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AN EXPLORATION OF TARGET VALUE DELIVERY IN A SINGLE-ENTITY DESIGN-BUILD ORGANISATION

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ABSTRACT

This paper has explored Target Value Delivery (TVD) in the specific context of a single-entity design-build organisation. It does not attempt to recommend one ideal form of TVD but to discuss the possibility of adapting it to various business environments and cultural scenes. TVD stood out as a candidate for deeper consideration when prospecting innovation opportunities in value delivery by simultaneously tacking procurement methods and internal process reforms. Design Science Research has been selected as the research approach. The artefact is a modification of the TVD reference model to leverage the potential of general contractors holding full-fledged design departments - a different structure from cases reported overseas leaning toward three-party Integrated Project Delivery (IPD). The experimental design of a tentative combined model with existing practices was grounded on the iteration with and review of multidisciplinary engineers over the last 1.5 years. The conclusion was that abstract concepts entangled in TVD could be challenging to convert into executable processes when over-relying on behaviour change by parties with different interests and priorities. Rather, systematisations such as devising applications that somewhat forcibly yet friendly guide TVD workflow could be potentially effective. The next step is instantiating the mechanisms contained in the customised model.

KEYWORDS

TVD, Design-build, IPD, Collaboration, Process Improvement.

INTRODUCTION

Target Value Delivery (TVD) is one of the representative methods of Lean Construction. It provides background reasoning and a structured delivery process for construction projects. Although TVD has been said to be implementable in any project type, it has been common to see it in IPD environments, where there is contractual support for project teams to align their interests and set an organisational structure around lean methodology (Tillmann et al., 2017).

TVD draws inspiration from Target Costing, which is defined as a disciplined process for determining and realising the cost at which a proposed product with specified functionality must be produced to generate the desired profitability (Cooper & Slagmulder, 1997).

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TVD takes the main features of manufacturing's Target Costing and adapts them to the peculiarities of construction, aiming to avoid cost overruns while enhancing customer value. According to Zimina et al. (2012), the main idea is to make client value drive design, thereby reducing waste and satisfying or, eventually, exceeding the client's expectations. Tommelein and Ballard (2016) have defined TVD as a method of setting project targets and steering design and construction toward them instead of calculating the cost of a design after its completion.

An issue with the TVD literature, as recognised by Rybkowski et al. (2022), is that many papers discuss the benefits of practices associated with TVD; however, only a few describe the specific protocol leading to the benefits compared to conventional practices. Similarly, many papers imply the need for trust between team members but do not document how to build trust.

Customisation is necessary because generic models convey the essential aspects behind the TVD idea but may be hard to follow because of the limited level of detail. On the other hand, a detailed model could suit only a limited group of business scenarios or sacrifice the easiness of understanding in a multi-stakeholder environment and its ultimate practical use. Amid such a paradox, this study has sought to customise the TVD reference model widely divulgated by the P2SL in its benchmark report (Tommelein & Ballard, 2016). The customisation has one specific caveat: it focuses on the unique context of a single-entity design-build organisation.

This paper aimed to explore the hypothetical implications of overlaying the TVD reference model on the current design-build process model to generate a third instance. This led to a tentative combined model with suggestions to operationalise its mechanisms.

RESEARCH METHOD

This study has adopted Design Science Research (DSR) to explore the creation of TVD variants that satisfy a practical need for process innovation. DSR has been employed in Lean Construction research with exploratory/prescriptive over explanatory/descriptive inclinations for years (AlSehaimi et al., 2013). Also referred to as Constructive Research, it consists of a research procedure to produce artefacts intended to solve problems in the real world and, by extension, contribute to the theory of the discipline in which it has been applied (Lukka, 2003).

The object of study is the work process of a Tier-1 General Contractor from Japan holding full-fledged design departments. The company operates nearly 70% of the projects under an integrated design-build scheme. All the trades are subcontracted.

The research procedure has been three-fold.

1. The first step was a literature review on TVD, including but not limited to articles from the IGLC-related media which seems to concentrate the publications in this research field. From this review, we have selected the TVD process of the P2SL's benchmark report (Tommelein & Ballard, 2016) to serve as the "reference model".
2. The second step was adapting/simplifying the extant process model from the quality assurance system established in the target organisation, hereinafter the "current model".
3. The third step was overlaying the academic model ("reference model") with the practical model ("current model"), matching the equivalent phases, which resulted in the "tentative combined model" (proposal version 1.0).

