RETHINKING PROJECT DEFINITION IN TERMS OF TARGET COSTING

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ABSTRACT

That phase of projects that immediately precedes design has been called by a variety of names, including design briefing, programming, front end loading, and project definition. It is widely agreed that this project definition phase is often ill performed, resulting in the design and construction of facilities that do not satisfy their purchasers or users. A number of lean construction theorists, including this author, have made contributions to rethinking project definition as a phase within lean project delivery.

Target costing is a methodology developed by manufacturers of consumer products to systematically improve product profitability, and is now being adapted for use in the delivery of construction projects. Target costing starts with setting a target cost, which is a very complex and difficult process in construction as compared to manufacturing. In this paper, project definition is revisited as the phase in which target costs are set. Both traditional and lean project definition models are reviewed, a philosophy and approach are presented and grounded in case studies, and a research agenda is put forward for project definition/setting target cost.

KEY WORDS

Customer, customer value, design, design brief, design concept, design criteria, predesign, programming, project definition, target cost, value.

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INTRODUCTION[2]

The deficiencies of project definition have been well documented, not least by Barrett and Stanley (1999). Seemingly good advice is too often ignored or the parties are not able to act on it for lack of power or competence. Cost management has a like tendency to be inadequate, as indicated by Craig Langston's comment regarding the difference between designing to a cost and costing a design: "Until initial decision making is changed from the role of the architect to that of all members of the project team, this efficient cost planning process will remain merely of academic interest." (Langston 2002).

Cross functional teams in every project phase is a feature of lean project delivery. This should go some way toward satisfying Langston's pessimism about decision making, but simply bringing downstream players into upstream processes does not automatically produce better results. The newcomers must know what to do when they arrive in unfamiliar territory. The design professionals whose territory is being invaded must learn new roles and responsibilities. Research is needed to develop and test processes and tools.

The research reported in this paper began with trying to understand how target costing is practiced in the world of product development, relying primarily on the books by Cooper and Slagmulder (1997, 1999). Under the influence of the manufacturers' focus on designing to target cost, the same focus was adopted in the initial experiment at St. Olaf's College. The Tostrud Fieldhouse project at St. Olaf's (Ballard & Reiser 2004) revealed the power of cross-functional teams pursuing explicit cost targets. However, the cross-functional teams were formed after schematic design, later than now seems optimal, and setting the target cost was excluded from the experiment altogether.

We began to think more carefully how to adapt target costing for construction. A central theme was the importance and difficulty of setting a target cost for a project. We realized that Tostrud, where the amount of money available was fixed by donation, was an extreme case. More commonly, the amount of money is fixed through expectation of return. Manufacturers can estimate returns on investment because they can determine in advance what price customers will be willing to pay for a product with given features and quality characteristics. In construction, each product is typically designed and constructed for one customer only, and that customer must, almost always, be intimately involved in the project development and delivery process. Further, we have long held the position that project delivery begins with a conversation between what's wanted, what satisfies those wants, and the constraints within which satisfaction must occur (Ballard 2000a). Hence ends, means and constraints naturally change during project definition until they are aligned and mutually consistent. These characteristics make setting target costs for constructed facilities very challenging and a worthy subject of research.

The focus of this paper is on the integration of target costing into the project definition phase of project delivery. A conceptual model is presented for project definition and a process is proposed for setting target costs in project definition, consistent with the conceptual model. The paper concludes with a review of past research in the form of completed case studies and case studies currently underway, and with a description of future research.

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[2] Portions of this paper were previously included in Ballard 2006b.

PROJECT DEFINITION IN LEAN PROJECT DELIVERY

Target costing research is being undertaken within the framework of Lean Project Delivery (Ballard et al. 2002). Figure 1 is a schematic of the Lean Project Delivery System. The initial phase of a project is called Project Definition and is represented as an interaction between stakeholders voicing purposes, design concepts and constraints.[3] This author conceives project definition, and indeed design itself, as a conversation through which those speaking produce something no one brought with them into that conversation (Ballard 2000a). Any of the three voices can speak first, and the conversation can proceed in any order, but most commonly the paying customer speaks first. The starting positions of each voice are typically modified in response to what others have said. In plain language, this means, for example, that a buyer of a facility can have his purposes change through awareness of alternatives not previously conceived, or through confrontation with the consequences of his desires. Exposure to new design concepts may persuade the customer to spend more money. Better understanding of consequences may persuade the buyer to forsake previous ambitions. Within the Lean Project Delivery System, exposing buyers to alternative futures and confronting them with the consequences of their desires is the responsibility of the project delivery team, which therefore must be involved in the project definition phase, contrary to common practice.

