cost reductions will be shared between the client and the project team. Setting such a quantitative target has thus far been done based on value additions to scope the client would like to fund (Long and Reiser 2010) or to limit the client's exposure to shared savings.

Table 1: Actual vs Market Cost for 6 Completed Projects

Project	Location	Date Completed	Market Cost (M)	Cost at Completion (C)	% Savings ((M-C)/M)*100
St. Olaf College's Tostrud Fieldhouse	Northfield, Minnesota	Aug-02	$13,533,179	$11,716,836	13.4%
Thedacare Shawano Clinic	Shawano, Wisconsin	2006	$13,600,000	$11,200,000	17.7%
Sutter Fairfield Medical Office Bldg	Fairfield, California	Nov-07	$22,000,000	$17,900,000	18.6%
Will C. Wood High School Science Building	Vacaville, California	2008	$16,908,251	$13,375,000	20.9%
UHS' Texoma Medical Center	Denison, Texas	Dec-09	$98,000,000	$89,200,000	8.8%
Sutter Mills Peninsula Hospital Expansion	San Mateo, California	Oct-10	$14,500,000	$13,700,000	5.6%

In some cases, no limit is placed on the range of cost savings to be shared. A number of large healthcare projects using these two separate financial elements to achieve their two different purposes are currently under way, but have not yet completed. Six projects that have been completed are shown in Table 1, with costs savings relative to market costs ranging from 5.6% to 20.9%, and averaging 14.2%. Market costs were estimated from programmatic data, prior to design. In all cases, budgets were set below market.

CHANGES NEEDED IN PROJECT DELIVERY

Implementing the recommended division of functions requires changes in project delivery. To prepare to specify those changes, this section first provides an assessment of traditional project management's methods for accomplishing the two functions, then an assessment of the methods used on nominally lean, integrated projects.

TRADITIONAL PROJECT MANAGEMENT[3]

Traditional project management assumes a high degree of certainty and levels of complexity sufficiently low that they can be buffered by adding time to schedules and money to budgets, and still keep projects economically viable. The fundamental requirement for successful application of traditional, non-lean project management methods is scope stability. If what is wanted can be definitively specified with no risk of major change, that enables traditional management methods to be successful. Such methods include:

- sequential processing
- fixed price contracting
- reductionist work breakdown structuring
- reactive project control.

Sequential processing comes with a rework penalty, in consequence of failing to consider all relevant design criteria when forming, evaluating and selecting from product and process design alternatives. For example, reviewing designs for constructability after they are fully developed often reveals deficiencies in the designs. Rework is needed to correct those deficiencies. The risk of incurring the rework penalty, and the amount of rework to be done, increases with the extent of design innovation. If an existing design need only be adapted slightly to differences in location or capacity, the probability that the currently accepted 'means and methods' will prove to be adequate is increased.

Fixed price contracting, when based on nominally complete design documents, is at risk for changes in the design, which provokes change orders, providing contractors an opportunity to increase their profit. When competitive bidding is used as the basis for contract award, bidders may rely on change orders for all their profit.

[3] This section of the paper is drawn from Construction Industry Institute Research Report 271 (Ballard et al. 2011).

This puts the parties to the contract in an adversarial, zero sum game. To the extent that scope is firm and design is complete, the risk of exploitation is reduced.

Work breakdown structuring is traditionally done to assure that all work scopes are assigned with no overlaps or omissions. Subsequently, the created structure is used as the basis for contract management and managerial control, which acts as if each contract and node in the work breakdown structure was independent, and hence could be optimized for duration and cost as a means for optimizing the project. To the extent that the assumption holds, namely that the parts of the whole are independent (i.e., the project is less complex), the penalties for using traditional work structuring and the associated management practices are reduced.

