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Evaluation of Target Value Delivery and Opportunity Management as Complementary Practices

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Abstract: Opportunity management and Target Value Delivery (TVD) have both been studied extensively but separately. The two approaches have been presented as solutions for increasing value in a project for the owner and users. However, it seems there has not been much research that addresses the link between the two approaches. The purpose of this study is to increase knowledge of how TVD can facilitate opportunity management. The results from a literature review are compared with the practice in two cases: TVD in a large infrastructure project and opportunity management in a large building project. The results from the building project showed a lack of inherent motivation for change and innovation in the project organization. The identified opportunities were aimed mainly at maximizing the project's operational value and keeping costs within the approved budget. TVD seems to handle this with extensive attention to maintain value for the end-users. Besides, the target cost element of TVD seems to complement opportunity management by creating incentives to be flexible about change and innovation. This paper's originality is to combine two well-established approaches that have many similarities but have yet to be explored in relation to each other.

Keywords: flexibility; lean construction; opportunity management; target value delivery

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1. Introduction

There seems to be a paucity of research that looks at opportunity management and Target Value Delivery (TVD) simultaneously, according to a scoping review that mapped links between the two approaches. This paper sets out to fill that gap.

It is well established that an uncertain event or condition in a project may affect its goal [1]. According to Johansen et al. [2], uncertainty can have an upside as well as a downside. The downsides can be called risks or threats, and usually, that is the part of uncertainty that attracts attention. The upside, opportunity, has unexploited potential from increasing the attention paid in both the design phase and the execution phase of most projects [2]. Opportunity management is about addressing uncertainty that may positively affect the project's end goal. Opportunities are closely related to innovation and change, and flexibility is needed if the project is to harvest any of the identified opportunities. However, the willingness of different stakeholders to innovate and change depends on their incentives. For instance, contractors in projects with transactional delivery models have limited incentives for flexibility in the execution phase [3]. Krane et al. [4] state that projects generally neglect opportunity hunting in the execution phase.

In TVD, risk and reward are shared, and there is closer collaboration between project actors than in project delivery models with transactional contracting. However, there also seems not to be much literature regarding how uncertainty management and lean construction tools and principles can complement each other [5,6]. Ballard [7] mentions a reduced barrier for innovation as one of the benefits of TVD. Still, former studies of TVD do not explicitly mention opportunities, even though it seems as though the essence of

that approach is to be open to opportunity management and to exploit project opportunities. This paper aims to explore whether there is a natural relation between opportunity management and Target Value Delivery.

Uncertainty in projects can have both positive and negative impacts on project parameters such as cost, time, quality, and environmental issues [8]. While risk management is about handling the elements that may harm the project's end goal, opportunity management is about handling the elements that will contribute to reaching the end goal. According to Flyvbjerg et al. [9], there is a high degree of uncertainty inherent in large construction projects. Davies et al. [10] argue that innovation is often avoided in large construction projects because of the risk that costs might increase. As in other industries, innovation is important for construction [11], and the industry sees ongoing changes from technologies such as 3D printing [12], drones, automated equipment such as robots and wireless sensors [13], and building information modeling (BIM) in particular. However, studies show that the industry must innovate at a higher speed [12,14], as the construction industry has an international tendency to lag in adopting innovation compared to other industries [15,16]. Instead of seeking novel ideas and innovative approaches, project managers aim to minimize threats [11,12]. This means relying on tried-and-tested techniques, established routines, and proven technologies [14]. The potential for innovation eventually suffers because of a focus on avoiding threats. An uncertainty management strategy that pays more attention to opportunities can be vital for exploiting the innovation potential. Still, projects are generally conservative about seeking new opportunities, especially in the execution phase [4]. The construction of Norway's new National Museum is an example of a large construction project that paid attention to opportunities in the execution phase. After falling behind on cost and time early in that phase, the project leaders decided to develop an uncertainty management strategy paying greater attention to opportunities [17]. This significantly increased the number of opportunities identified and exploited during the execution phase.

