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Lean Project Delivery in the United States Public Sector – History and Current State

Gestión de Proyectos Lean en el Sector Público de los Estados Unidos: Historia y Estado Actual

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Abstract

Since the late 2000s, public agencies in the United States have been developing alternatives to traditional capital project delivery models in pursuit of better project outcomes. Most public agencies have legal authority to deliver projects through a design-build contract and have been using this contracting method to foster greater collaboration and to integrate the target value design process into a Lean project delivery model. The approaches and practices of four public agencies - San Diego Community College District, University of California San Francisco, the University of Washington, and the California State University System - that have been utilizing this approach are highlighted in this paper. Specific requirements identified to foster the desired collaborative environment, integration of Lean principles and practices, value creation, budget and cost performance, and schedule performance are shared. Metrics from selected projects give evidence that this approach is delivering greater value for these institutions, the design and construction community, taxpayers, and most importantly the internal customers that are using the constructed assets. Knowledge transfer of the resources developed to procure these types of projects and to create and sustain the environment necessary for project success has greatly benefited these institutions and serves as a potential portal for other public agencies to follow.

Keywords: *Lean in the Public Sector; Lean Project Delivery; Design-Build; Target Value Design; Last Planner® System.*

Resumen

Desde finales de la década de 2000, las agencias públicas de Estados Unidos han estado desarrollando alternativas a los modelos tradicionales de ejecución de proyectos de capital en busca de mejores resultados. La mayoría de las agencias públicas tienen autoridad legal para efectuar proyectos a través de un contrato de tipo diseño-construcción y han estado utilizando este método de contratación para fomentar una mayor colaboración e integrar el diseño del valor objetivo en un modelo de gestión de proyectos Lean. En este artículo se destacan los enfoques y prácticas de cuatro agencias públicas (el Distrito de Colegios Comunitarios de San Diego, la Universidad de California en San Francisco, la Universidad de Washington y el Sistema de la Universidad del Estado de California) que han estado utilizando este enfoque. Se comparten los requisitos específicos identificados para fomentar un entorno colaborativo, la integración de los principios y prácticas Lean, la creación de valor, el desempeño del presupuesto, de los costos y del cronograma. Métricas obtenidas de proyectos seleccionados proporcionan evidencia de que este enfoque está brindando un mayor valor para estas instituciones, la comunidad de diseño y construcción, los contribuyentes y, lo más importante, los clientes internos que utilizan los activos construidos. La transferencia de conocimientos desarrollados para conseguir este tipo de proyectos y para crear y sostener el entorno necesario para su éxito ha beneficiado enormemente a estas instituciones y sirve como un potencial portal a cruzar para otras agencias públicas.

Palabras clave: Lean en el Sector Público; Entrega de Proyectos Lean; Diseño de construcción; Diseño de Valor Objetivo; Sistema Last Planner®.

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1. Why Some Public Owners Have Embraced Lean Project Delivery in the United States

Public agency procurement laws and regulations in the United States, other than Federal government procurement, are promulgated at the state level. These legal codes vary greatly from state to state and even within a state depending on the type of public agency. In general terms, most public agencies have access to design-bid-build and design-build delivery contracts for their capital facilities projects. Some agencies also have access to construction management at risk and construction management multiple prime delivery models. Only two public institutions to date, Michigan State University and the University of California San Francisco, have authority to enter into integrated forms of agreement to support true Integrated Project Delivery (IPD).

The use of design-bid-build and fixed price design-build contracts has historically resulted in contentious contract change management and schedule performance on projects. As a result, public owners have explored other ways to deliver better project outcomes moving towards Lean Project Delivery. Lean Project Delivery for the purposes of this paper is defined as an organized implementation of Lean principles and tools combined to allow a team to operate collaboratively towards aligned goals to create value and flow while delivering a project. To achieve this, public agencies are using collaborative contract models that support target value design through a progressive design-build process as well as requiring the use of the Last Planner® System in lieu of traditional Critical Path Method scheduling and associated fragnet analysis for schedule delays to the project.