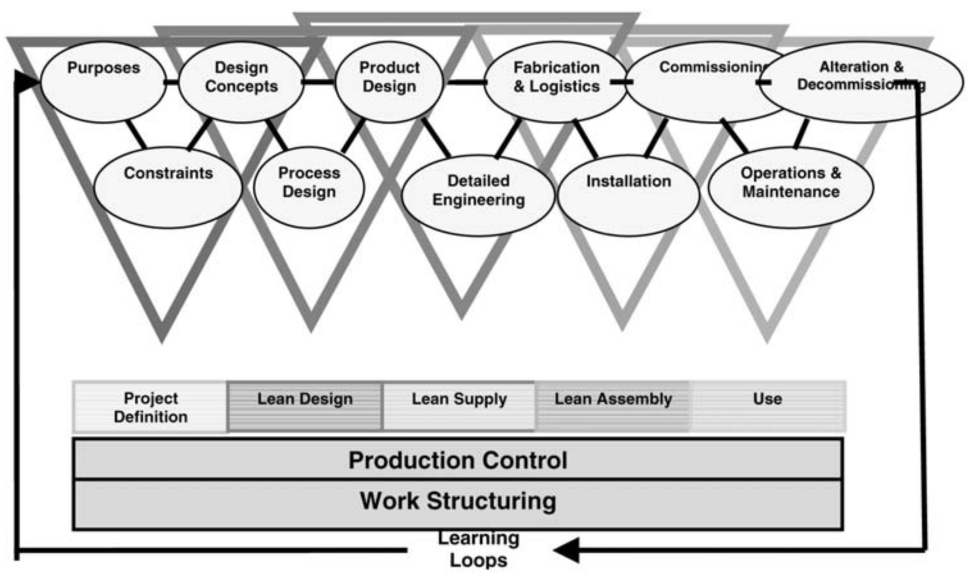

Figure 1: Lean Project Delivery System

3 This is a modification of the Lean Project Delivery system schematic presented in Ballard 2000a. Constraints have taken the place previously occupied by Design Criteria.

Until there is alignment between purposes, design concepts and constraints, it is imprudent to move into the design phase.

In recent years, a number of construction management researchers (Kamara et al. 2000, Pennanen 2003) have advocated excluding design from project definition. This position was taken much earlier by Peña (Peña et al. 1977), who understood the pre-design phase as defining the problem to be solved by design. The concern all these authors seem to share is that solutions will be advanced prematurely, seducing clients into commitments against their interests. This is a genuine concern, but neither justifies nor requires exclusion of design alternatives from the project definition process as a means for clarifying and even revealing or generating client purposes and values. It has been argued by others (e.g., Whelton and Ballard 2002, following Rittel and Webber 1972) that complex, quick and uncertain projects pose wicked problems, one characteristic of which is that exploration of solutions is required in order to understand the problem; i.e., conceptualization of the process in terms of problem definition and problem solving is inappropriate. See also Barrett and Stanley 1999 for another critique of rationalistic planning processes.

The project definition triad can be exploded into more detail, as shown in Figure 2. There are two motions in the conversation. The first, previously discussed, is the circular motion between the three primary elements: Ends, Means, and Constraints. However, there is also development required within Ends and within Means. In the first, purposes are crystallized in conversation with design concepts and constraints, then the means for achieving those purposes are specified as characteristics of the facility to be designed and constructed, then finally those values are translated into technical specifications. Example: The purpose is to produce a concert hall, one value is 'being able to hear a pin drop anywhere in the audience space', and the technical specification is the desired auditory clarity expressed in decibels[4] .