These procedures were conducted by the authors, who have a mixed background in R&D, cost estimation, and site management, sharing an interest in BIM and Lean. Over 1.5 years of research, the authors conducted interviews with fellow engineers from business development, design planning, cost management planning, construction management consulting, structural engineering, construction engineering, R&D, digital promotion, and site management. Collaborators have shared experiences of past projects and parallel process improvement efforts, including some that have not yet been implemented or standardised. Those inputs reinforced or modified our hypotheses when drafting the proposed TVD combined model.

ASPIRATIONS FOR TVD: A COMMENTED REVIEW

SIMULTANEOUS MANAGEMENT OF DESIGN AND COST ESTIMATION

Macomber et al. (2008) have reported that traditional "over-the-wall" practices in construction, performed by specialists in isolation, have resulted in expensive, unbuildable, and delayed projects when TVD would come to turn the current design process upside-down. They argued that TVD could lead to a workflow in which the design is based on a detailed estimate rather than being calculated based on a more detailed design. Regarding the production phase, design should occur within the boundaries of constructability parameters rather than evaluating the constructability of a design.

A practical consequence provoked by the TVD way of thinking is the shift in order between 'design' and 'cost'. Conventionally, the estimated cost is calculated based on drawings so that "cost follows design". Target costing implies setting cost first and then steering design to meet the target so that "design follows the target cost". In the former, cost is 'controlled' against an existing design alternative by reviews and redesign until it is acceptable to go through decision gates. In the latter, the cost is 'planned', and design continuously pursues adherence to targets, making it right the first time, yet through a possibly longer delivery.

Fig. 1 illustrates cost estimation and design as "one set" instead of a sequential flow.

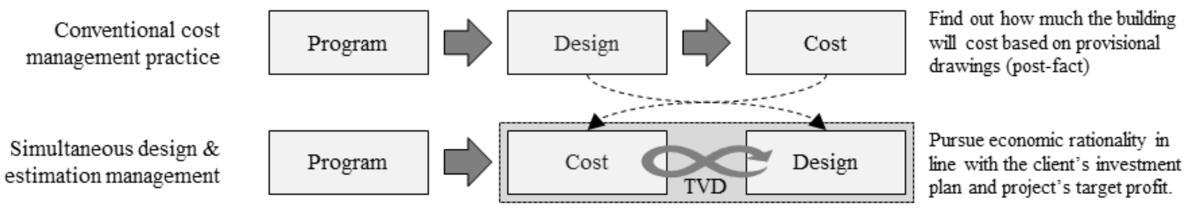

Figure 1: Change in the design-cost order logic (Conventional practice vs TVD)

TVD processes undertake a series of continuous improvement efforts to reach the desired goals for the project while adhering to the target value cost. Once the value for the customer is defined, the process takes advantage of rapid cycles of suggestions, analyses, and implementations (Alves et al., 2017). Compared to traditional methods, where the project team will identify user preferences and find solutions to meet customers' needs, in TVD (and IPD), a very high level of common understanding is reached through active participation of the owner, who will work together with designers and builders toward maximising value.

However, pursuing value implies trade-offs between design alternatives and re-distributing quotas among disciplines as the design evolves, demanding a disciplined approach. Cost allocation requires constant monitoring and eventual revisions. TVD calls for a simultaneous design and cost estimation management approach whose mechanisms explore value-up opportunities. Pennanen et al. (2010) discussed the "steering range" concept and the pursuit of good quality design solutions to be achieved at a reasonable price.

Theoretically, TVD induces a process in which the project team collectively identifies potential issues and produces decisions first rather than working alone and then coming together for group reviews. Even though some may claim to conduct simultaneous design and cost estimation through periodical meetings, such an approach relies on inter-organisational cooperation and people's behaviour, which can work but is tricky and not guaranteed.

TVD is said to work better in collaborative environments with intense information sharing between project stakeholders. Apart from the literature review, with the case at hand, design, cost estimation, and construction planning teams would not need, metaphorically, to cross the street to see each other but take the elevator and meet with colleagues under the same roof, thus configuring a near seamless co-location. Ideally, that would create room (i.e., time) to focus on the relationship with the client and the underemphasised fine-tuning with subcontractors.

RELIABLE EARLY GUESSES FOR SETTING TARGET VALUES

Determining expected costs in the TVD processes can be challenging because construction projects are complex systems that often start with limited information. The target cost determined before design development is based on the customer's requirements for the product performance and the customer's willingness and ability to pay for such performance (Penannen & Ballard, 2008). The difference between the market cost and the allowable cost hints at the project feasibility during the early stages: the discrepancy between allowable cost and market cost indicates that the owner should revisit his or her assumptions about the requirements or, eventually, decide not to fund the project (Alves et al., 2017).