This paper focuses on three public agencies that were early adopters of target value design using design-build contracts – San Diego Community College District (San Diego, California), the University of California San Francisco (UCSF), and the University of Washington (Seattle, Washington). In addition, the paper explores how the California State University System has been an innovator in enhancing collaboration and encouraging greater practice of Lean design and construction.

2. Moving Towards Target Value Design through Design-Build Contracts

To create greater value for taxpayers and users of their facilities, both the San Diego Community College District and the UCSF made the decision to move towards a target value design model in the late 2000s. Target value design is a disciplined management practice to assure that the project meets the operational needs and value of the users, is delivered within the allowable budget, and promotes innovation throughout the process to increase value and eliminate waste. The target construction cost is typically benchmarked against current best-in-class projects. (Flyvbjerg and Gardner, 2023) refer to this as the anchor in an appropriate reference class of projects. In addition, non-financial values are defined for the project based on the needs, goals, and aspirations of the specific building or built environment users. The successful design-build team works collaboratively with the owner and internal customer representatives to design the project together within the target cost. This allows for engagement, exploration of alternatives, and discussion tied to priorities and trade-offs as necessary to remain with the target cost and optimize the value creation.

The San Diego Community College District Experience

The San Diego Community College District (SDCCD) is one of the largest community college districts in the United States serving more than 34,000 students in three colleges and 12,000 students at five Continuing Education campuses in 2022.

SDCCD was one of the earliest public agency adopters of target value design through use of a design-build contract in early 2008. Inspired by what Sutter HealthCare was doing with target value design in the private sector through integrated forms of agreement, SDCCD used enabling legislation that went into effect on January 1, 2008 to craft a design-build RFP and contract that allowed a best value selection of a design-build team evaluating the following factors: Technical Expertise (30%), Price elements (20%), Design Excellence (15%), Life Cycle Cost Analysis (10%), past Safety Record (10%), Skilled Labor Force availability (10%), and Commitment to diversity in local and disadvantaged business subcontractor participation (5%). The price elements evaluated as part of the proposal review were 1) design-builder fee (overhead and profit) on the target construction cost, 2) design and pre-construction fees and 3) general conditions and requirements costs to support the

project during construction (Umstot et al., 2009). This first target value design-build contract was awarded in October 2008 with a direct construction target cost of $37,500,000. As an anchor, this target cost was developed through comparison with other projects with similar attributes and functions.

In addition to the target cost, SDCCD had other important values for consideration during the design and construction process. These included sustainable buildings and associated grounds to reduce greenhouse gas emissions, reduce energy consumption, reduce water consumption, and lower total cost of ownership. SDCCD's governing Board of Trustees adopted a Green Building policy in 2003 that requires at least 5 percent of a project's total energy be generated from renewable resources such as solar or thermal energy on-site. All new facilities and major renovations are to obtain, at a minimum, a Leadership in Energy and Environmental Design (LEED) Silver certification from the U.S. Green Building Council. Furthermore, all buildings must exceed Title 24 of the California Code of Regulations energy efficiency standards by at least 10 percent. Another core value identified as part of the target value design process was the importance of total cost of ownership of the asset. SDCCD had constrained budgets for maintenance and operations so any money invested in the initial capital expenditure that could reduce these costs over the life cycle of the building was desired.

Following this initial project, 11 additional projects were delivered using the target value design approach. An analysis of the benefits of implementing Lean project delivery at SDCCD from 2008 to 2013 is discussed in (Umstot et al., 2014). In summary, the use of target value design reduced change orders by 3.3 percent from past projects, increased the level of sustainability as measured by LEED Gold versus LEED Silver certification from 29 percent to 44 percent of projects, and helped reduce maintenance and operations costs from $3.93 per square foot in 2009 to $1.45 per square foot in 2012 surpassing the target goal of $2.55. The latter significantly reducing the total cost of ownership over the expected life of the systems and building.