Flexibility for innovation and change is needed when practicing opportunity management. Olsson [3] argues that stakeholders' opinions on flexibility seem to be related to their incentives. Stakeholders who have incentives related to the project's end purpose are generally open to flexibility. In contrast, stakeholders with incentives linked to the project's outcome are increasingly likely to have a negative orientation to flexibility. Project management and owners value flexibility in the front-end phase, but they become less positive as the project moves to the design phase, and they are usually negative about flexibility in the execution phase.

Flexibility has value for the stakeholders that benefit from changes and the late locking of projects. At the same time, it is seen as a disadvantage for the stakeholders that must adapt by waiting and reworking. A lean construction mindset can secure more substantial incentives to implement change for the stakeholders who experience the disadvantages of flexibility in projects.

In the traditional view, time and cost usually increase through change orders (change of contractual time and cost) or for unforeseen reasons (change of actual time and cost). The collaboration between clients and contractors is based on contractual thinking where the actors have different, often contradicting, incentives. This ultimately leads to silo thinking. Lean construction is a set of principles and practices that have emerged to keep a project within the owner's project constraints. Tzortzopoulos et al. [18] highlight TVD along with concurrent engineering (CE), integrated project delivery (IPD), benefits realization, and building information modeling (BIM), as the significant product development approaches emerging from lean construction. According to Ballard [7], TVD reduces the barrier to innovation through shared risk and reward and challenging but achievable delivery targets. Do et al. [19] argue that several forces are likely to drive up the total costs in all projects but that specific tools and behaviors within TVD counteract some of these forces and ultimately drive down project costs. With TVD, a project can shape its future rather than pursuing

targets based on early predictions. The method creates a common goal for the client and contractor, and it establishes a basis for closer collaboration.

This paper seeks to investigate if there is a natural relation between opportunity management and Target Value Delivery. The purpose of the paper is to increase knowledge of how TVD can facilitate opportunity management. Thus, the research question for this paper is:

RQ: *How can TVD and opportunity management complement each other to generate and maintain value in projects?*

The paper is divided into the following sections. First is a description of TVD, emphasizing target costing and what different stakeholders find valuable in a project. Second, theory on opportunity management is presented, emphasizing why opportunities may be neglected and how different stakeholders see an opportunity differently. Next is a description of the method and research design used. After that, the results from two case studies are presented: a Norwegian infrastructure project that used TVD as a central part of its delivery and a building project in which opportunity management was implemented. Finally, the results from the case studies are discussed, and a conclusion is provided.

1.1. Target Value Delivery (TVD)

TVD was introduced as "Target Value Design" in the early 2000s. Ballard [7] argues that "Target Value Delivery" should be used instead of "Target Value Design". The latter suggests that the mindset is limited to the design phase, while the former includes the whole delivery process. "Target Value Delivery" should also be used instead of target costing (TC) since TVD is a development of TC which focuses on value rather than on cost alone, and where the relevant features of TC were adapted to fit the construction context [20]. Based on the above, this paper uses "Target Value Delivery" as the preferred term for this concept. Like TC, TVD is focused on cost mechanisms, but it pays more attention to generating value throughout a project [21]. The *value* term in TVD includes the sustainable elements of economic value, environmental value, social value, safety, and time and is thus about more than just economic value [7].

The TFV theory proposed by Koskela [22] highlights three different conceptualizations of production: transformation (T), flow (F), and value generation (V). The transformation concept of production highlights the changes achieved by resources, workers, machines, etc. It is about converting one set of resources into another set of new resources [23]. The flow concept of production focuses, e.g., on reducing waste [24] and calls attention to the movement of material toward the input, the application of resources to the project, and the development of the project as a whole. The value generation concept of production is customer-oriented and emphasizes designing products that fulfill the customers' requirements [25]. According to Gomes Miron et al. [21], the value concept can be approached from two different directions: the value added by the transformation (T) or the value generated by the interaction between client and supplier (V).

Ballard [7] highlights set-based design, choosing by advantages, and A3 reports as lean methods for steering to targets in the design phase. Another fundamental concept of TVD comes from value engineering and the search for alternative components in product development. According to Ballard et al. [26], construction projects are becoming more complex and uncertain, and they are pushed to move faster. Those authors emphasize the importance of relational contracting and early contractor involvement (ECI) to cope with some of these challenges.

