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MANAGING HUMAN-CENTERED INNOVATION WITHIN TVD IN HEALTHCARE PROJECTS

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ABSTRACT

Responsible for delivering major healthcare projects, the University of California in San Francisco (UCSF) has devised creative ways of reducing waste and increasing value through project delivery. In a previous paper, we described UCSF Health's journey to rethink project delivery practices. The adoption of Target Value Delivery (TVD) is a core enabler of their success. The University has consistently adopted TVD to deliver complex healthcare projects within or below their allowable costs. Previous papers have provided evidence and insights into why and how such success has been achieved. However, the focus so far has been on collaboration and cost management. This paper describes the strategies utilized to focus on and manage value generation. The term human-centered innovation was chosen to emphasize stakeholder engagement and empathy building as input to idea generation. This approach shaped how TVD is implemented in these case studies. Its analysis provided insights into complementary design and decision-making strategies traditionally used in TVD. In particular, the design strategies observed in this research expand the documentation of TVD best practices to include not only solution development strategies but also participatory and empathic ways of understanding, framing, and reframing design problems.

KEYWORDS

Target Value Design, Value Management, Value Generation, Integrated Project Delivery, and Healthcare Design.

INTRODUCTION

Target Value Design (TVD) is a lean design and construction method that focuses on achieving the target cost of a project while ensuring its quality, performance, and expected outcomes. In TVD, the cost is considered an input throughout the design process. Project teams steer the design process through trade-off decisions to achieve the target cost while maintaining the desired quality and expected performance.

Initially introduced in the manufacturing industry, the first time TVD was successfully adopted in the construction industry was in 2002, in the St. Olaf's College Project in Northfield, Minnesota, by the Boldt Company (Ballard; Reiser, 2004). Since then, the approach has increased in popularity and adoption in the U.S., generating lessons learned and best practices based on its practical application (e.g., Ballard, 2008; 2011).

The name TVD can be traced back to Toyota's Target costing approach. Target costing has been defined as a *"system of profit planning and cost management that is price-led, customer-focused, design-centered, and cross-functional*" (Ansari *et al*., 1997). Macomber et al. (2007) proposed a shift from "target cost" to "target value design" to emphasize that

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construction projects are not limited to cost and that the delivery of value to customers is paramount.

However, since its successful adoption in the early 2000s, its increased popularity has been associated with its ability to steer projects to meet or exceed financial performance successfully. Thus, its documentation in the literature focuses primarily on describing how those financial goals have been achieved in the different projects. At the same time, the aspects of managing value to customers are less explicit in the literature. Hence, the research question that motivated this study was: How can we improve value management within target value design to focus more on customer value (along with steering a project to a target cost)?

This paper aims to contribute to closing this gap by offering a perspective on managing human-centered innovation to focus on customer value. Such an approach has been successfully adopted within the application of TVD in multiple case studies. The term "human-centered innovation" was chosen to illustrate its focus on stakeholder engagement and participation in the TVD process. Human-centered design is a term often used to describe design philosophies and practices that offer a humanistic perspective on innovation theory and practice (Auernhamme & Roth, 2021).

The research method used in this paper is a multi-case study approach. Figure 1 summarizes the characteristics of all case studies. These case studies were selected because they successfully adopted TVD to deliver projects within their targets for costs, scope and performance, while adopting a unique approach to managing customer value. Data from the case studies started to be collected in 2013 through a research project. Data-gathering techniques changed over the years. From 2013-2016 data were collected by several researchers and graduate students from the UC Berkeley P2SL laboratory through interviews and document analysis. From 2016-2019 one of the researchers joined UCSF's Real Estate Department, changing data collection methods to focus group discussions, document analysis, and participant observation. In 2021, the same person joined one of the analyzed projects under UCSF Health, shifting data collection techniques to participant observation and interviews. This paper reflects on the data collected and insights gained over the years.

