COMPANY OVERVIEW

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DPS Group is a global consulting, engineering and construction management company, serving high-tech industries around the world. DPS has sector experts in key locations in Europe, the US, Asia, and the Middle East, bringing world-class resources and the latest innovative technologies to every project. DPS delivers Full Service Engineering with a 'client first' mentality and personal touch across a range of disciplines: Project and Programme Management, Procurement, Design, Construction Management, Health & Safety Management, Commissioning, Qualification, and Start-up. DPS employ more than 1300 people worldwide, including 250 in its DPS Group Cork Operations where this case study is based.

OVERVIEW & BACKGROUND TO THE LEAN INITIATIVE

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DPS Group modestly prides itself as being an early adopter of Lean thinking and practices in both Irish and International construction sectors. The company invests heavily in staff subject matter experts, Lean education and training, and in internal process improvement initiatives. The company attributes, in no small part, increased competitiveness and recent project success to that investment in its capability development. DPS support local and national Lean Construction (LC) conferences and events and bring International LC experts to its offices to share best practices and research with its own staff and clients. DPS also contribute to the LC body of knowledge presenting latest research findings at global, national, and local LC conferences and events.

A common concept in construction is that there are three legs to a project: Schedule, Cost, and Quality. Typically, a client is advised to pick any two at the expense of the third, for example, you can have cost and schedule but not the quality you want; or you may get the quality and schedule that you want but not within your budget. This traditional approach was unacceptable to both the Client and the Engineering, Procurement, Construction Management, & Validation (EPCMV) provider on this case study project – instead, the fast-track nature of the assignment called for proactive management of all three legs of cost, schedule, and budget. The client in this case study is a global pharmaceutical company with several facilities located in Ireland.

Initial thoughts were to use a proactive methodology that would drive cost downward from the start to avoid commencing with an excessive estimate laden with contingency. DPS was familiar with using Last Planner® System (LPS) in design, construction, and commissioning and had also used another Lean Construction approach, namely Target Value Design (TVD), on a previous project. The concept and principles of TVD were presented to the client and it was agreed to use the process on this project.

LEAN INITIATIVE UNDERTAKEN – LEAN THINKING, TOOLS, TECHNIQUES

Target Value Design

According to Glenn Ballard, a pioneer of Lean in Construction, Target Value Design (TVD) is a management practice that drives the design [and construction] to deliver customer values within project constraints, and it is an application of Taiichi Ohno's practice of self-imposing necessity as a means for continuous improvement.

The primary concept of TVD is to drive down the cost – or maintain cost and increase value – of a project through the design and delivery phases without reducing the quality provided or the schedule for completion (see Figure 1). TVD is a proven and effective process to ensure the owner receives all three legs of schedule, cost, and quality.

Figure 1. Driving Force of TVD *(Source: Target Value Delivery: Practitioner Guidebook to Implementation Current State, 2016)*

The Lean Construction Institute (LCI USA) assert that "TVD is a very different model from the traditional, large-batch process of design, estimate cost, and value engineering — a process replete with waste. Clients do not value the process of rework and loss of quality that comes from this traditional "value engineering" process. The driving force of TVD is to increase value while decreasing cost for all team members".

In his 2011 publication *'Target Value Design: Current Benchmark'* Ballard notes that "In the building sector, it has been customary for architects to work with customers 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 too often, found to be greater than the customer is willing or able to bear, requiring designs to be revised, then re-costed, and so on. This cycle of design-estimate-rework is wasteful and reduces the value customers get for their money. Cost has been an outcome of design".

TVD, therefore, is a design strategy and process that offers designers an opportunity to engage in the design conversation concurrently with those people who will procure services and execute the design. It focuses on designing based on the project values, which become design criteria rather than mere aspirations. Using TVD, the design and construction is steered towards the target cost. A continuous and proactive value engineering process is utilised during the design phase to quickly evaluate the cost implications of design options. Cost is a constraint (one of many) rather than an output of the design process.

Benefits of TVD include:

- Proactive rather than reactive problem-solving.
- Less fighting and more collaboration.
- Better value delivered for the money.
- More satisfied clients - designs that fit stakeholder values.
- Better work-life balance for contractors and architects.
- Continuous improvement and kaizen within projects and between projects.

Implementation on the Case Project

In assessing a cost budget for this project, previous experience would have pointed towards a figure of €100Million (± 50%) for the project. The project leadership team would then use TVD principles to steer and direct the design teams' efforts towards achieving this cost target. The principles of TVD were introduced at design concept stage because if a budget is not in place for concept design then the project could emerge with a figure that is unacceptably high and causing further investigation to remove scope to achieve a cost figure agreeable to the client. Using TVD pre-empted this on this project and avoided the non-value rework tasks of shrinking the scope back – such outcomes traditionally emerged from initial over-design or over-specification. Therefore, the concept design stage commenced with a predetermined target budget in mind. However, towards concept completion it could emerge that the budget target figure was insufficient to accommodate all project scope and specifications, thus requiring re-examination of the budget. For example, at pre-concept the client would have had a figure of €100Million in mind, but post-concept this could have crept up to €105Million after addition and removal of various elements of scope. A decision must then be made regarding the 'value' that is being added by the additional €5Million. This analysis and decision on the cost target must be made and agreed before proceeding to the next stage of design development, namely "Basis of Design" (BOD).