Dodge Data and Analytics conducted a survey of 81 owners with significant capital project portfolios in 2016 on behalf of the Lean Construction Institute (LCI, 2017). The results of the survey found that for typical projects, owners' projects were on budget 41 percent of the time, under budget 10 percent of the time, and overbudget 49 percent. Eighty-three (83) percent of owners reported their best projects finished on or under budget. Specifically, 37 percent finished on budget, 46 percent were under budget and only 17 percent were over budget. Many of these best projects were implemented with high Lean intensity. Lean intensity was defined in the analysis as using a wide cross-section of Lean approaches and tools including the Big Room environment, target value design, pre-fabrication, and the Last Planner® System. The two areas with the biggest difference in utilization between best and typical projects were the Big Room at a 38 percent spread and target value design with a 34 percent spread. The SDCCD Lean project delivery experience is similar to the study's best project budget performance with 83 percent of the projects finishing on or under budget (Umstot et al., 2014).

3. The UCSF journey

UCSF is a leading public university dedicated exclusively to the health sciences with professional schools of dentistry, medicine, nursing and pharmacy with 3200 students enrolled in degree programs, 1650 clinical residents or fellows, and 1180 post-doctoral scholars (UCSF, 2023).

The UCSF Lean journey began in earnest with the Smith Cardiovascular Research Building and the UCSF Medical Center at Mission Bay projects. The Smith Cardiovascular Research building started construction in 2008 and was completed in 2010 using the Big Room concept. The building houses nearly 500 research scientists and clinicians who work on the development of new treatments for cardiovascular diseases (Bascoul et al., 2018). The UCSF Medical Center at Mission Bay started design in 2007 and was delivered in an integrated fashion with the General Contractor retained under a Construction Manager at Risk contract which included pre-construction services in an integrated Big Room. The $1.5B project opened on time February 1, 2015 and consisted of 3 hospitals within the Medical Center: 1) the 183-bed Benioff Children's Hospital with urgent/emergency care, primary care, and specialty outpatient services; 2) the Betty Irene Moore Women's Hospital offering cancer care, specialty surgery, and a 36-bed birth center; 3) the 70-bed Bakar Cancer Hospital for adults. (Dombrowski, 2015). The leaders of the project opined that the integrated Lean delivery of this project potentially saved $200 million or 13 percent of the total constructed cost (Robeznieks, 2015).

In 2012, UCSF used target value design through a design-build contract for the first time on the Block 25A – Mission Hall project, a 7-story, $94M academic building. The design-build team was challenged to meet the $94M target cost and worked diligently to reduce it from a projected cost of $107M to the $94M target through the target value design process

(Umstot and Fauchier, 2017). UCSF continues to use design-build contracts and target value design on projects, but in 2019 took a step toward true integrated project delivery (UCSF, 2019) on the $2.875 billion 900,000 SF new hospital tower at Parnassus Heights in San Francisco. This is the only integrated form of agreement project that has been authorized for a public agency to date in California.

UCSF has continued to evolve their utilization of Lean project delivery including the development and publication of a Lean Project Delivery Guide (Tillman, 2018). The guide is focused on five major areas: 1) Collaborative project delivery, 2) Value management, 3) Target value design/delivery, 4) Elimination of waste and rework, and 5) Last Planner® System implementation. A maturity matrix is shared for each of the five areas with practices and effects described for each of four ascending levels of maturity (from Level 1 - lowest to Level 4 – highest). In addition, the guide suggests key performance indicators that may be selected by project teams using Lean project delivery. These include indicators, measurements, frequency and target goals for each of the five areas described above.

3.1 University of Washington's Approach to Lean Project Delivery.

The University of Washington in Seattle has been using an integrated design-build contract to deliver projects via target value design since 2017. To date, they have successfully completed 10 projects using this contract with another 17 currently in design or under construction (University of Washington, 2023). Projects ranged in value from $2.6M to $224.5M with a mean project budget of $42.4M and median project budget of $29.5M.