A typical concern among owners and contractors is making good guesses with limited information when design intent is still arising from the brief. Alves et al. (2017) have highlighted the importance of educating clients to make better decisions. The alignment of values and needs to set targets and pursue solutions should also be intentionally conducted within the temporary project organisation that might hold varying degrees of familiarity with the disciplined target value approach. Choosing-by-Advantages (CBA) and Set-Based Design (SBD) are often recommended in the design phase to help the team steer the design to the target cost (e.g., Do et al., 2014; Rybkowski et al., 2022).

Macomber et al. (2008) and Zimina et al. (2012) warned to be careful about thinking that "we already do this". Leaving aside the literature review, the case at hand was no exception. Still, when the authors discussed the above with colleagues on the field, an argument favouring TVD was that it could provide a structured way of doing what is already done tacitly, being particularly useful in communicating with young engineers and negotiating with subcontractors and clients. Some mentioned the ability to "de-subjectivise" decision-making by creating a platform for exploring feasible concepts with high-value delivery potential. Unfamiliar with the Lean Construction lexicon, they did not mention CBA or SBD but referred to similar approaches to guide decision-making without these labels.

Fig. 2 suggests employing TVD support methods earlier in the pre-planning process.

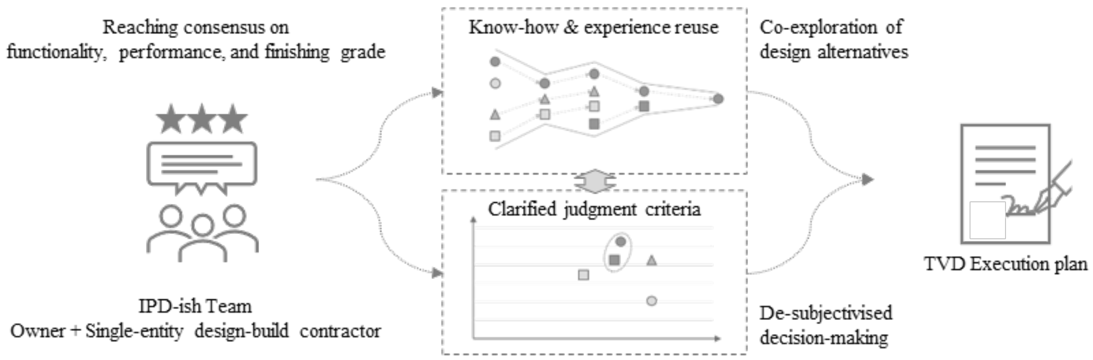

Figure 2: Arrangement of techniques to reach reliable early guesses and set fair targets

Single-entity design-build firms seem to have a slight advantage of the unique ability to use past project data to generate design alternatives and construction scenarios. Knowledge repositories of design solutions and building technology are somewhat structured and equipped with search engines. The linkage between knowledge repositories and design studies with target cost in mind could help make informed decisions, even though tentative and exploratory, fostering mutual understanding and collaboration between owners and the design-build entity.

In addition to tools and techniques used to define value and induce flow associated with the TVD process, a parametric system (literally, a computer program) could potentially help realise simultaneous design and cost estimation and streamline design practice by reducing iterations subject to subjective judgments that can be stressful, time-consuming, and prone to error.

ADAPTATION OF THE TVD PROCESS MODEL: A PROPOSAL

A NEW DESIGN-BUILD STYLE ENABLED BY THE TVD PROCESS

The international experience with TVD, especially in the US, has suggested that TVD – as a method for guiding processes – goes hand in hand with IPD – a project delivery approach with implications in contracts (see Ballard & Reiser, 2004; Do et al., 2015; Tillmann et al., 2017). It has been reported that IPD projects have specified Lean Construction methods (including TVD) in the contract as an enabler to realise IPD ideals. Some other sources have mentioned the "open book" information disclosure to increase transparency in estimates and track records for accountability, which is particularly relevant for shared risk/rewards schemes.

Bringing TVD to the table is a journey accompanied by challenges in many layers, including procurement methods and contract types influencing each other. In this case, TVD enables broader changes while structuring an alternative process.

Fig. 3 shows the position of TVD as an alternative process style.