At this point, an increased level of detailed design commences and some initial purchase orders (PO) are placed for specialised equipment, but everyone is directed by the overall agreed TVD figure. The team was mindful that BOD phase carried a contingency estimate of ± 25% that, after 4 months of engineering the estimate, can then be tightened and fixed at 10% contingency. At this point the original TVD figure of €105Million could have reduced to €95Million or increased to €110Million. This figure now becomes the agreed project TVD sum. The client may, having assessed the confidence level of the TVD figure, consider reducing the contingency element of the TVD sum. The team has at this stage been working with the concept of TVD for over 6 months and from concept through detailed design have been working towards a target project cost figure, thus enabling confidence in a reduced contingency. This aligns with recent research on TVD, as illustrated in figure 2.

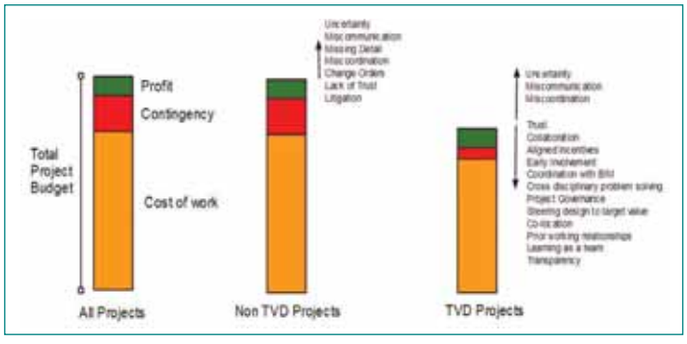

Figure 2. TVD Project Forces (Source: Do et al., 2014)

Figure 2 illustrates the breakdown of a project's costs. The total project cost includes the cost of work, contingency, and profit. The cost of work can be further broken down into direct and indirect cost – it is the sum of all the participants' costs of work. Compared to projects that do not use TVD, less contingency was required using TVD here because the entire project contingency was pooled together instead of being carried individually by each participant. By pooling the contingency together, the project team needed to allocate less contingency to cover the same amount of uncertainty in the project.

Examples of Decisions & Impact

At concept stage, the TVD figure and process are managed by the leadership team. At detailed design (DD) stage there may be up to 10 design teams inputting to the project. The project leadership team will initially sit with each team, for example, process, electrical, mechanical, HVAC, civil – structural – architectural (CSA), and collaboratively validate their assigned pool of money for the design deliverables. The designer must consider each decision they make in relation to achievement of the quality goal and assess whether this decision will add or subtract or will not change the TVD figure. An example is where the designer proposed a type 1 surface finish cladding solution to the building and the client

is now requesting a more expensive type 2 cladding with a high gloss finish. In the traditional costing model, this design change would have been added to the drawing and the extra cost would not have been recognised until the price was returned from the contractor. Whereas with the TVD method, the designer immediately advises the client that the client's decision will negatively affect the TVD fund. The cost increase can be assessed and advised, and the client can promptly adjudicate on the cost versus value benefit of the request. While awaiting the client's decision, the ?50k increased cost figure is added to the weekly TVD reporting tracker as a 'potential' increase and the impact is immediately visible to all on the tracker dashboard.

It was important at this point to also assess potential added value offered by the specification and cost increase, and the decision-making could not rest on cost alone. In this instance, the designer advised that the €50k cost increase was mitigated by a €25k material and labour-install saving as the type 2 cladding incorporated a built-in weathering trim, resulting in an overall net uplift of €25k to the TVD figure. This discussion occurred weekly with the design leads to ensure visibility and clarity of the impacts of each request and decision on the TVD fund. By implementing this element of weekly standard work, a culture of ownership for awareness of the cost impact of decisions in design was developed and a realisation that any deviation from the agreed specification and scope would generate a cost impact became embedded within the project team. The responsibility, therefore, was to recognise the impact, either positive or negative, and report this to the client immediately for review of acceptance of the financial impact. The client may respond by stating that the request is a critical value-add element that has been approved at board level and therefore the TVD figure can be increased with no impact to other scope elements. The client may also decide not to increase the TVD figure and insist on a review of the scope, either within this discipline or across disciplines, to achieve savings and align with the TVD figure. This required certain behavioural norms and changes to traditional thinking across design disciplines, as the process piping dept may find themselves looking for savings within their design scope to allow the €25k uplift for the type 2 cladding. In this instance CSA proposed changing the brick paving footpaths and other landscaping features to more cost-effective alternatives which were acceptable to the client – this balanced the uplift to allow the type 2 cladding be specified.