The University clearly conveys their expectations in the very first paragraph of their integrated design-build contract (University of Washington, 2021).

*"**Integrated Design-Build.***
***1.1.1** The Design-Builder and the Owner wish to fully embrace principles of collaboration and integrated delivery in the performance of the Work. Integrated delivery emphasizes a cooperative approach to problem-solving that involves all key parties: Owner, Design-Builder, and Design-Build Team Members. To this end, the Design-Builder and the Owner agree to employ the following techniques to maximize efficiency and minimize waste on the Project:*
***1.1.1.1** Create a culture of open and honest communication;*
***1.1.1.2** Integrate the Design-Build Team Members, including all Risk/Reward Team Members, as early as possible into the design process;*
***1.1.1.3** Utilize Building Information Modeling (BIM) efficiently and effectively;*
***1.1.1.4** Utilize Target Value Design efficiently and effectively;*
***1.1.1.5** Utilize Lean Principles efficiently and effectively;*
***1.1.1.6** Establish a collaborative environment where all parties have the opportunity to contribute their best efforts for the benefit of the Project as a whole rather than to the benefit of individual parties; and*
***1.1.1.7** Establish business terms that allow for equitable shared risk and reward for the Risk/Reward Team Members.*
***1.1.1.8** Create an environment that engages Business Equity Enterprises (BEE) to the fullest extent practicable."*

The University of Washington uses a risk/reward approach for the design-builder and selected members of the design-build team using a similar mechanism to that used in an Integrated Form of Agreement (IFOA). Like other progressive design-build contract models, the final target cost is established at the end of the design/pre-construction phase allowing the entire team to collaboratively optimize the value proposition within the base target cost. The risk/reward pool comprises Design-Build team members, each of whom is performing the Work with its Fee "at risk" and each of whom is eligible to share in the incentive compensation. The incentive compensation is an amount that is increased or decreased based on project outcomes and is distributed to the risk/reward team members in accordance with a distribution agreement established early in the contract. The incentives are tied to 1) value added to the project throughout the project design and construction cycle based on contract agreement benchmark milestones (e.g. design/preconstruction agreement; final target cost amendment); 2) achieving identified project milestones; and 3) cost savings if the final project cost is less than the final target cost. Project costs are billed at the actual costs reasonably and necessarily incurred by the risk/reward team members in the performance of the work.

The value-added design/pre-construction phase incentive compensation adjustments are intended to promote innovation at the time when change is least disruptive to the project and when savings can be most efficiently used by the University to add desired scope, features, or upgrades. More specifically, this is to incentivize early decisions with certainty to add value. Cost savings realized late in the construction process are typically too late to be reinvested into value enhancements in the project that require design and/or procurement. During construction, the incentive compensation

percentage is reduced to reflect this, but is focused on reducing rework, improving productivity, and generally executing the project work as efficiently as possible.

The University also clearly articulates the Lean principles that are required for the project including: open communication, collaboration, reliable promising, quality and reduction in rework, work performed by the organization or individual best qualified to do so, value of ideas regardless of source or status, optimization of the entire project (not simply components or elements), and continuous improvement.

The governance model for the project is also very similar to an IFOA project with creation of a Project Management Team as well as a Senior Management Team comprising senior level representatives from the University, Design-Builder and Architect. The Project Management Team (PMT) includes representatives from the Owner, the Design-Builder, and the Architect working together in a collaborative manner to provide management-level leadership throughout the Project. The Senior Management Team provides supervision, coaching, and management of the PMT including oversight of the decisions of the PMT and changes in personnel as required. In the event the PMT cannot reach agreement on an issue, the Senior Management Team is tasked with collaboratively resolving the issue with the PMT as part of the issue resolution ladder. In addition, there is a Project Executive Committee which is a small, high-level committee representing broad University perspectives as well as project-specific views that is responsible for all major project decisions, recommendations, and trade-offs within the established parameters of the project.