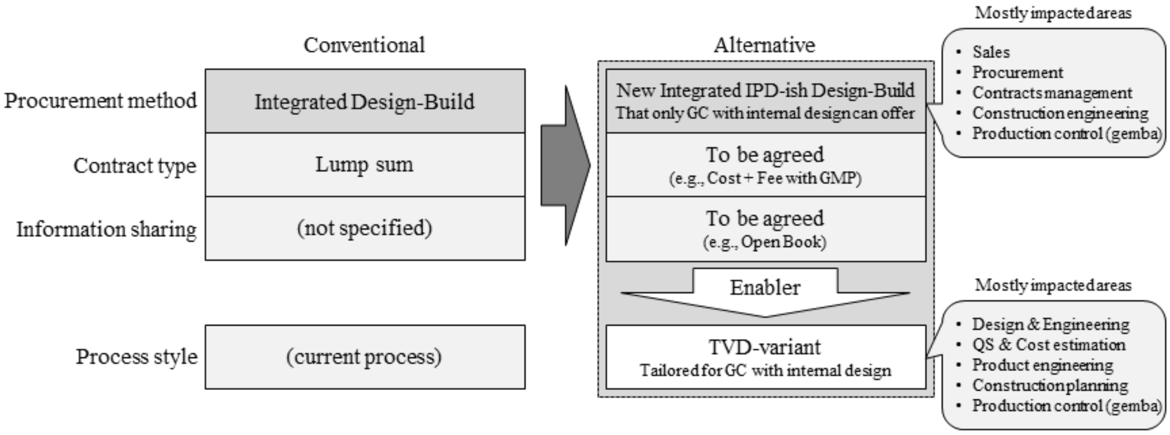

Figure 3: TVD as an enable to realise collaborative delivery methods

Similar benefits could be potentially achieved through a well-executed integrated design-build scheme or IPD. This proposal (experimental adaptation of the TVD reference model) does not attempt to refute established models but explores one more possibility. Compared to conventional design-build, the owner plays a more active role in decision-making. Compared to IPD, there are fewer contact points to deal with trade-offs.

The closer engagement of the owner compared to conventional design-build schemes will likely affect the workflow of sales, procurement, contracts management, and construction engineering more in-depth. Meanwhile, simultaneous management of design and cost estimation shall strongly impact design, quantity surveying, product engineering, and construction planning. Ultimately, all are impacted, including the construction site, particularly in vertically integrated business structure design, like in this case.

Fig. 4 shows the position of TVD as an alternative process style.

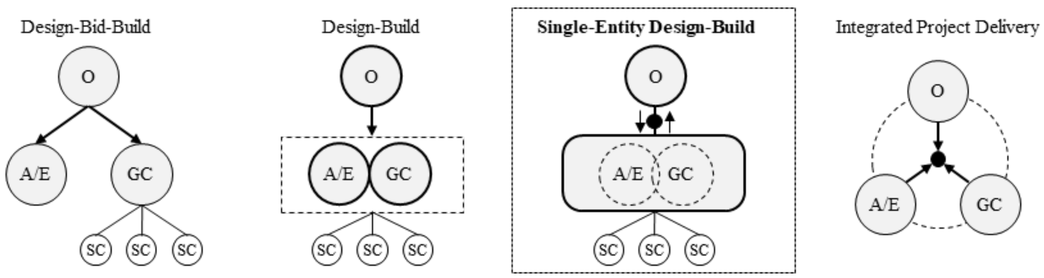

Figure 4: Target ordering method for the proposed TVD-variant

POSSIBILITIES FOR GENERAL CONTRACTORS WITH INTERNAL DESIGN

Past cases of integrated Design-Build projects have suggested that integrated governance leveraging collaborative techniques such as co-location and BIM coordination could suffice to steer design and construction to targets.

Single-entity design-build firms could, theoretically, but not necessarily will, take advantage of TVD more than separate design and construction organisations working on a collaborative procurement scheme. An exclusive value that general contractors could offer is a more profound frontloading, bringing multidisciplinary collaboration upstream of the project, including constructability and supply logistics considerations to early design stages leveraging the learning effect. It would be possible due to having the design department, cost estimation department, construction planning department, and the site within the same company. The point of contact between core members of the IPD-ish team reduces to a two-party owner and design-build contractor rather than a three-party owner, designer, and contractor.

At the daily operational level, data transactions carried out solely between those departments could be smoother than having to interface and manage iterations with independent design, quantity surveying, and construction management consultants in addition to orchestrating construction execution. We mean “smoother” in terms of response speed and access to shared databases and collaborative work platforms.