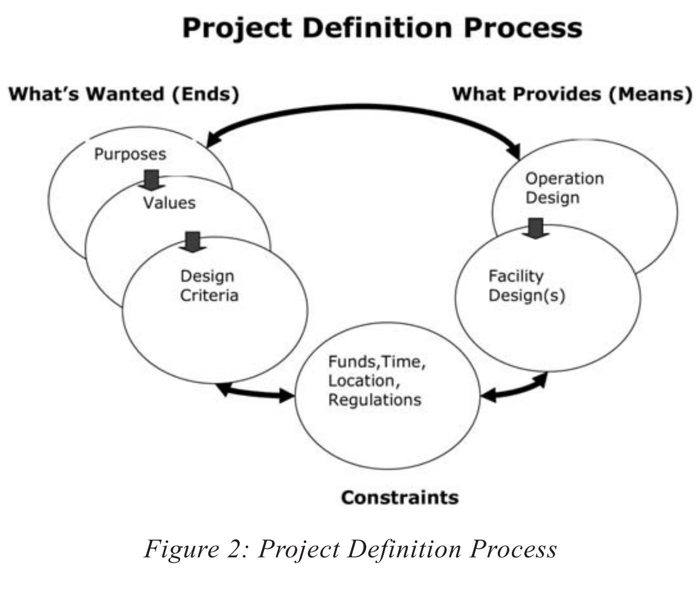

Figure 2: Project Definition Process

4 Quality function deployment (QFD) is commonly used in product development to translate from the voice of the customer into the voice of the designer/engineer. The seminal text on QFD is Akao 1990.

The second developmental motion occurs within Means, and consists first of design concepts for how the facility is to be used; referred to in Figure 2 as "operation design". For example, how does the client want patients to move in a hospital? How long will a typical patient be in the system, and how much of that time will be spent waiting or traveling? How many visits will a patient require in order to get satisfactory treatment? How many staff will be needed? Will the risk of infection be lowered? The idea is to first decide how the facility is to be used before trying to design the facility. Once the facility's use is designed, attention can turn to design of the facility itself. At this point, in project definition, design is very conceptual and it may be appropriate to carry forward multiple design concepts from project definition into design proper.

This motion from operation to facility design is standard practice for industrial facilities (Gibson and Hamilton 1994) and is now being extended to the healthcare sector, but is proposed as appropriate for all types of facilities, including office buildings and institutional facilities. Pennanen's use of space utilization analysis can be understood as part of this approach, which is driven by the fact that the amount of money expended on the use of facilities often far exceeds the money spent on facilities management, which in turn may exceed the 'first cost', the money spent on facility acquisition[5] (Saxon 2005).

Cost Management: Traditional versus Target Costing

Traditionally, cost has been managed on construction projects in the same way time has been managed. Both have been driven by the design of product and process, rather than serving as criteria for acceptable designs. Both cost and time management have attempted to exert control, after budgets are fixed, by after-the-fact monitoring, detection of negative variances, and taking action to recover to targets. The Last Planner System™[6] of production control (Ballard et al., 2002) provides a proactive means for control of time, akin to the act of steering toward an objective. We intend to develop target costing as an equivalent for managing cost. Indeed, target costing extends further than Last Planner™, providing means for setting cost and time targets in alignment with stakeholder values and design concepts. In the building sector, it has been customary for architects to work with clients to understand what they want, then produce facility designs intended to deliver what's wanted. The cost of those designs has then been estimated, and most often, found to be greater than the client is willing or able to bear, requiring designs to be revised, then recosted, and so on. This cycle of design-estimate-rework is wasteful and reduces the value clients get for their money. Cost has been an outcome of design. Target costing is a management practice that seeks to make cost a driver of design, thereby reducing waste and increasing value.