Table 1: Summary of Case Studies Characteristics

	Case 1	Case 2	Case 3	Case 4
	2005	2015	2015	2019
Contract Model[3]	**Modified CMAR**	**Modified DB**	**Modified CMAR**	**IFOA**
Initial Estimate	1.5 bi	275 mi	170 mi	4.5 bi
TVD Savings	200 mi	19 mi	TBD	TBD

A LOOK THROUGH THE LENSES OF HUMAN-CENTRISM

Human-centered design (HCD) is a term often used to describe design philosophies and practices that offer a humanistic perspective on innovation theory and practice (Auernhamme & Roth, 2021). This approach generally implies an active engagement of customers in the product development process (Dell'Era & Landoni, 2014). The concept of HCD is rooted in the belief that the design process should be centered on empathetic thinking and focused on the needs, perspectives, and experiences of the people who will use the design solution.

The empathic design was presented as a process that involved observation, data collection and analysis, and iterative prototyping. Most significantly, it was identified as a way to uncover people's unspoken latent needs and then address them through design (Leonard & Rayport, 1997). It relies heavily on ethnographic research methods to uncover not what people are doing

[3] CMAR – Construction Manager at Risk, DB – Design Build, IFOA – Integrated Form of Agreement

but also the reason behind their actions in an attempt to understand how people make sense of what they do (Diller, Steve; Shedroff, Nathan; Rhea, Darrell, 2005).

Beckman and Barry (2007) explain that HCD belongs to a second generation of design theories and methods that depart from traditional design approaches. On the one hand, the first generation leveraged operations research and optimization techniques, leading designers to think explicitly about how to decompose a complex problem into a set of smaller, well-defined problems, assuming that all these problems can be predicted, well-defined, and made explicit upfront. On the other hand, the second generation focuses on collaboration, co-creation, and leveraging the tacit knowledge of stakeholders, who are deeply engaged in the design process. The design then shifts from a clear-cut problem-solving process to a problem-formulating process in which getting to a collectively acceptable starting point (so that appropriate resources could be committed to solving the problem) is the core of the effort (Beckman & Barry, 2007).

There are several key differences between first and second-generation design theories and methods. Firstly, the designer takes on a facilitative role, guiding and supporting the stakeholders in the design process. Secondly, stakeholders' involvement changes from consultation to active participation in the design process. Thirdly, the design is iterative and flexible, allowing for multiple rounds of feedback and iteration, generally resulting in a solution shaped by the stakeholders' collective perspectives and experiences.

Based on human-centered design literature, Beckman (2022) developed an "innovation cycle," suggesting that human-centered innovation occurs in four quadrants within a learning cycle. This "innovation cycle" was used in this paper to guide empirical data collection and support the understanding of findings. Its four elements are described as follows (Quadrants 1 and 2 represent the "understanding the problem" or "why" portion of idea generation, whereas Quadrants 3 and 4 represent the "solution finding" or "how" portion of idea testing and implementation):

- Reflective observation and empathy building (Observe and notice - Quadrant 1): Fostering empathy for customers by considering their experiences and needs throughout the design process. Ethnographic research methods can help designers understand the emotional, social, and physical aspects of customer experiences.
- Abstract conceptualization (Frame and reframe - Quadrant 2): It is the understanding and synthesis of data gathered. It is the process of integrating different components to create new experiences. Frame and reframe is the process of getting to abstract conceptualization.
- Active experimentation (Imagine and design - Quadrant 3): Generating options and validating ideas through quick experiments. Iterating on the design solution based on feedback from stakeholders to ensure that the design meets their needs and requirements.
- Concrete experience (Make and experiment - Quadrant 4): Getting to the how. Materializing the ideas into artifacts or products. Testing it in the context of use.

Design theory and design methods are not topics covered in papers that describe best practices for TVD (i.e., Ballard 2008; 2011). By bringing this distinction between the first and second generations of design methods, the intent of this brief literature review was to highlight that different design approaches can support the adoption of TVD.