Conventional Early Contractor Involvement (ECI) tied by IFOA (Integrated Form of Agreement) is usually unable to provide a seamless system architecture where design-in-progress can be checked against productivity rates and unitary costs maintained, calibrated, and updated by players on the production side even though they are willing to collaborate and disclose data for the sake of the project. Besides the tangible aspects, players of the single-entity design-build organisation might benefit from a sense of security in sharing within the same organisation. Innovation opportunities, however, in learning from external interactions could be hindered if complementary measures are not taken.

In this regard, there is an apparent opportunity for general contractors with internal design to pull simultaneous management of design and cost management to the next level through a digital approach that complements collaborative delivery methods and streamlined workflow. The basic idea is to integrate the early design process with cost estimation systems and past project outcome databases to synchronously inform estimates within the design activity nearly as real-time cost simulations. Consequently, steering design would benefit from informed and somewhat parametrised design and production choices in line with the customer’s investment plan. Data visualisation could help strengthen trust among the parties. The complexity of the infrastructure to enable such system integration escalates with as many layers as it consists of.

Fig. 5 describes a speculative vision of building consensus under a TVD scheme. The rationale consists of establishing close collaboration with the owner.

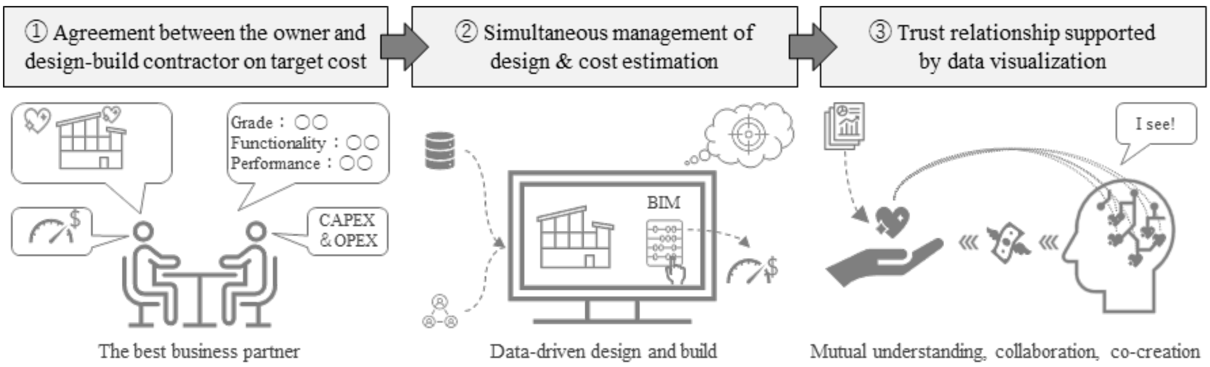

Figure 5: Tentative scheme image of TVD implementation

MODEL OVERLAY AND PROCESS IMPROVEMENT

The reference model for the TVD process has been repeated in the literature over the years, suggesting that it has become somewhat consolidated (see Ballard, 2008; Zimina et al., 2012; Tommelein & Ballard, 2016). In this research, we have adopted this reference model as a departing point and compared it against the current project process model, adjusting equivalent phases. The phases described in the current model follow the internal quality assurance system standards. For the sake of this study, that model has been simplified.

Many of the premises of TVD, including collaborative practices associated with IPD environments, are embedded in routine work in the current model. By default, the target price and the target cost are set early in the project but can be revised as the design evolves and teams are furnished with additional information. Productivity data accumulated and totalised by the engineering department over the years of construction practices pair with cost data maintained by the cost estimation department to provide the project team (mainly sales, planning, and design) with data to experiment with design alternatives and deliver quick trial calculations. As design evolves, quantities can be extracted from BIM models calibrated to delivery estimates.

Common data management infrastructure at the organisational level enables smoother data integration across applicable departments compared to external transactions ad-hoc, where interoperability protocols could be required. As the data platform continues to evolve, rounds of Value Engineering (VE) could earnestly occur inside each phase thanks to the simultaneous design and cost estimation rather than in stage gates. The expected consequence is the ability to conduct design with near-real-time cost simulations and enable the authentic "steer design to targets" through conformance check cycles.

Fig. 6 illustrates the adaptation of the reference model to a trial variant.