Applications of Target Costing in Construction

The inclusion of cost as a design criterion is hardly unprecedented in the construction industry. Developers appear to be among the most disciplined practitioners, likely because the building product is their direct means for achieving business objectives. As such, they are in very

[5] "…concentration on first capital cost is not optimizing use value: support to the occupier and containment of operating-cost." (p. 28, Saxon 2005)

[6] "Last Planner" is a registered trademark of the Center for Innovation in Project and Production Management, dba Lean Construction Institute.

nearly the same position as the developers of consumer products who invented target costing. Manufacturers and developers alike achieve their profit objectives by producing products that will be useful to others, and by producing those products for a cost sufficiently below the selling price.

The products of construction are, among other things, 'tools' used for accomplishing human purposes. But those tools can be more or less immediately connected to the profitability of their producer, and hence investment decisions regarding facilities can be more or less easily made based on expectations of financial return on those investments. In contrast to a developer, consider a company for which facilities are an indirect means for achieving business objectives. They will certainly try to pay no more than necessary, but may struggle to apply financial return on investment criteria in making investment decisions. This is more difficult for those for whom facilities are more like fax machines than like hospitals or refineries. Having a fax machine is a cost of doing business, so the natural objective is to minimize that cost rather than to optimize return on investment. When facilities directly produce the company's product, as is the case for a refinery, then financial criteria can more easily be applied to those means of production.

Consider yet another situation. An educational institution is given a donation to build an athletic facility. No more money is 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. These different situations can be captured for our purposes as follows: the initial specification of target costs will be made in terms of either a minimum acceptable return on investment or maximum available funds. The developer and the oil refiner require a minimum ROI. The first calculates ROI on the facility itself, either through sale or lease. The second calculates ROI on sale of the product produced through use of the facility; e.g., a manufacturing facility or hospital. Users for whom the facility primarily serves non-production purposes may try to minimize the amount they pay for their use, typically establishing a budget amount as a maximum. Non-profit institutions such as governmental offices and universities typically have limited funding flexibility, and so tend to establish an upper limit on what they are willing to spend for a facility—though once established, the tendency is to spend to the limit so long as the facility can be made more valuable. There are perhaps other situations than those described here, but these cover a large part of the construction industry.

TARGET COSTING IN PROJECT DEFINITION

From the target costing perspective, the project definition phase can be understood in terms of "business planning" and "feasibility study". Business planning operates at the first cycle of the conversation between ends, means and constraints, and serves as an initial test of the advisability of pursuing a project, answering the question: "If we could build a facility X that would enable us to do Y (accomplish certain purposes) for Z (a certain amount of money in a certain amount of time in a certain type of location), would we do it?" If that decision is positive, the next step is a feasibility study, the primary outcomes of which are a target cost and scope, and a decision if to fund the project. Feasibility studies answer the question: "Can we build X that will enable us to do Y for Z?"

Figure 3 shows the project definition process as a sequence of steps, divided between business planning and feasibility study, and concluding with a project target cost and scope. This specific sequence may not be followed exactly on any project, but the logical progression from initial statements of ends, means and constraints, through both circular and developmental motions, to mutual alignment is necessary for successful definition of all projects.[7]