Past research has identified difficulties in applying tools associated with first-generation design methods, i.e., tools that aim to make all requirements explicit upfront (Sahadevan & Varghese, 2018) or to decompose problems into well-defined pieces (Lima et al., 2008). However, their theoretical underpinnings are rarely discussed. Similarly, several studies describe the successful adoption of methods and techniques that support dialogue and the collective understanding of problems-solution space, such as the collaboration that happens in multi-disciplinary design clusters, participatory design processes, set-based design, and Choosing-by-Advantages (CBA) (Ballard, 2011; Bascoul et al., 2018; Parrish & Tommelein,

2009; Arroyo, 2014). Although these approaches align with second-generation design theories, their theoretical underpinnings are rarely discussed. This literature review aimed to bring these distinctions to light so that these approaches and their contributions can be better understood from a theoretical standpoint.

EMPIRICAL FINDINGS

The University of California San Francisco (UCSF) is a public institution dedicated exclusively to health science. It focuses on research, education, and patient care, employing 3,400 faculty and 22,800 staff. UCSF generates nearly 43,000 jobs and has an $8.9 billion economic impact in the Bay Area, California, U.S.

UCSF Health is a department of UCSF focused on the delivery of care. It administers the University's hospitals and clinics: (a) UCSF Medical Center at Parnassus, Mount Zion, and Mission Bay; (b) UCSF Benioff Children's Hospitals in San Francisco and Oakland; and (c) Primary care and specialty clinics throughout Northern California. In addition, the department receives comprehensive project management services from UCSF Real Estate's Health Design & Construction unit, including programming and design, budget development, construction administration, inspection, and move-in assistance.

Since 2006, UCSF Real Estate's Health Design & Construction unit has undertaken a long journey to reshape project delivery practices within the University, introducing mechanisms to design, build and operate cutting-edge care facilities successfully. The University has chosen a very participatory route to deliver projects, which will be described in the following sessions.

1. The owner organization and key stakeholders

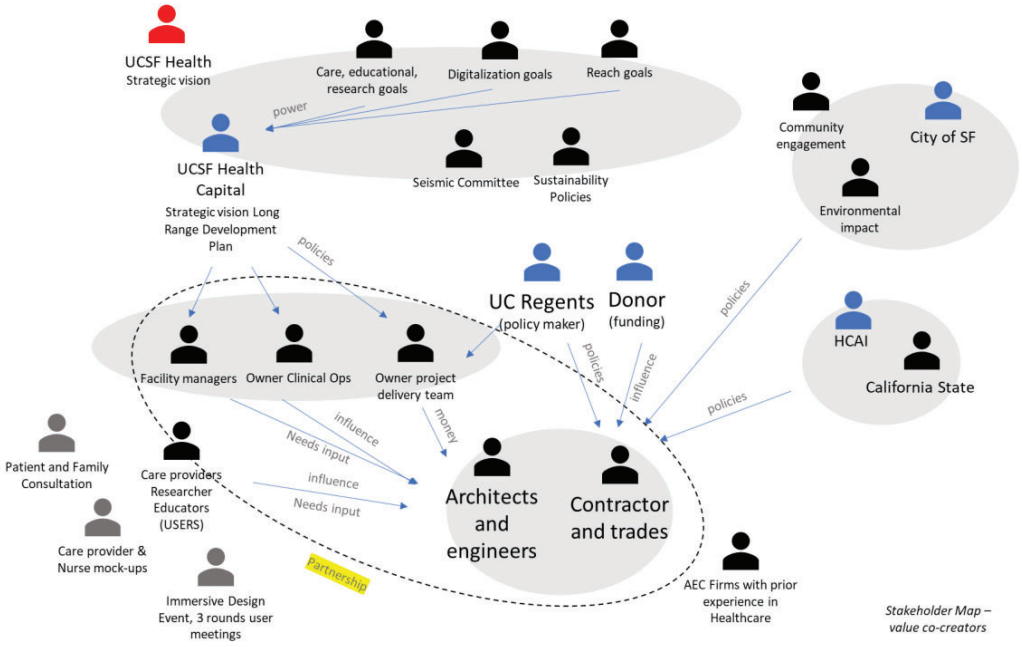

Figure 1: Key stakeholders involved (typical of all case studies)