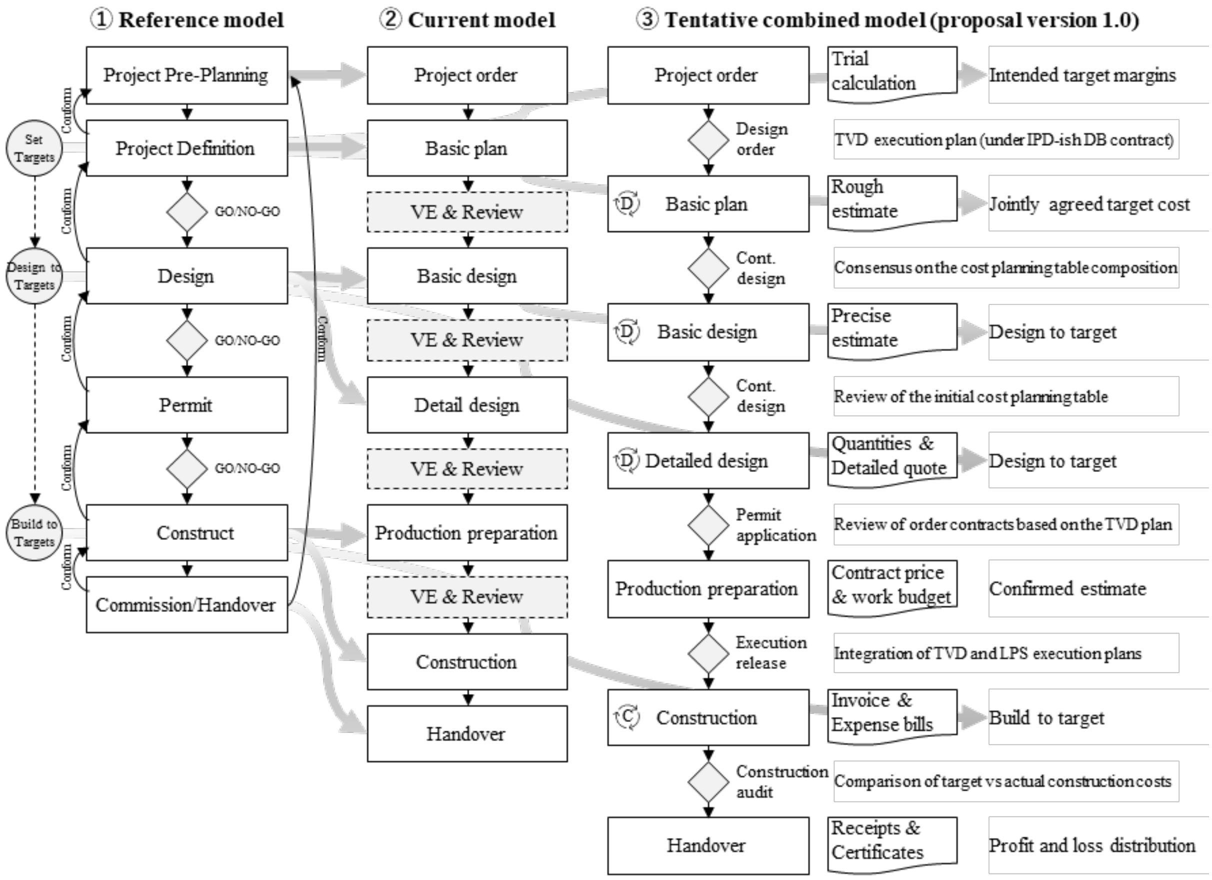

Figure 6: Adaptation of the TVD reference model to fit the existing internal process

TOWARD NEW MECHANISMS TO ADVANCE TVD

Design-build organisations can leverage the experience of past projects by referring to pieces of solutions that worked well to compose initial proposals (like in SBD). Design alternatives should be heuristically assessed, individually and collectively, against customer preferences "objectivised" by parameters and weights (like in CBA). Partial results are reinforced by technical data, computer simulation, and forecasts of fluctuating market conditions.

In conventional project structures, such as the case at hand, VE occurs as discrete events rather than a continuous effort to steer design to targets. A consequence is the high incidence of rework when the tentative design does not adhere to the targets, which could lead to potential quality deterioration in a desperate attempt to get back on track. Conducting cost simulations of incomplete designs, subject to changes, tends to cause anxiety to designers and work burden to quantity surveyors and cost estimators. Because of the workload, there are some determined points when totalisation is held, usually resulting in large quantity surveying and cost estimation work packages (i.e., prioritising resource efficiency rather than flow efficiency).