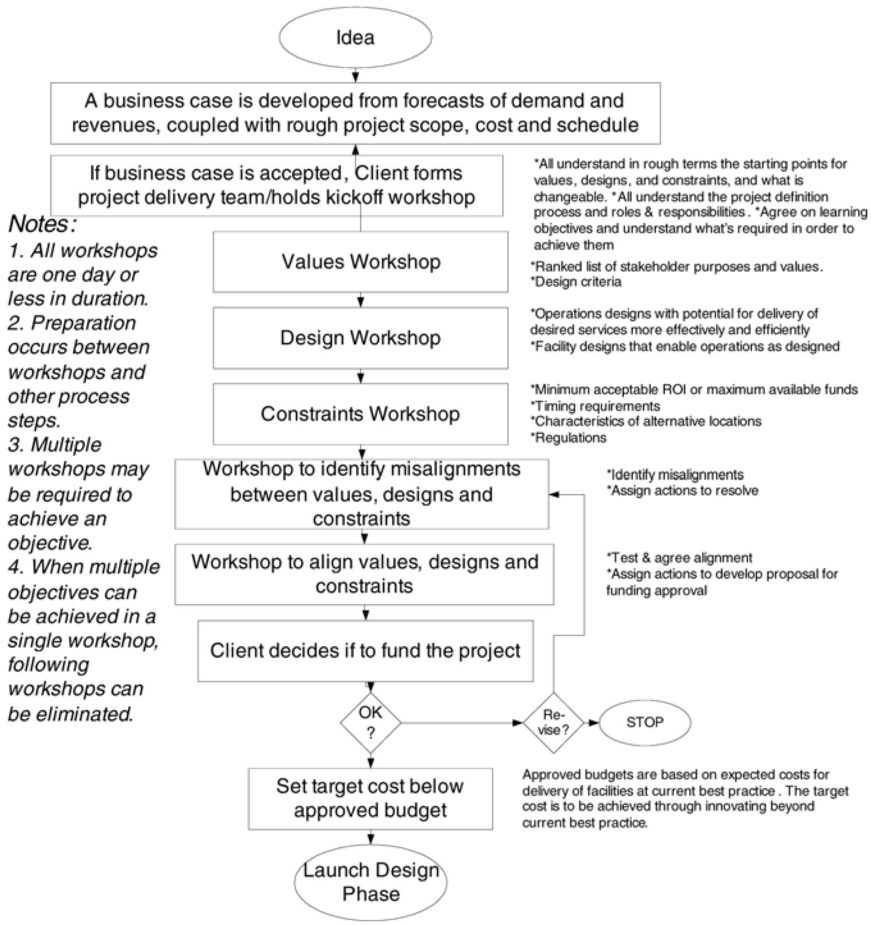

Figure 3: Project Definition Process—sequential

Target Costing Hypothesis

The following process for setting a target cost is proposed as a hypothesis to be tested:

1. Assess the business case.
2. Determine minimum acceptable ROI or maximum available funds.

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7 This model of project definition is very close in spirit to that described in Emmitt et al. 2004, which also adopted a value generation perspective.

3. Decide if to fund a feasibility study.
4. Start a feasibility study by selecting a project delivery team.
5. Determine and rank stakeholder values.
6. Scope the facility that will deliver the values.
7. Determine the expected cost if the facility were provided at current best practice.
8. If expected cost>available funds or violates ROI, adjust scope by sacrificing lesser ranking values.
9. Decide if to fund project delivery given the scope and expected cost from the feasibility study.
10. Start project delivery by setting a target cost below expected cost in order to drive innovation beyond current best practice or by setting a target for the delivery of values/scope beyond current best practice.
11. If applicable, agree how to 'spend' cost savings; e.g., return to capital investment, invest in previously eliminated values, share between owner and project delivery team.

It is assumed that the process is initiated by emergence of a need or an opportunity. The first step is to assess the business case. This assessment will be different for buyers in different circumstances, as described earlier, but will generally involve forecasting demand, estimating the cost of producing the capacity to meet that demand, and assessing the rate of return on investment against expectations—all within the context of constraints such as location, regulatory requirements, availability and cost of capital, etc.

Part of the hypothesis is separate funding of a feasibility study and inclusion in that study of the team that will deliver the project if it survives feasibility. This amounts to an acceleration of spending by the client. Many clients hesitate to accelerate spending, fearful that it will only add to the final cost of the facility. Research questions posed in this complex hypothesis are:

- Does it pay to accelerate spending and under what circumstances?
- How best to select project delivery teams; e.g., test for compatibility, engage self assembled teams?
- How best to assure that the use of the facility is explored and agreed upon before attempting to design the facility itself?
- Is an evergreen, ranked list of stakeholder values beneficial and feasible as a tool for value management?
- Can the practice of estimating future cost based on benchmark practice be effectively implemented?
- Is the practice of setting a target cost below a current benchmark budget ("expected cost") in order to drive innovation beneficial and achievable?

There is also the question how best to size and manage contingency to achieve target costs. Hypothesis: Implementation of Target Costing will reduce variability of work flow, and reduce the uncertainty of project ends and means, which in turn will allow reduction of contingency needed to absorb variability.