There is a complex chain of stakeholders that influences the outcomes of a project. In these case studies, we have identified the following owner groups: (a) owner stakeholders who influence through their strategic vision for the organization and goals for the project, (b) owner clinical operations team, user groups, and patient representative groups that have more immediate requirements based on their current practice, (c) owner policy deployment teams, such as sustainability, seismic requirements, health policies compliance, etc. (d) owner technology

department; and (e) facilities management group. Outside the owner organization, several key stakeholders also influence the project: (a) the city's community engagement program, (b) the city's environmental requirements committee, (c) the healthcare seismic state agency, and (d) the city's code compliance agency. The type of influence each stakeholder brings is also identified in the picture. The types of influences were characterized by: (a) policymakers, (b) resource control, (c) decision-making power, and (d) required input due to the participatory nature of project delivery.

For each of these stakeholder groups presented in the picture, there are accompanying documents that aim to clarify their requirements and set the parameters for the project. The first type of document applies to several projects within that organization, and examples are seismic and sustainability policies, city codes, university guidelines for new construction, etc. The second type applies to this project and developed in the front end of project development (before the project team was onboard) – business case and programmatic requirements. Finally, the third type is developed by the project team to capture the input of key stakeholders – project charter and conditions of satisfaction, patient and user surveys, user feedback on prototypes, community engagement feedback, etc.

Despite the efforts to make all requirements explicit and documented, this environment is quite dynamic - non-identified stakeholders emerge, new individuals replace existing roles, circumstances surrounding the owner and their business change, and with that, multiple requirements emerge continuously through project delivery. That creates tension between explicit and tacit knowledge with a never-ending need to review and update what has been documented.

To deal with this dynamicity and tackle the tacit knowledge around stakeholder requirements, an integrated project delivery strategy has been adopted to support a participatory process. As portrayed in the picture, a partnership is formed between representatives from the owner organization, builders, and designers. Important to note that in this case, the owner organization is represented not only by the design and construction management team but also by the clinical operations, the information technology, and the facilities management department within the University. In the project directories, about 20% of the individuals are from the owner organization.

2. The project delivery strategy

In previous papers, the authors explained the strategies used in these projects to increase collaboration and integration in project delivery (Melo et al., 2015; Tillmann et al., 2022). Regardless of contract type, all projects benefited from mechanisms to increase relatedness among participants, mitigate diverging interests and align participants with acting as one single team. In this paper, these mechanisms are summarized into three categories (Figure 2):

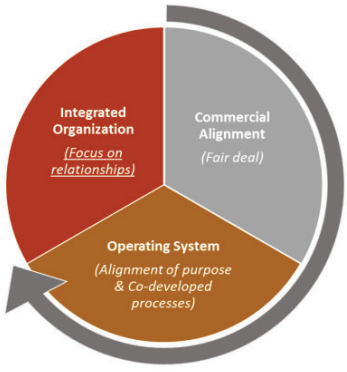

Figure 2: The three critical dimensions of collaborative project delivery

- Integrated organization (the ultimate goal): Co-location, multi-functional teams - the ultimate goal is to make companies behave like a single company with aligned objectives.
- Commercial alignment: sharing risks and rewards (when possible), being open about project finance, expected profit margin, and managing risks collectively.
- Operating system: Agreed upon routine and meeting cadence, Innovation in Design and Construction Center, Use of BIM for progress communication. Lean methods: Target Value Delivery and Last Planner System.

These mechanisms intend to focus on the relationship among parties and create a sense of unity in the purpose and processes of the project. This series of projects has been consistent with the successful application of Target Value Delivery, not only by meeting the target cost but also by meeting or exceeding programmatic and business case expectations.