As in production, the lean principle of deploying small batches to create a "good flow" is applied here. The proposed model brings VE inside compliance check cycles, giving almost the impression it is not there. Systematisation is intended to make VE an ordinary thing without straining designers and estimators or at least reducing the stress level. Automation of cost simulations (not only quantity extractions but real-time visualisations of the impact of design changes) would not only speed up the process but contribute to increased design quality by creating room to explore alternatives in a data-informed process.

Even though experienced designers may have a "sense" of the impact of these changes, data visualisation provides them with the confidence to make decisions, creating room to focus on other value-adding activities, such as dedicating more time to understanding customer value and delivering responsive solutions. At the same, less experienced designers can accelerate their learning curve and nurture that "sense", relying less on team members' review and feedback.

Since TVD implies steering design to targets and assuring that construction costs meet target costs, an equivalent compliance check cycle for the production phase is also proposed. In the future state, a combination of technologies that grasp the current state and progress on-site help automatically record execution progress performance. Because in some design-build schemes, design decisions are only made after production starts, keeping track of executed costs is critical to adhering to targets.

Fig. 7 shows the expansion of the compliance check cycles from the broader workflow.

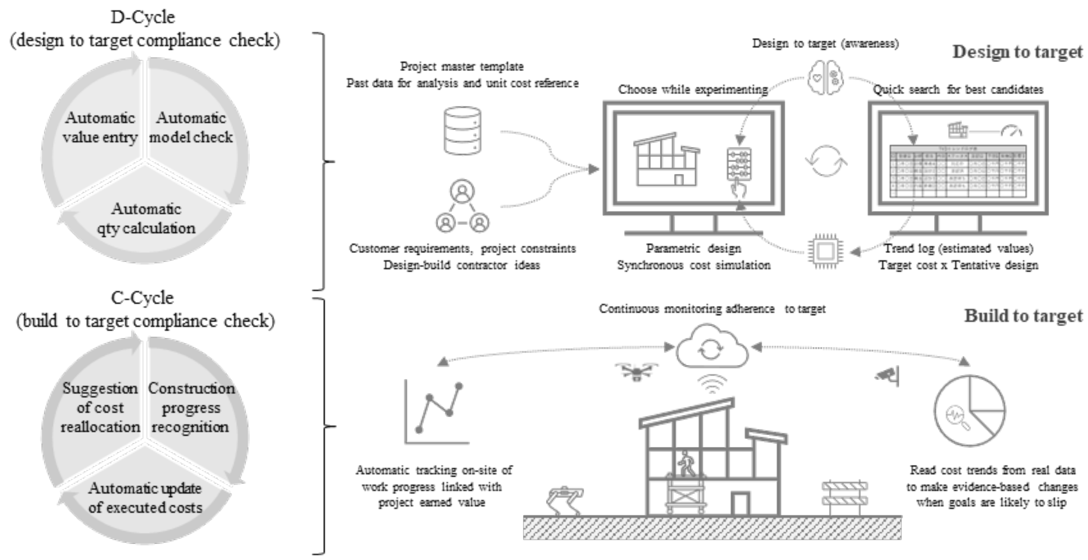

Figure 7: Conceptualisation of supporting mechanisms to realise a sound TVD process

DISCUSSION

Recently, general contractors in Japan have expressed their efforts to diversify contracting systems to satisfy increasingly diversified customer needs. Meanwhile, some large-scale design firms have claimed to start offering TVD services but do not necessarily refer to Lean Construction, at least on the surface. Coinciding features could arguably relate to a Japanese TQC/TQM heritage.

An opportunity for TVD, even among those initially sceptical about introducing "the new process", might relate to previous observations by Ballard et al. (2015) and Tillmann et al. (2017) that companies do not seem to be only after a profit but seek a long-term partnership with their clients, willing to work around the clients' constraints to make the project feasible, accepting a stretched starting point for a target cost.

When this research team started exploring the innovation opportunities with TVD, the provisional title of the initiative was "Toward a new style of integrated design-build that general contractors can provide". While there is hype on IPD, Partnering, Alliancing, and other derivates from overseas, a full-fledged integrated design-build has been successfully in place for an extended time and is an inherent part of the organisation's DNA. The closest relationship between the owner and the design-build entity, involving them throughout the design and construction processes, is an attractive part of IPD that could be assimilated by design-build contractors, even though there is no definite conclusion about the extent to which IPD (i.e., in the purest AIA's format) makes sense in such a structure.