The PMT mutually agrees on the greatest project risks and the disciplines that will be engaged as early in the Project Definition Phase as practical and appropriate including these engineering consultants: Structural Engineer, Civil Engineer, Mechanical Engineer (HVAC & Plumbing), Electrical Engineer, and Building Envelope expert. They also consider these specialty trade contractors in a similar manner: Mechanical, Electrical, Plumbing, Steel Fabricator, Building Skin/Glazing, and others as appropriate for the project.

The execution of the design and construction of the project is done through Project Working Teams which are interdisciplinary groups of design-build team members and representatives of the Owner organized by the PMT. These teams are key to the collaborative target value design process to develop the target program, set-based design alternatives, procurement and prefabrication strategies, permitting documents, and project implementation once the project is permitted.

To gain alignment, the project team develops a charter that includes the value proposition for the project through vision and goals; the project governance structure and decision-making model, and perhaps most importantly how the team will behave (Figure 1).

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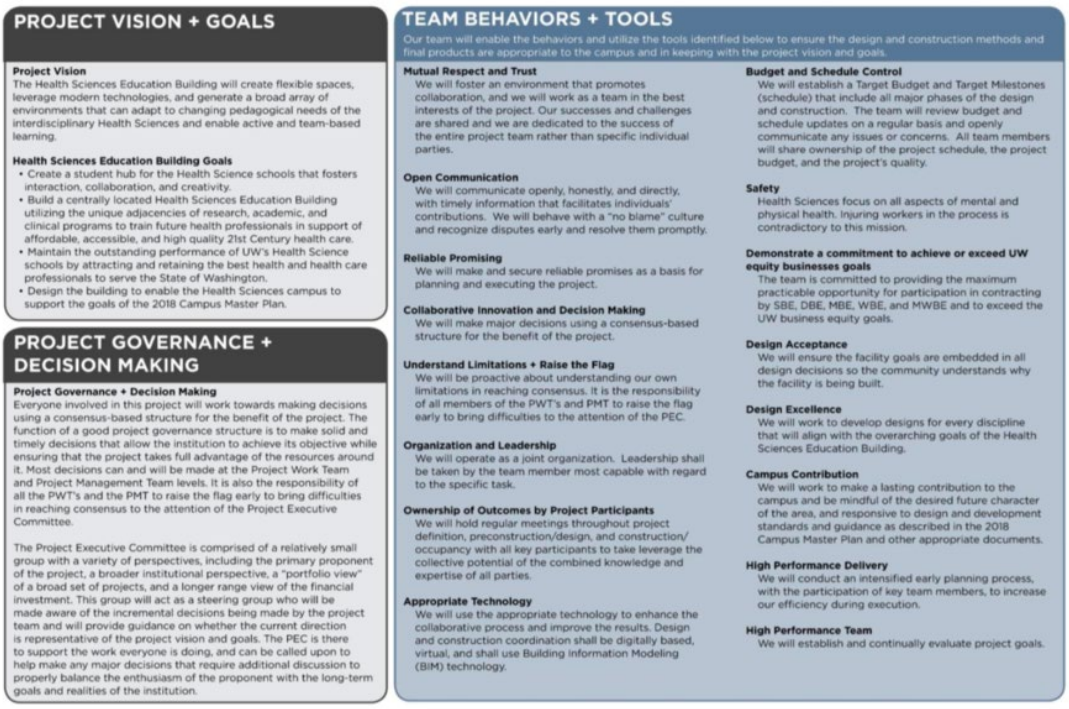

Figure 1. *Project Charter for yhe Hans Rosling Center for Population Health at the University of Washington, Seattle Campus (Aske et al., 2023)*

Two recently completed projects at the University include the Hans Rosling Center for Population Health Center, a 300,000 square feet (SF) interdisciplinary building for three public health disciplines, and the 100,000 SF Health Sciences Education Building serving all six schools health sciences disciplines at the University. The results from these two projects are shown in (Table 1).