The focus on value generation and value for customers was an expectation set since the early stages of all projects. In Case Study 1, for instance, the owner set the expectations for the team to *"make decisions by consensus but based on what is best for the project, not individual companies"* on Case 2, the selection process included the expectation that the team *"should work with the ultimate purpose to cure cancer"*; and on Case 4, the expectation set was that *"decisions are made based on what is best for patients."* During interviews, the owner explained that UCSF Health has a very easy-to-remember mission statement: Caring, Healing, Teaching, and Discovering. Those words are always mentioned when the team introduces themselves to potential partners during the selection process: *"This is who we are, and everything we do should always be to support this mission."*

One of the critical elements contributing to this focus on value is the project organizational structure and the owner-stakeholder integration. The projects are organized in Project Innovation Teams, multi-disciplinary cluster groups composed of designers, consultants, owner stakeholders, engineers, and builders. The owner stakeholders may also manage these clusters. In Case 4, for instance, out of the 12 PITs in the project, one is managed by the clinical, operational side of UCSF Health, acting as a liaison to UCSF clinical staff and users. Designers, builders, and consultants are also part of this PIT, gathering customer information, brainstorming design ideas, and developing options to validate with the different stakeholder groups.

In that same project, the other PITs were led by industry partners but also included the active participation of owner representatives, who helped co-design solutions and provided support to capture input from other stakeholder groups. For example, the MEP PIT was led by the general contractor but had the participation of owner representatives that engaged facilities management staff in providing information and feedback on design.

In Case 4, the decision-making structure also represented an integration of the owner's construction management team and the owner's clinical operations team, having seats on the Project Management Team and Senior Management Team and acting as liaisons to the University's leadership group.

An analysis of this team's weekly routine provided insight into how such a structure is operated. During a typical week, the team spent: (a) 50% of the time on Project Innovation meetings - generating ideas, discussing requirements, and resolving interdependencies or conflicts; (b) 25% of time consulting stakeholders and receiving feedback on ideas; (c) 12 % of time coordinating specialty work and solving interdependencies among systems; (d) 10% of the time on meetings to make decisions, and (e) 8% of the time on deploying strategies to improve team's culture. Naturally, these percentages will change depending on the project phase, but this snapshot illustrates how this structure works during the early design development phases.

3. TVD and the adoption of human-centered innovation strategies

All case studies followed a similar TVD process, which is comprehensively described by Melo et al. (2015). In this session, the specific items that refer to managing customer value and customer requirements are described. Beckman's "innovation cycle" described in the literature review was used here to provide a framework to analyze the findings. Below is a list of strategies observed in the projects, categorized according to the four quadrants of the innovation cycle:

a) Reflective observation and empathy building (observe and notice):
   - Hybrid team of owner stakeholders and industry practitioners engaged from early project stages. That allows project participants to build empathy and understand better the why behind requests, preferences, decisions, and also limitations or consequences of their requests;
   - A validation study that is carried out collaboratively by this hybrid team;
   - Owner stakeholders as an integral part of the team – i.e., managing PITs for idea creation, evaluation, and liaison with other stakeholders with a strong message around the expectations to focus on what is best for patients;
   - Active participation of key external stakeholders in idea creation (i.e., permitting agencies, inspector), who are dedicated exclusively to the project and act as an integral part of the team;
   - Extensive stakeholder consultation throughout the different phases of design, which in this case includes patients, users, donors, owner leadership, city community, regulatory agencies, etc.; and
   - ICDC Academy, a series of presentations by UCSF clinical staff and other critical stakeholders in the big room, allows the team to engage with them and ask questions about their work and expectations regarding the project. The academy generally starts at the end of validation and runs throughout the construction phase, allowing for empathy building by those working in the field. Interviewees have expressed that this emphasis supports team building as it creates a unified culture driven by a greater purpose.