CASE STUDIES

Two experiments in target costing have been completed on construction projects in this research: the Tostrud Fieldhouse project at St. Olaf's College in Northfield, Minnesota (Ballard & Reiser 2004) and the Acute Rehabilitation Center (ARC) project at Sutter Roseville Medical Center in Roseville, California (Ballard 2006a). Two additional case studies are currently underway, both health care and both in Northern California.

The Tostrud Fieldhouse case study was presented at IGLC 12. The ARC project at Sutter Roseville offers another opportunity for examining the application of target costing to construction. Virtually the same team of owners, designers and builders has delivered a series of projects at Roseville, overlapping in time. ARC is the ninth project in that series. The first project, Emergency Room Expansion, was delivered traditionally and went back twice to the Sutter Health Board of Directors for additional funds. According to Sutter Health personnel, multiple submissions for funds, projects completed over budget, and projects completed late were normal occurrences up to that time.

During the period after this first project, Sutter Health committed to using the lean project delivery system for its multi-billion-dollar capital program, a response both to poor performance and to the challenge of completing a $6 billion capital program by 2013 in competition with other health care providers for limited resources. In response to this corporate commitment, on each successive project at Roseville, the delivery team introduced changes, moving from traditional project delivery toward a target costing approach. The successful elements in their approach have been published as a current benchmark in target costing (Ballard 2005), the key elements of which are:

1. The client evaluates the business case and decides whether to fund a feasibility study.
2. The feasibility study involves all key members (designers, constructors, and client stakeholders) of the team that will deliver the project if the study findings are positive.
3. The client is an active and permanent member of the project delivery team.
4. The feasibility study produces a detailed budget aligned with scope.
5. All team members understand the business case and stakeholder values.
6. A cardinal rule is agreed upon by all performers – the Target Cost cannot be exceeded.
7. Cost estimating and budgeting is done continuously through intimate collaboration between design professionals and cost modelers—'over the shoulder estimating'.
8. The Last Planner™ system is used to coordinate the actions of team members.

At 50% construction documents, ARC had $9.2 million in available contingency within its unchanged $58.6 million budget. Although far from perfect, ARC was a significant advance on previous practice.

Table 2 shows the elements of the hypothesized process for setting a target cost that were included in the two completed case studies. Future research will include elements not previously included.

Case studies currently underway

Unfortunately, the Tostrud and ARC experiments were conducted in ignorance of earlier case studies reported in Nicolini, et al. (2000). In that action research, two U.K. Ministry of Defence housing projects were used to experiment with target costing and whole life costing in construction. Their findings included the following:

> "Our data suggest that probably the main barrier to the adoption of a fully-fledged version of target costing in construction derives from the extant commercial practices in the UK construction industry. As we have shown, the industry, and especially large contractors, often operates without a full understanding of the costs through the supply chain. The norm is of first developing designs, then inviting prices from suppliers who have not been involved in design development. The result is usually a series of prices based on commercial judgments, not true costs. Costs, as opposed to prices, are rarely investigated, and as a result margins are dependent upon expediency. The UK construction industry lacks the data needed to drive costs down through systematic improvement. The application of target costing, intended as a disciplined practice of strategic cost management for reducing the overall cost of a product over its entire life cycle is seriously jeopardized in this context." (Nicolini, et al., p.321)

Table 2: Process steps implemented on completed case study projects

	Tostrud Fieldhouse	**ARC**
Setting the Target Cost		
Assess the business case	x	x
Determine min ROI or max funds	x	x
Fund a feasibility study		x
Engage project delivery team		partial[8]
Rank stakeholder values		
Translate values into design criteria		
Best practice estimating		
Explicit alignment of ends, means & constraints		
Set target cost below expected cost		
Decide how to apply savings	x[9]	
Set contingencies appropriate to the variability to be buffered		

[8] Architect/Engineer and Construction Manager/General Contractor participated in the feasibility study within ARC's project definition phase. The benefits relative to costs of involving specialty subcontractors is a research question for future projects.

[9] On the Tostrud project, available funds were to be applied to value adding changes, with any remaining funds applied to the facility operations and maintenance budget. An explicit decision was not made regarding disposition of cost savings on the ARC project. It appears to have been assumed that any savings would be returned to the capital fund, but in fact 'savings' tended to be spent on values that had previously not been affordable.