Despite the limited diffusion of IPD in the Japanese construction sector, there are a few cases of IPD-like projects pulled by experienced foreign-affiliated owners. Still, it is believed that it will be challenging, though not impossible, to engage the entire construction ecosystem, including trades, that early in the process. At the present state of things, there are many reasons why subcontractors are not assigned from the very beginning, including technical and delivery capabilities whose requirements will only be clarified as the design progresses, seasonal workforce availability, and, finally, competition.

In this case, discussions about the risk-reward pool of IPD-like schemes produced different reactions. In actual projects, these issues are subject to how project participants' fees are set and how they traditionally make a profit. For instance, while there is an incentive for general contractors to be more productive and steer to targets, some trades might be accustomed to having their profits based on the amount of work. Thus, along with the ordering method, contract types must be revised. While the worth of a shift in the delivery system approach remains inconclusive, there is not much controversy on the will to innovate with contracts and improve processes. One possible trend is the effort to convert abstract process models into semi-induced routines by introducing systems and software applications that naturally guide ("enforce") project stakeholders to follow the process by the book with less drastic behavioural changes.

Indeed, the term Target Value Delivery (with Delivery as D) has been utilised in this paper after Ballard's argument: "The term 'target value delivery' is used instead of 'target costing' because the cost target is but a means to value delivery. The name 'target value design' is also rejected because it suggests that steering to targets only occurs in design (Ballard, 2020, p. 149)."

The C-cycle (production phase) of the proposed model is particularly relevant in Design-Build contexts (either single-entity or conventional). Many decisions with moderate to high impact on costs, such as finishing specifications, are only determined when construction works are already going on. The synchronisation of design-estimation-construction progress is essential to keep track of targets when cost planning is subject to change at later stages. Constructability considerations addressed by careful studies on construction method selection and site productivity enhanced by supply chain and logistics coordination are a large part of the proposed recipe.

Production decisions intertwined with design choices are enhanced by a conscious and programmed frontloading (i.e., intentional early-involvement efforts that bring production decisions in planning and design phases) intrinsic to the single-entity design-build structures. As per the MacLeamy curve, it is well-known that the earlier decisions are made, the easier they are to implement and cause less impact on cost, but the dynamics of projects may not always allow it (AIA, 2007).

Some C-cycle elements already exist and/or have been developed regardless of TVD. The point of the TVD variant model is to put together a plethora of elemental technologies into a unified package tailored to the intended project delivery scheme. For instance, various progress tracking, recording, and feedbacking systems leveraging Robotics, IoT, and AI could be used for data gathering, analysis, status communication, and action recommendations in a less human behaviour-dependent way, providing efficiency and neutrality to the workflow. Ultimately, the TVD variant offers a process style supporting experimentation and the realisation of alternative procurement methods holding less tested contract types and information-sharing mechanisms with fellow project stakeholders, including clients and subcontractors.

LIMITATIONS

The "tentative combined model" in this paper is essentially speculative. It has not been deployed in a full-scale project. The intent was to establish a departing point to position further technology development initiatives (i.e., systems that help operationalise the proposed automated mechanisms) and guide future process reforms inspired by Lean Construction methods. Finally, it has focused on the specific case of a single-entity design-build firm that may not fit companies with similar or different structures.

FUTURE WORK

As an extension of the identified limitations, future works include but are not limited to:

(1) Verify the proposed model in actual projects and refine it based on feedback from the field;
(2) Examine the generalisability and examine further adaptations of the proposed mode;
(3) Advance the conceptualisation of supporting mechanisms and move to development stage;
(4) Consider system integration with off-the-shelf and in-house developed applications.

CONCLUSION

This paper has explored TVD in the specific context of a general contractor holding full-fledged design departments - a different structure from cases reported overseas tending to pair TVD with IPD. While it had been reported that TVD could help sophisticate the project process by emphasising flow efficiency, potential hindrances are emerging from changes at various levels related to behaviour change dependency and data infrastructure for workflow automation. Iterations with engineers from multidisciplinary fields helped draw up a tentative framework. As a result of these iterations, the leading feedback was that abstract concepts entangled in the TVD could be challenging to convert into executable processes when over-relying on behaviour change by parties with different interests and priorities. In lieu, applications that somewhat forcibly yet friendly guide practices toward TVD processes could be effective. The main argument in favour of simultaneous management of design and cost estimation was the potential gain in transparency and agility in the process by having traceability of cost estimates give margin to participants, including the owner, the design-build entity, and the trades to be less conservative about estimation. The next step is operationalising the mechanisms in the proposed modified model that could serve as the basis for future systems development.

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