Russell-Smith, et al. [27] call for more attention to methods that assess a building's life cycle energy and environmental impacts. Projects today face several sustainability challenges: protecting nature, reducing CO_2 emissions, recycling materials and goods, and the use and transportation of materials [28]. Novak [29] discusses how TVD can generate greater delivery of sustainability values. Russell-Smith, et al. [30] propose to combine life cycle assessment and TVD to produce more sustainable building designs to

perform at higher environmental standards. Reducing waste is central to lean construction. Schoeman et al. [31] propose value stream mapping (VSM) as a practical tool to identify opportunities and challenges in waste management operations. Orihuela et al. use VSM to present an opportunity protocol, and they use cost structure to promote TVD for project design teams [32]. Torp et al. [6] propose a conceptual model where uncertainty management and the Last Planner System are integrated.

1.1.1. Setting a Cost Target

In the traditional view, the project cost is based on the sum of the cost of work and profit. In TVD, however, this is reversed as the project sets a target cost, which is based on what the project outcome is worth (value). When the cost of work decreases, the profit increases. Figure 1 compares the cost mechanisms in TVD with the traditional approach.

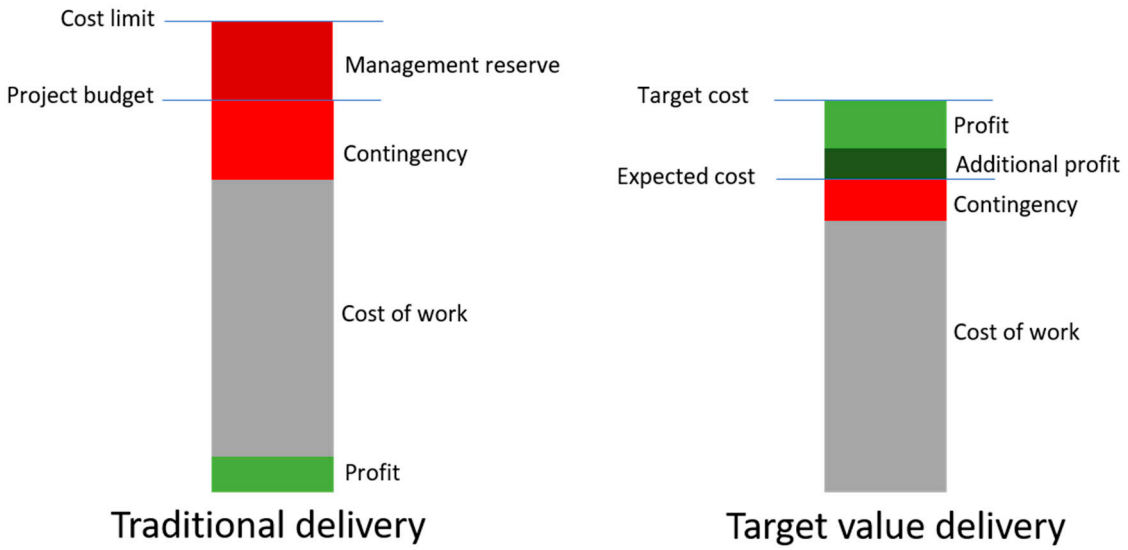

Figure 1. Cost mechanisms in traditional delivery vs. target value delivery, based on Do et al. [19].

Several aspects affect the total project cost. Do et al. [19] investigated 47 different TVD projects, and they showed that implementing TVD reduces the likelihood of cost overruns and it reduces the contingency percentage in the project budget compared to the non-TVD projects. They mention trust, collaboration, early involvement of contractors, cross-disciplinary problem-solving, and transparency as examples of sources that drive down the project cost. Uncertainty, miscommunication, and miscoordination are examples of forces that drive up costs and are present in all projects, including TVD projects.