Traditional project control starts with the identification of negative variances between SHOULD and DID. That signals the need for management attention, a scarce resource, which is to be expended on analysis and corrective action. This might be likened to driving a car while looking in the rear view mirror. Maintaining the analogy, a more proactive concept of control is steering the car toward its destination, which implies a management focus on the plan to complete rather than a focus on how well you are performing to your original plan. Obviously, traditional project control is the more appropriate when both project ends and means are fixed and definitive.

Consistent with traditional project management practice, clients could calculate their allowable cost and reserve the difference between expected cost and allowable as an owner contingency. Expected cost could be determined from fixed price contracts, awarded after design is nominally complete, with no change from traditional project delivery. This would appropriately specify their allowable cost, but the problem remains how to prevent that allowable cost being exceeded. As noted in the previous section, it seems likely that the extent to which fixed price contracts accurately predict costs at completion varies inversely with project complexity and uncertainty. Given the difficulty in predicting the level of uncertainty and complexity in projects prior to execution, it would be desirable to have a more robust method for reducing the risk that actual costs exceed allowable than risk shifting through fixed price contracting, and further, that method looks to be inadequate except for projects where the cost risk is inherently low.

LEAN/INTEGRATED PROJECT MANAGEMENT

Despite substantial advances in practice and in outcomes, the best examples of lean/integrated project management still fail to adequately manage the two functions: 1) provide sufficient funds to achieve the business purpose of the project, and 2) Reduce project cost below the maximum allowable. Changes needed:

- Base the allowable cost on asset worth
- Share the basis for the allowable cost, the business case, with the project team

Assuming an allowable cost is stipulated, its basis can be cost or worth, and that basis can be revealed or concealed. The argument for the client calculating an allowable cost based on worth of the asset to be constructed is that, without it, there is no basis for protecting the project from failure to achieve its objectives. The argument for sharing the basis for the allowable cost is to enable business plan validation, and to develop and maintain trust between client and project team. Validating the client's business plan provides the project team members an opportunity to assess the extent to which achieving project objectives within the client's conditions of satisfaction for time, cost, location, regulations, etc. is feasible, and hence the commercial risk they are being asked to take on. It also allows them to improve the plan, either by changing objectives or conditions of satisfaction, or both. In the absence of plan validation, the client's stipulation of an allowable cost is perceived as arbitrary and subject to change at the whim of the client.

What then should be changed in how projects are delivered? In the next section, the findings from this section are combined with the model for project delivery known as the LCI triangle.

LCI TRIANGLE

The Lean Construction Institute has developed recommendations for approaching project optimality, which is especially well suited for uncertain and complex projects, but is also effective for less challenging projects. These recommendations are embedded in the graphic shown in Figure 3, presented here with this author's interpretation. This model is the basis for the CMAA publication *Managing Integrated Project Delivery* (Thomsen et al. 2010).

For projects to approach optimality, three elements are required (shown in Figure 4):

Figure 3: LCI Triangle (adapted from Howell 2011)

1. Commercial terms that align the financial interests of the participating companies with the interests of the client.

2. An integrated organization in which downstream players participate in upstream processes, and vice-versa.

3. An operating system structured to pursue the lean ideal, to follow the relevant principles in that pursuit, and to use the best available methods and tools, both managerial and technological, to apply those principles.

   The principles underlying the commercial and organizational sides of the triangle are, respectively:

1. Money must be able to move across contractual and organizational boundaries if projects are to approach optimality.

2. All relevant criteria are to be applied simultaneously to the generation, evaluation and selection of product and process design alternatives.

These criteria are embodied in various specialists, who must be engaged in the design process rather than brought onto projects only when their specific work is to be performed.