Cultural Change

On previous projects the design engineers wouldn't have had a culture of owning that budget. "We considered this to be the role of the cost department and not of a designer." noted a design lead, adding "After BOD we would have listened to client feedback and incorporated this into the DD. Costs would have increased but that wouldn't have been a concern of ours as the quantity surveyors dealt with all cost related issues with the client". An example from this project related to a client request to add five lifting beams to new locations, in addition to the 10 beams already in the design. Traditionally the designer would have complied with the client's request and added five beams to the drawing. However, with the new awareness around the concept and culture of working with TVD, the designer advised the client of the cost impact and together both client and designer examined the location and purpose of the original 10 beams to ascertain if all were required, especially with five more being added. This exercise led to a reduction of three beams, and thus a net increase of only two beams and with a qualified value increase to the functionality of the facility. The principles of TVD compelled the assessment of the need for each beam. One was found to be required once every three years, and it was decided to use a mobile lifting solution in that case. The traditional mindset and thinking of 'put it in just in case it will be required' is challenged by the principles of TVD and a much deeper consideration of the value versus cost argument is advocated.

The culture around a new way of working was critical as some disciplines had to surrender some of their fund to finance a client request for extra scope in another discipline. A success on the project was the early design and tender of the CSA element, resulting in early visibility of the contractor's costs for that work. This tender was 10% under budget allowing a portion of this saving to be reallocated to the process kit as this was trending towards 10% over target, thus creating a balance on the overall TVD trend.

Value Aspect

TVD can also drive up cost; however, if this exposes opportunity for increased lifecycle value to the project then the client may be satisfied to increase the fund. An example of this occurred on this project when the existing roof on the building to be refurbished was found to be fit-for-purpose but would need remediation work within 5 years. This prompted an extensive survey to be carried out, resulting in a finding that investment of €200k would be required in a piecemeal fashion over the next 20 years to maintain the roof integrity. However, it was also established that an initial investment as part of this project would get the work completed for €75k as the roof was clear and accessible without plant, cable trays, or penetrations. The client decided to spend the €75k upfront to save on the €200k spend over the 20-year lifecycle cost plan. This emphasised the "Value" element of TVD by considering the lifecycle maintenance investment costs at the DD stage.

Tracking TVD

Each discipline had its own tab on the TVD tracker and each design occurrence was recorded live as it happened on the cloud-based system. The relevant QS received a notification if the tracker had been updated, which prompted the need to review any cost impact noted by the design engineer. DPS project leadership team reviewed the dashboard with the engineering leads at the weekly governance meeting. An important part of this inter-discipline meeting was the collaborative evaluation of the impact of changes in one department on work and costs in other design departments. Referring again to the extra lifting beam example, other disciplines' design elements were impacted as lighting, fire protection, and ducting air

flows would have required modification, thus necessitating extra design hours to address compliance and quality of the completed product. This review meeting then raised new items on the tracker as the impact on the lighting, fire protection (extra sprinkler head), and ducting had to be added, resulting in a more accurate and complete impact assessment to carry forward to the client. The weekly TVD review meeting with the client examined the TVD trend and compared planned with actual to ensure visibility of any need for further attention. A critical aspect of the meeting was the importance of visiting each individual cost increase as any creep, despite being within the trend parameters, still had to be challenged and not blindly accepted. Figure 3 illustrates the cost analysis performance within the overall process discipline as discussed in the weekly governance meeting.

Figure 3. Process Department TVD Cost Tracking (Source: DPS Group)

LEAN INITIATIVE IMPROVEMENTS & IMPACT

The TVD process was consistently developed over the course of the project and has since been brought forward onto current and future projects with this client. The culture surrounding TVD is also developing, ensuring designers are becoming more aware of the impact of their decisions on the cost fund. Designers have become more vocal in declaring change and assessing its financial impact. This is of huge benefit to the Project Managers as there is less reactive work in seeking financial approvals for client changes in design packages that have already been delivered.

Probably the greatest benefit of TVD was the challenge posed by the necessity to differentiate a business "need" from a "want". Business case needs are the project team's prime delivery objective and should be captured in the project baseline concept report. Business wants or "nice to haves" must be challenged through strong project change control and by offsetting of other items and maintaining focus on achieving the target value through relentless pursuit of alternatives and resisting scope creep is a critical accomplishment of TVD.

Care is needed around reporting everything as being an extra cost. Effort must be made towards mitigating the impact of the change by examining the request to assess if alternatives exist that will still provide the client with the outcome or value required, but without necessitating major extra investment. The client testified to the increased visibility and improved financial reporting and could also assess the broader financial impact of a change request in a much timelier manner than with the traditional cost reporting mechanisms.

The value and impact of TVD is captured by the client's Project Manager who noted that:

> "The ongoing value of the TVD process exists in it being a leading indicator of change to come on the project. It creates an environment of shared responsibility of costs between engineering disciplines, for example, a small change within one discipline driving a large saving or cost increase being flagged and discussed in real-time is valuable to schedule and cost control."