In two case studies not yet completed, the findings from the U.K. case studies are well corroborated. The business case was not completed nor were feasibility studies performed prior to launching the projects. In the first case, a medical office building, the client accepted a casual square foot estimate as the target cost and attempted to launch design to that cost. After several frustrating false starts, the project team 'called the question' and subsequently returned to a feasibility phase in parallel with the client initiating business case analysis.

In the second case, a new 140 bed hospital, again project definition was truncated with negative impact on the project. The results of an outdated and incomplete study were taken as the starting point for scope definition and budget. An architectural firm and a construction management/general contractor firm were selected and charged with designing to that scope and budget. They struggled valiantly, but produced an estimate 30% over budget. The client organization is structured as an association of affiliated healthcare organizations, with the 'parent' providing capital financing and project management. The 'parent' decided that they were willing to spend this new amount on the hospital, but the affiliate failed to adequately analyze the business case; i.e., its ability to repay the parent that amount of money for the revenue-producing capability scoped into the project. Unfortunately, the project delivery team was told that the business case for the new budget had been analyzed and found acceptable, and were launched on a feasibility study to determine if the minimum scope required by the affiliate could be provided for the maximum funds they were supposedly willing to spend. Engineering consultants and specialty contractors were asked to participate in the feasibility study, in expectation of performing the work should the project be deemed feasible. It is worthy of note that the project was judged to not be feasible, even with reduced scope, and despite vigorous assertions to the contrary by some client personnel, providing supporting evidence for the importance of the feasibility study and for the importance of the project delivery team deciding for itself if the project is feasible at given scope and budget.

To further complicate the situation, in the course of that feasibility study, the affiliate confessed to misgivings about their ability to recoup their investment and suspended the project pending a further reduction in scope, involving a radical reorganization of the hospital, having spent $6 million in what might prove to have been false starts.

In contrast, the ARC project business planning was carried out methodically. Business Planning & Development (BP&D) contributed a forecast of demand. Finance contributed a forecast of revenues, obviously working from the demand forecast and plans for services to be offered. The Facility Planning & Development group (FPD) of Sutter Health developed a rough scope, budget and schedule for the project. All three work products were integrated into a business plan, which previously included a recommendation whether or not to fund the project, but for the ARC project, included a recommendation to fund a feasibility study, with project leadership passing from BP&D to FPD. Sutter Health is revising its business planning procedures. The new procedure will make the ARC process standard operating practice.

CONCLUSIONS

Project definition has been understood for some time as the first phase in lean project delivery. The underlying conceptual model for project definition has been expanded in this paper and is expressed as a conversation between ends, means and constraints. After incorporating the target costing methodology, project definition is appropriately understood as the phase in which business planning occurs and feasibility studies are performed. Its deliverables are decisions if to fund projects and target scopes and costs for those projects that are funded. A process for project definition so conceived has been put forward.

The critical importance of business planning has been revealed in the most recent case studies. A review of the literature suggests that the industrial sector is much more disciplined in this regard than the general building sector. Case studies suggest that the healthcare sector may be deficient in its business case analysis of capital projects despite the obvious importance of costs and financial returns in the sector. The case studies reported by Nicolini, et al. (2000) raise the issue of applying whole life costing in construction, both as regards the lack of relevant data and the inadequacy of traditional tools such as net present value analysis. All the case studies reported in this paper stress the importance of shifting the industry's focus from prices to costs. One vital element in that shift is the inclusion of specialty contractors and suppliers in project definition and design.

Future research will be carried out through the University of California, Berkeley's Project Production Systems Laboratory. Target costing is a primary research initiative of the newly formed Laboratory, which is funded largely by industry contributions to serve as a learning laboratory for the construction industry. A number of projects have volunteered to participate in target costing experimentation. Each will learn from earlier experiments and try to go beyond the previous best practice benchmark. The first wave of

projects will perform experiments on elements from Table 2 that have not yet been tested, and on alternative ways of performing previously tested elements, and also will perform experiments on processes for designing to target costs in the design phase of project delivery.

Acknowledgments

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