Table 1. *Results of Incentivized Progressive Design-Build Risk-Reward Teams on Two Projects at the University of Washington, Seattle Campus (Aske et al., 2023)*

Project	Hans Rosling Center for Population Health	Health Sciences Education Building
Design-Build Contract Value	$180M	$78M
Percentage of Team Participating in Risk/Reward Pool (as % of Total Design-Build Contract Value)	79%	67%
Design-Build Cost Performance	$5M savings	$230,000 savings
Owner Contingency Savings	$5.5M savings	$300,000 savings
Schedule Performance	On-time	On-time
Added Value Scope Incorporated ($)	$9M	$4M
Incentive Return on Investment	130%	46%
Added Value Scope Incorporated (% of Contract Value)	4.6%	5.1%
Incentive Achieved	Full	Full
% Increase to Risk/Reward Partner Fee	26%	32%

The target value design process worked well for both projects. Seventy-nine (79) percent of the design and construction team members participated in the incentive pool for the Hans Rosling project and 67 percent for the Health Sciences Building calculated on the basis of their costs as a percentage of the total cost. Based on the metrics shown in (Table 1), this was sufficient to foster achievement of the desired project outcomes. Both projects finished on time and both projects

finished with significant savings. Furthermore, added value enhancements to each project totaled $9 million and $4 million, respectively. This is a key outcome of the target value design process.

The University as part of its continuous improvement efforts hosted a retrospective workshop with their design-builders, architects and internal staff in September 2022 to capture what had worked well to date and where had teams identified opportunities for improvement. The two primary areas for future improvement focus on 1) the project definition or validation phase and 2) greater clarity on incentive pool participation and alignment of incentives with overarching objectives beyond meeting the target cost.

3.2 The California State University System – Providing Lean Tools to 23 Campuses

The California State University (CSU) System has 23 campuses throughout California. With nearly 458,000 students enrolled in Fall 2022, it is the largest university system in the United States. The 5-year capital expenditure plan for fiscal year 2022 through fiscal year 2026 is $16.4 billion. The CSU System has a number of contract types for their capital projects, but has settled on use of a Collaborative Design-Build contract (CSU, 2019) using target value design for many of their larger projects.

San Diego State University (SDSU), one of the 23 campuses, has used this approach since 2015 starting with the delivery of the $100M, 90,000 SF Engineering and Interdisciplinary Sciences Building which was completed in 2018. Subsequently, SDSU also used this approach to build the new $310M Snapdragon Stadium that completed in August 2022 within the target cost and in a construction duration of only two years and two days.

The CSU System Office of Capital Planning, Design and Construction is responsible for carrying out the construction and physical development of CSU campuses and any buildings, facilities and improvements connected with the CSU throughout the state of California. The office decided in 2017 to develop a Collaborative Construction Planning Process specification based on the Last Planner® System (CSU, 2018) for elective use throughout the 23 campuses in lieu of the traditional critical path method scheduling specification. This was developed collaboratively over the course of a year and rolled out for use in the fall of 2018. In addition, Last Planner® System training was offered throughout California to introduce the principles of pull production and the elements of the new specification to members of the capital project planning and delivery staff. This specification has served as the basis for many other public agencies desiring to migrate to pull production planning in lieu of traditional critical path method approaches that have not met their project needs.

Subsequent to this, the CSU System has developed draft specification sessions for Collaborative Project Delivery (CSU, 2021a) and Lean Construction Processes (CSU, 2021b). While not available for wide-spread use yet, these specification sections are being tested on select projects.