Project budgets normally include a contingency to handle uncertainty. Torp et al. [33] discuss different uses of the word "contingency", and they conclude that it could be divided into a project management reserve (expected to be used) and a project owner's management reserve, not expected to be used unless something unexpected happens. In traditional delivery, profit is included in the total budget as the cost of work and a project management reserve (contingency). On top of this, there is a project owner's management reserve (management reserve), which should not be touched unless there are severe unexpected events. However, because of risks leading to increased cost, some of this reserve is often used. Studies show that the traditional transactional way of conducting projects often leads to a final cost that exceeds the project budget. Flyvbjerg et al. discuss the "iron law of megaprojects", which suggests that large construction and infrastructure projects, public and private, more often than not, are over budget, over time, under benefits, over and over again [9]. The work by Flyvbjerg and colleagues has been challenged by Love and Ahiaga-Dagbui [34]. According to Flyvbjerg [31], approximately one to eight in a thousand megaprojects will realize the promised benefits while being within the time and budget. The easiest way to solve cost overruns is to have a more generous project budget. However,

a project budget that is too generous with money and management reserves may result in spending money beyond the project scope and delivering higher quality than what is necessary. This is also called "gold plating", and in the worst case, it means reduced efficiency [2]. Besides, this approach reduces incentives for the project to produce novel ideas and innovations.

In TVD, the owner defines the allowable cost, the maximum amount of money the owner is willing to spend on the project. The project team determines the expected cost, which is based on the market price. Torp [35] argues that the main challenges with cost estimates seem to be: the composition of the estimation team, the level of detail in the estimation model, lack of focus on opportunities, underestimation of uncertainty, and underestimation of expected cost. He argues that an uncertainty analysis should be conducted to decide the correct expected cost. If the allowable cost is larger than or equal to the expected cost, the project can proceed. Then, the owner and contractor agree on a target cost for the project. The goal is to drive down the expected cost of the project by implementing different TVD measures to reach the target cost. However, the target cost is merely a metric to define how much profit the project team will earn. This means that the cost could be reduced even more and give the project team more profit. Likewise, if the actual cost exceeds the target cost, the profit decreases. The target cost gives the project team a clear incentive to reduce the cost of work.

In traditional delivery models, the profit is decided beforehand, so project teams have no real incentives to stop gold plating. The TVD approach, on the other hand, gives the project team incentives to avoid spending money unnecessarily and beyond the project scope, since lower costs increase the contractor's profits. It is crucial for the owner and the end-users that the value of the final product is not affected by the hunt for reduced cost of work. TVD tries to cope with these conflicting viewpoints by highlighting the importance of trust, collaboration, early involvement of contractors, cross-disciplinary problem-solving, and transparency in projects.

Rolstadås and Johansen [28] argue that projects are about value, and that value is more than successfully delivering a complex project in terms of time, cost, and quality. Value is what connects projects with a long-term effect on society and organizations. Sustainably managing a project creates long-term effects and greater value for society and project owners.

Industries have gradually adopted a more sustainable project approach during the last decade. Construction sites claiming to be CO_2 neutral and environmentally concerned have become part of the decision-making process for many new projects. However, this change has happened slowly, and it can be argued that it is not at a pace that solves climate change. The green revolution will create new jobs and new industries, but it will also introduce new risks regarding being safe in our towns, having enough fresh water, building more cities, and using more material, while not compromising the UN's 1.5 °C goals. Sustainability should be considered when determining value in a TVD process.

1.1.2. Value for Whom?

The value expectations of different stakeholders are defined at the front end of projects. Many viewpoints affect how a project should deliver and capture value [36]. There are many definitions of value in the literature, but a comprehensive assessment of the term is outside the scope of this paper. Drevland [37] (p. 45) offers this definition of value:

"Value is the result of an evaluative judgement. This judgment is guided by values and based on the evaluator's knowledge at hand. It is always based on comparing two or more alternatives in a given context. This context envelops all get and give consequences for a particular party from a decision made on the basis of the value judgement. The get and give consequences are always in the form of gained or lost experiences or expressed in monetary terms as a placeholder for experiences. The consequences are not summative; the value judgement is done by considering them all at once".