The first is based upon the view that innovations are left unrealized on projects because of the ‘who pays, who gains?’ problem. This was the primary driver behind the formation of the original Integrated Project Delivery by Owen Matthews and his fellow team members in the Orlando, Florida area in the late 1990s (Matthews and Howell 2005). The second is anti-sequential processing, and historically is synonymous with the concurrent engineering pioneered on product development projects (Prasad 1996**).**

PROJECT OPERATING SYSTEM

The third side of the triangle, the project operating system, has been addressed by Thomsen et al. (2010) and also by Ballard et al. (2011). The latter use the expression “Managing by Means”, drawing on Johnson and Brom’s (2001) *Profit Beyond Measure*, in which managing by means is opposed to managing by results, a way to differentiate lean management from traditional.

Lean is understood by this author to be a management philosophy defined by the ideal it pursues, the principles followed in pursuit of the ideal, and the methods used to implement the principles. The ideal pursued is to give customers exactly what they need to accomplish their purposes, with no waste. This is an ideal that can always be more closely approached but never fully achieved, hence the centrality of continuous improvement (of people and processes) in the lean philosophy.

The principles followed in pursuit of the ideal vary in their applicability to different types of work—again the opinion of this author. Principles of lean management of projects include:

- Don’t just do what clients ask. First help them understand what they want by revealing the consequences of their desires and by making them aware of alternatives they had not previously considered.
- Design how the asset will be used before designing the asset. (This is most compelling when the asset is itself a means of production, but is obviously true in the case of housing as well.)
- Design for the whole life of constructed assets, including costs and benefits to use the asset.
- Make money able to move across organizational and contractual boundaries in search of the best project-level investments.
- Apply all relevant criteria simultaneously to the evaluation and selection from design alternatives.
- Simplify site installation to final assembly and commissioning.
- Pull materials and information to construction sites in work packages at the last responsible moment.

The methods used to apply the principles vary even more in their universality and permanence. A few widely applicable methods in lean management are:

- For reducing the time work spends waiting for workers: Value Stream Mapping
- For reducing variation between SHOULD and DID: Last Planner®
- For learning from breakdowns: Prevent-Detect-Correct-Analyze/Plan-Do-Check-Act
- For matching buffers to variation that cannot yet be eliminated: Buffer Management
- For defining projects in terms of customer value and conditions of satisfaction, and for steering design and construction to deliver that value within the customer's conditions of satisfaction: Target Value Design

Value stream mapping, learning from breakdowns, and buffer management are applicable to any type of process. Last Planner is applicable to processes that require humans to cooperate. Target Value Design is applicable to project production systems in which goods and/or services are designed and made.

SUPPORTING CASES: TARGET VALUE DESIGN PROJECTS

Target value design is an adaptation to construction projects of the target costing used in product development projects to manage product profitability. It has been used on at least six completed projects and is being used on more now in design or construction. Although allowable costs have not consistently been based on worth, validation by the project team of the client's business plan occurred on all six projects. The six completed projects have averaged a cost at completion 14.2% under the estimated market cost. The objective has typically been to provide more value for the money, as opposed to reducing cost to acquire for its own sake. Yet, even the apparent exception, the Science Building Project at Will C. Wood High School in Vacaville, sought cost savings in order to fund renovation projects in the school district.

More data points are needed to increase confidence in the reliability of lean practices to deliver customer value within their conditions of satisfaction, but the data in hand is supportive.

CONCLUSIONS

The use of two different financial elements to accomplish the contradictory functions traditionally performed by project budgets has been proposed. Evidence has been presented both in arguments from generally accepted principles and from the results achieved by the few projects that have been executed with budgets based on allowable cost and reliance on shared savings to reduce the project cost without sacrificing purpose or value.

Future research is needed:

1. to explore the limitations of this proposal for clients not building for their own use; e.g., developers

2. to empirically test the hypothesis that fixed price contracting is a reliable strategy for limiting the cost to acquire only for relatively certain and simple projects, projects where cost risk is low to non-existent
3. to understand and quantify the risk to project success added by misguided attempts to reduce cost
4. to collect and analyse performance data from more projects using the target value design approach
5. to develop or validate more accurate and rigorous methods for estimating asset worth

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