The Collaborative Project Delivery specification has many similarities to the University of Washington integrated design-build contract. These include a section on collaboration and associated expectations (partially shared below):

1. *Create a culture of integrity and open and honest communication,*
2. *Create a culture of goodwill, and always act to promote high morale with all project staff,*
3. *Lead by example by demonstrating the behavior you expect from others,*
4. *Integrate all Design-Build Team Members as early as possible into the design process,*
5. *Utilize Building Information Modeling (BIM) efficiently and effectively,*
6. *Utilize Target Value Design efficiently and effectively,*
7. *Utilize Lean Principles efficiently and effectively,*
8. *Establish a collaborative environment where all parties have the opportunity to contribute their best efforts for the benefit of the Project as a whole rather than to the benefit of individual parties, encouraging project-centric thinking,*
9. *The Design-Build Team Members accept the relationship of trust and good faith established by the Contract and covenants to work collaboratively and proactively with each other to perform and complete the Work for a cost within the GMP budget and schedule, to support the overall objectives for the Project, and to assure the Design-Builder and subcontractors profit from the project.*

In addition, the project governance model, project charter requirements and project incentives are defined with similar methodology and language as the University of Washington. Noteworthy differences are: 1) incentives tied to safety performance to fund special event(s) to celebrate reaching 100 work days with zero recordable injuries and zero lost time

injuries; 2) A monthly pull planning incentive of a gift card of $100 to the Last Planner® meeting participant, selected by the Project Management team, that has best contributed to improving the meetings and metrics of the project including percent plan complete improvement or shortening duration required to reach project milestones; and 3) Up to five milestone incentives during the project with 100% of the incentive distributed to the staff and craft that championed and achieved the milestone.

The Lean Construction Processes specification covers fundamentals of Lean Project Delivery, reliable commitments, communications protocol, project validation study, expected cost of the project based on the validation study, continuous cost modeling, the target value design process, integrated design principles, pull-based design production, risk evaluation matrix and management plan, and built-in quality.

4. Conclusions

Public agency owners are moving toward more collaborative project delivery models. They are doing so by setting up projects for better collaboration through expressing and modeling desired behaviors. Specific expectations are being defined in the contract agreements and specifications and integrated into the selection process for capital project delivery. Integrated project governance is becoming more commonplace with essentially three levels of responsibility and decision-making: at the project management team, senior management team, and project executive committee. Project teams are capturing joint understanding and alignment in succinct project charters that outline the project goals, objectives and aspirations as well as mutually accountable behaviors.

The use of the target value design process is being used more frequently, particularly in a design-build contract, with setting the final target cost or guaranteed maximum price at the completion of design and pre-construction. The target value design process consistently includes value definition and alignment, project validation to assure scope and available budget are in alignment, integrated project working groups, set-based design, cost modeling and continuous estimating, use of incentives to meet desired outcomes for value addition, total cost, schedule and safety.

Use of the Last Planner® System is more frequently being required as part of the contract and the CSU Collaborative Construction Planning Process specification is being used in the CSU system and beyond to define expectations and specific requirements for teams. Maturity matrix models have also been developed for specific Lean behaviors or approaches on projects with clearly defined maturity levels that include specific examples of practices and their impacts reflective of each maturity level.

The data as captured for the relevant projects in this paper indicate that the use of Lean project delivery is indeed resulting in better project outcomes with respect to value creation and addition, overall cost performance, and more reliable schedule delivery.

The case studies shared here are all for higher education public agencies that have been on a Lean journey for more than a decade. These projects serve a wide range of internal customer needs including healthcare, laboratories, sports facilities, and specialized instructional space. There is also knowledge transfer among these institutions to share lessons learned and new approaches to achieving better project outcomes. This is evidenced by similar language in contract documents and through efforts to continuously improve them. This knowledge transfer is moving beyond higher education into other public agencies including the California Department of General Services, Los Angeles World Airports, and San Francisco International Airport as notable examples, among many others. Each is adopting greater Lean project delivery requirements into their contracts and projects including target value design based on the success they are observing on others' projects and on their own..

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