Generating value for customers and users is an elementary component of a sustainable strategy. Therefore, it is essential for success that contractors understand and support the client's business idea [38]. According to Drevland [37], value is based on three different motivations: transactional, selfish, and altruistic. Transactional motivation is usually based on a formal agreement. Parties often have a selfish motivation, so they try to exploit any ambiguities to increase value for themselves, avoid future liabilities by delivering value to protect themselves, and maintain good relationships and reputation for future business. Lastly, value is sometimes delivered simply for altruistic reasons (e.g., corporate social responsibility). Drevland [37] discusses what is valuable for different actors in construction projects:

- Owners: product factors such as investment cost, operating cost, usability, business cost, business outcome, image and identity, a building's ability to adapt to changes in infrastructure and processes, and disposability. Process factors include transaction costs, education, and user buy-in (acceptance of new ways of working).
- Individual users: usability for their specific purpose, education, and user buy-in.
- Designers, builders, and suppliers: product factors such as profit through maximized trade-off, image and identity, and buildability and constructability. Process factors such as the reliable release of work between work crews and safety on-site.
- Society as a whole: product factors such as usability, employment, tax revenue, infrastructure and service capacity, scarce resources, and environmental impact. It also includes process factors, such as usability (e.g., how it affects the surroundings during construction), safety, and employment.

With so many stakeholders involved in construction projects, it is evident that the motivation behind value delivery will vary for each stakeholder, and it is likely to cause conflicts. For instance, when a contractor pursues a maximal trade-off for themselves, a specific action can be performed at the expense of user value. The TVD approach tries to deal with this by always putting user and customer value at the core. Closer collaboration throughout the project ensures that the project does not slip off course.

Whenever a party (the principal) depends on another party (the agent) to undertake a task on the principal's behalf, a principal–agency relationship is formed [39]. The project performance is affected by how well the principal (i.e., project owner/client) and agent (i.e., project manager/contractor) co-operate. According to Müller and Turner [40], the best project performance is obtained through a collaborative approach with a partnership between principal and agent, medium levels of structure, and an empowered principal. This creates a trustful relationship, gives the agent authority to deal with uncertainty, yet retains some control for the principal. However, this is not easy to obtain, and tension occurs when the principal creates a culture of inflexibility and control over their projects, based on a fear of the agent undertaking the project to maximize utility in their interest.

Turner and Müller [41] propose a communications strategy to curb hostile environments. They argue that the best results are achieved by balancing formal and informal communication, holding regular face-to-face meetings, and analyzing quantitative data where appropriate and as required by the client. Ding et al. [42] have studied the optimal added value sharing ratio in a target cost contract project in a principal–agent relation. They argue that the added-value-sharing model is complex, but it suggests that the owner should determine a sharing ratio at the time of bidding and that potential bidders respond accordingly and reflect their attitude to risk in the bid price.

1.1.3. Experiences from Norwegian Projects

A limited amount of research has been conducted on projects where target costing and target value design have been used in the Norwegian construction and infrastructure industry, as these are still relatively new practices there. However, some research indicates that processes related to determining the target cost have been demanded in TVD and non-TVD projects [35,43–45]. The challenges recorded included the following:

- There were high conflict levels between client and contractor when deciding the target price [35,45].
- There was inexperience with the TVD approach [35,43].
- The clients performed a rough cost estimation, while the contractors performed a detailed cost estimation. This caused a gap between the estimates [44].
- It was a prerequisite for contractors who took part in the procurement competition to deliver within the target cost. Still, after a contractor was chosen, a more detailed cost estimation showed that they could not deliver within what they promised after all [43].
- There was a lack of transparency as to how numbers were estimated, even in projects with an open-book approach [43,44].
- Owners and contractors disagreed on how much overhead and contingencies should be added by contractors and subcontractors [45].

The research insinuates that project teams should be aware of potential drawbacks, especially until more experience is gained regarding this relatively new practice in the Norwegian construction and infrastructure industry.