b) Abstract conceptualization (a collective effort of framing and reframing the problem)
   - Multidisciplinary Project Innovation Teams with owner stakeholders' involvement, where most of the ideation process happens. Here ideas are discussed, often leading to a co-designed solution;
   - Multi-disciplinary innovation, which is (temporary) workshops set up anytime the team needs to extend the time spent on PITs to further frame and reframe the problem and solutions with a specific scope (these meetings can be initiated by any team member – including owner stakeholders); and
   - Some strategies help the team to set the boundaries for problem framing and reframing. Examples are: (a) cost modeling methods, (b) design constraints to support pre-fabrication and easiness of logistics and installation, (c) project priorities represented in the project Conditions of Satisfaction; and (d) defined priorities for the decision-making process that is collectively defined by the integrated team (or discussion of factors to be considered during CBA processes).

c) Active experimentation and validation (imagine and co-design)
   - Cloud-based Innovation Log, this is a tank of ideas that all team members have access to and can contribute with ideas;
   - Set-based design, used to mature certain areas where the team sees multiple options could bring similar benefits to the project;

- Immersive Design Events are examples of workshops held to dive deeper into the needs and preferences of clinical staff and validate some of the designer's early assumptions. Also in that category are patient surveys built around design options and virtual mock-ups built early to validate some operational workflows with staff;
- CBAs and A3s are used as methods for presenting and discussing ideas; and
- Physical mock-ups, virtual mock-ups, and virtual reality are used to validate ideas and assumptions.

d) Concrete experimentation (make and experiment)[4]

- Value engineering here means design options that were validated and decided on but had to be revisited as saving opportunities emerged, indicating that the team learned something new. Based on this new information, that design should be revisited.
- Continuous estimating was placed here to illustrate a similar point. Options are sometimes drawn first and only later sent to estimators for cost input, who provide feedback. The team then learns about new cost implications and revisits the design seeking alternative solutions.

The picture below represents the observed initiatives displayed in the four quadrants of the innovation cycle (adapted from Beckman, 2022). This picture also distinguishes between the strategies observed in these case studies and typical strategies used in the application of TVD.