1.2. Opportunity Management

The use of the terms risk and uncertainty seem to be inconsistent in the literature. In traditional project management theory, risk management is applied to managing both opportunities and threats. The Project Management Institute, for instance, defines risk as an uncertain event or condition that may have a positive or negative effect on a project's goal [1]. However, some authors believe that risk is an insufficient term because it is heavily associated with a project's possible unfortunate effects. Perminova et al. [46] argue that the terms risk and uncertainty should not be managed similarly because many traditional risk management tools and techniques are more effective when coping with threats than when handling both opportunities and threats. This study aims to strengthen opportunity management theory, so this paper adopts the term uncertainty to include both positive uncertainty (opportunities) and negative uncertainty (risks and threats) in a project's design and execution. This is aligned with theories that claim that uncertainty management creates a more balanced approach than risk management when talking about managing both threats and opportunities [2,47]. The contention is that a change of perspective from risk to uncertainty enhances opportunity management and creates a more balanced approach to uncertainty management. Torp et al. [6] argue that, in terms of lean construction, the opportunity perspective can be expressed as waste reduction or increase in value.

1.2.1. Why Is Opportunity Management Neglected?

Klakegg argues that opportunities often remain unexploited, even though the theory considers risks and opportunities as equally important [48]. To cope with the high degree of uncertainty inherent in projects, uncertainty management must play a vital role. There are several possible explanations why opportunity management is not prioritized in projects [49]. Some of them are listed below:

- The existing techniques, routines, and technologies focus on mitigating or removing threats [50].
- Pursuing an opportunity could be costly and time-consuming. There is the possibility that the effort needed to harvest an opportunity exceeds the potential benefits [2].
- If the project is likely to meet the predefined cost, schedule, and specifications, there is limited motivation for changing the course [17].
- Individuals commonly worry more about threats than they search for opportunities [4].
- "Bad is stronger than good". Baumeister et al. [51] show that people are more motivated to avoid adverse events than to pursue good ones.

Lovallo et al. [52] write that managers routinely reject risky ideas and favor marginal and "safe" investments. They further argue that project managers are more risk-averse than CEOs, as the CEOs consider the investments in the context of a bigger portfolio. The

central assumption in the theory of loss aversion is that threats have a more significant impact on people than opportunities. That is, the psychological impact on a person from the risk of losing a certain amount of money is, given the same probability, higher than the opposite psychological effect of winning the same amount of money [53].

1.2.2. Opportunities for Whom?

Like value, opportunities can be seen differently, depending on the viewpoint. According to Johansen et al. [2], in every project there are three major groups of primary stakeholders who have different viewpoints:

- The project owners may take four different roles. The asset owner represents the owner's organization and evaluates the business case against available funding and resources (portfolio management). The project executive officer is a part of the owner's organization responsible for a single project's governance. The sponsor provides funding for the project, and there are the users of the final product.
- The organization managing the project has a project manager, who is the single point of contact with the owner through the project executive officer. It contains both the internal project team and external suppliers and contractors, and it is responsible for delivering the project results.
- External persons or organizations include primary and secondary stakeholders affected by or affecting the project. This includes authorities, resource owners, service providers, and the media.

Krane et al. [54] argue that internal conflicts between the project owner (principal) and the project manager (agent) are often overlooked in risk management. The project management team tends to have a short-term focus on operational risks, while the project owner has a strategic mindset. The researchers found that risks to strategic objectives were not prioritized, even though they were more numerous than the operational risks. They also assumed that neglecting strategic risk affects how well the strategic objectives are achieved.

Tversky and Kahneman [55] argue that the perception of different alternatives when analyzing uncertainty is affected by the reference point and by whether the participant uses an intuitive or a more analytical approach when analyzing opportunities. This means that the choice of chasing an opportunity and the benefits from the opportunity can be perceived differently by different project actors. For instance, within the project organization, an architect could feel strong ownership of how the construction is designed and resist changing the architectural design more than the contractor might. On the other hand, the contractor would value improved buildability, so that the building process could be more efficient [37]. Furthermore, an opportunity that may increase the cost could be seen as critical by small actors but insignificant by those with large financial muscles. Olsson [3] argues that flexibility has a cost for those who need to adapt, so it can be assumed that the opportunities identified in a project are beneficial for the actors who have incentives to pursue them. Schöttle et al. [56] have shown that collaborative decision-making processes lead to value-adding opportunities.