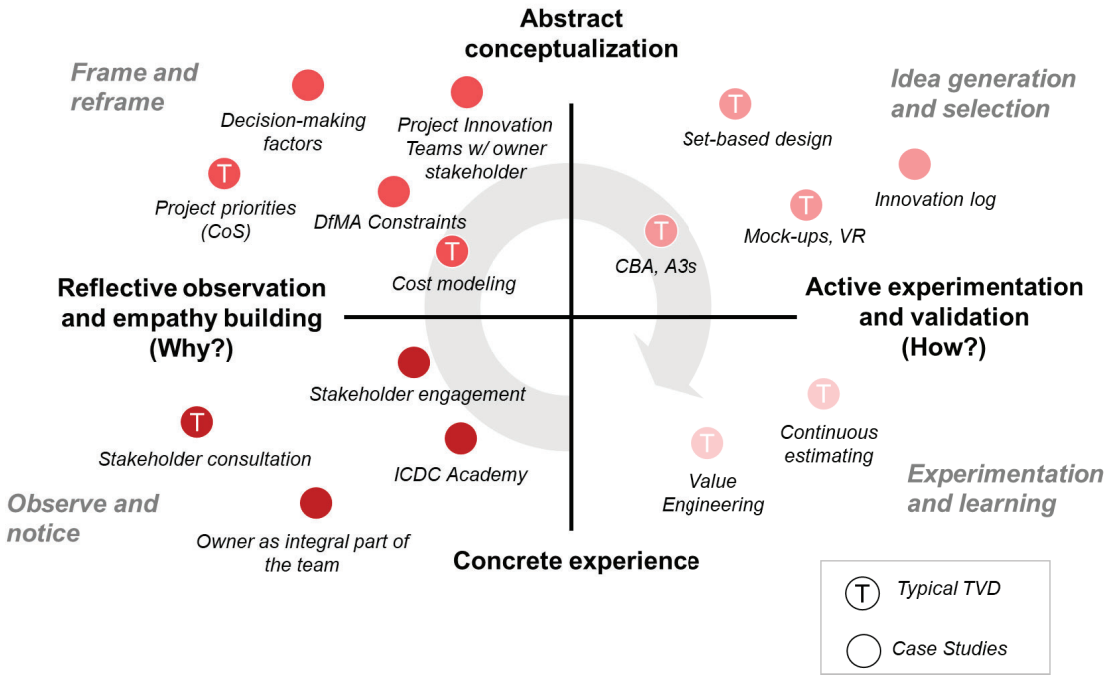

Figure 3: Human-centered innovation strategies used within TVD (Adapted from Beckman 2022)

DISCUSSION

Based on a human-centered approach to innovation proposed by Beckman (2022), the strategies to focus on and manage customer value were analyzed in the case studies. These cases illustrated mechanisms to engage customers in the crucial stages of the human-centered approach: (a) solution development (Quadrants 3 and 4) and (b) problem definition (Quadrants

[4] Concrete experimentation should be understood in this study as the crystallization of a design solution and subsequent documentation on the final set of drawings.

1 and 2). The examples ranged from typical approaches to more unique approaches. Some of the unique approaches include the ICDC academy, with the ultimate purpose of connecting people for empathy building. Another unique approach was the participation of owner team members in the day-to-day management of requirements capturing, idea generation, evaluation, and selection (as opposed to only participating in the evaluation and selection of ideas). In addition, other unique mechanisms were identified during the problem framing and reframing stage. For example, constraints that are discussed on a conceptual level, such as parameters for pre-fabrication, the project's agreed conditions of satisfaction, or even a high-level discussion about the factors to be considered during decision-making. Those serve as guardrails to support problem framing and reframing.

More traditional techniques and methods used on TVD were also observed. This study categorized continuous cost estimating and value engineering as steps pertaining to the fourth quadrant. The reason for that is because they often happen when there was a need to revisit a solution that was already generated or solve emerging issues based on new learnings before setting the final decision. Displaying these mechanisms on the innovation cycle enabled the realization that current best practices for TVD generally fall into the *"idea generation and selection"* and *"experimentation and learning"* categories of the innovation cycle, whereas the unique ones observed in this research can be placed in the *"observe and notice"* and *"frame and reframe"* categories of the cycle. This finding indicates that these unique ideas might bring a complementary perspective to the current best practices of TVD. Also, due to their focus on the "Why" and a deep understanding of customer needs, they represent a greater emphasis on value generation and provide evidence that these approaches can be successfully implemented within TVD while also achieving financial targets.

From a theoretical perspective, this research also corroborates with findings from many previous studies (Ballard, 2011; Bascoul et al., 2018; Parrish & Tommelein, 2009; Arroyo, 2014) that describe the benefits of adopting methods and techniques that support dialogue and the collective understanding of problems-solution space. Thus, building on previous research findings, this paper provides insights on how TVD adoption can be enhanced from the perspective of managing customer value, specifically in what relates to the use of methods and techniques that fall in the second generation of design theories.

CONCLUSIONS AND FUTURE RESEARCH

The research question that motivated this study was: How can we improve value management within target value design to focus more on customer value (along with steering a project to a target cost)? This paper aimed to answer that question by offering a perspective on managing human-centered innovation to focus on customer value during the application of TVD. The journey of UCSF Health to rethink its project delivery methods to focus on value included adopting several strategies related to a humanistic approach to design. This approach shaped how TVD is implemented in these case studies. Its analysis provided insights into complementary design and decision-making strategies traditionally used in TVD. In particular, the design strategies observed in this research expand TVD best practices to include participatory and empathic ways of understanding, framing, and reframing design problems. This research also provided evidence that these approaches can be successfully implemented within TVD to improve customer value without compromising the achievement of financial targets. Finally, this research shows that human aspects of design theories may bring underlying contributions to the construction management discipline, which might not be fully understood and deserves further investigation.

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