According to Rolstadås et al. [57], projects are usually based on an identified need. A project's goals should be aligned with this need to ensure that the stakeholders' needs are met. To achieve this, performance, business, and societal goals are defined. The societal goals describe the benefits of the project to society from a long-term perspective. The business goals support the societal goals and describe the project's benefit for the end-users. The performance goals describe the project's final delivery with specific and verifiable measures [58].

Johansen et al. [2] argue that opportunities can be viewed with three different levels of consequences based on the three different levels of objectives in a project:

- First-order consequences appear in the frame of project execution and deliverance of the project performance objective, including cost, time, and quality constraints.

- Second-order consequences emerge after project completion. These include benefits for the organizations that have been involved in the project.
- Third-order consequences are the broader effects on society and end-users.

Singh [59] emphasizes the importance of "creative lean (CLean) construction", where approaches are design-oriented, rather than production-oriented. The idea is to implement CLean construction in the design phase to identify opportunities and eliminate waste in the consumption patterns and, in the most extreme cases, even eliminate the need for production. According to Rolstadås and Johansen [28], the building and construction industry is responsible for 60 percent of the land, 50 percent of the raw materials, 30–40 percent of the energy, and 15–20 percent of the freshwater in the world. These are examples of third-order consequences that should be considered in the design and construction of building projects if the industry is to become more sustainable. Økland et al. [60] argue that several aspects of sustainability are considered in the early phases of railway investment projects, but there are no explicit requirements to perform an overall analysis of sustainability.

Rolstadås et al. [17] describe six different principles that offer opportunities with first-order consequences: "reduce cost", "avoid cost overruns", "deliver faster", "avoid delays", "provide higher quality" and "avoid unnecessarily high quality". One opportunity could possess several of these characteristics. Opportunities with respect to cost, time, and quality can be distinguished into two categories: (1) opportunities that improve the deliverance of the initial plan; (2) opportunities from unexpected events that emerge during the project. Taleb [61] writes that something very predictable that does not happen can be considered a black swan (a random event with low probability and high impact). The chance to capitalize on both planned and unexpected events shows that there may be a massive potential in opportunity management. Opportunities with second-order consequences are usually opportunities that generate value for the owner and the end-user. Opportunities with third-order consequences generate value for society. Safety, reputation, and environmental impact are types of valuable opportunities for most projects, without necessarily improving the project's operational performance. However, efficient operational performance can be considered a sustainable measure itself, because the construction industry produces a lot of emissions [27]. Silveira and Alves [62] discusses how TVD-related practices can be used to design environmentally friendly buildings by addressing the needs of multiple stakeholders and looking at problems holistically.

2. Materials and Methods

A scoping review was conducted to explore if any literature mentioned uncertainty management and lean construction together. The scoping review followed the stages described by Arksey and O'Malley [63] to map research activity in the relevant literature. The scoping review was performed by searching books, journal papers, and conference papers in the NTNU Library, Oria, and the web search engines Google Scholar and Scopus. A personal database and articles recommended by research colleagues were also included. To narrow the search toward uncertainty management and lean construction, specific terms—such as target value delivery, choosing by advantages, target costing, opportunity, and uncertainty—were used. The next step was to combine these words into search queries. The search was limited to open-access papers, which are available to all researchers. However, it did not consider the quality of the papers, as the review was mainly conducted to map the research activity. The search hits were filtered using the operator "TITLE-ABS-KEY" and limitations such as "Target Value De*" After employing the limitations and removing duplicates, 253 articles remained for the refining process. Of these 253 articles, only 31 articles had enough relevance for both uncertainty management and lean construction to be included in the research. Table 1 presents the inclusion and exclusion criteria for the research process.

Table 1. Inclusion and exclusion criteria for the research process.

Inclusion/Exclusion	Criteria
Inclusion criteria	Literature mentions opportunity management/opportunities OR uncertainty management/uncertainties AND specific terms related to lean construction.
Exclusion criteria, screening process	Papers are to be excluded when terms in the search string have a different meaning than what is intended in this paper. E.g., the word "opportunity" is mentioned in the text but not in a way related to opportunity management.
Exclusion criteria, full-text articles	Only literature with relevance to TVD and opportunity management is to be included.

The main exclusion factor was that many papers addressed opportunities in settings other than opportunity management. For instance, when discussing "the opportunity for this approach to work", "the opportunity cost of X", "opportunities for further research", etc.

The scoping review included literature about uncertainty management and lean construction. Therefore, it had a broader starting point than the scope of this paper. A detailed description of the full review will be presented in a later paper. This paper focuses on the literature that explores how TVD and opportunity management complement each other. To exclude papers that were not relevant, the authors evaluated the final 31 full-text articles from the scoping review and evaluated their connection with opportunity management and TVD. After this effort, three articles remained that had relevance to both opportunity management and TVD. They are listed in Table 2.

Table 2. Papers with relevance for both opportunity management and TVD.

Author(s)	Year	Title
Orihuela, P., Orihuela, J. and Pacheco, S.	2015	Communication Protocol for Implementation of Target Value Design (TVD) in Building Projects
Schöttle, A., Arroyo, P. and Christensen, R.	2018	Demonstrating the Value of an Effective Collaborative Decision-Making Process in the Design Phase
Singh, V.	2018	Towards Creative Lean (Clean) Construction: From Lean Production to Lean Consumption

Some papers mentioned opportunity management and value management but were excluded because they did not mention Target Value Delivery, Target Value Design, or Target Cost. For instance, Yang et al. [64] proposed a tool to help companies capture value through sustainability, but it was excluded because there was no mention of TVD. The full search process was inspired by the PRISMA chart described by Moher et al. [65] and Peters et al. [66]. It is described in Figure 2.

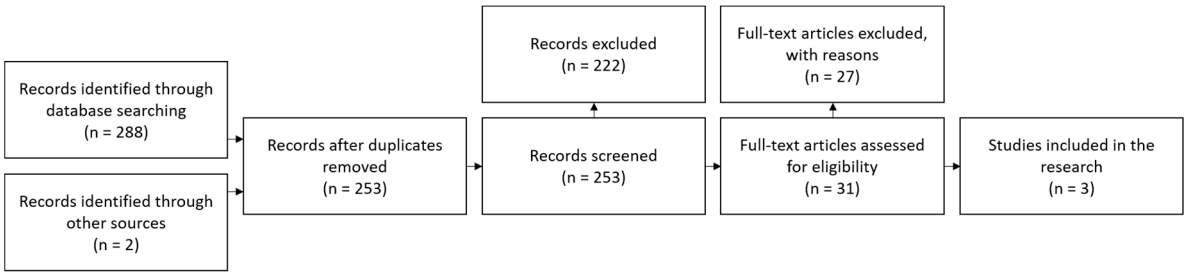

Figure 2. Flowchart of the screening process. Only three papers had relevance for both opportunity management and Target Value Delivery.

The screening process provided a limited amount of literature on opportunity management and TVD. Therefore, in addition to the scoping review described above, a separate literature review focusing on opportunity management and TVD theory was conducted. The search was aimed primarily at new literature on the topic (2011-2021), but some earlier literature also was included, as those sources describe the origin of some of the approaches. Initial testing of terms in the search string was performed before relevant papers were found using keywords such as "opportunity management" combined with either "Target Value Delivery", "Target Value Design" or "Target Cost". In addition, snowballing was performed, starting with articles by key authors in the two approaches. Examples are Ballard [7] in TVD and Hillson [50] and Johansen, Olsson, Jergeas, and Rolstadås [2] in opportunity management.

The research question asks how TVD and opportunity management can complement each other in projects. Therefore, the decision to perform case studies is based on Yin [67], who writes that case studies have a specific advantage when the research questions start with "how" or "why" and when they look at contemporary events where the researcher has limited or no control. Experiences of opportunity management and TVD come from two projects, each of which is examined as a single case study. The construction of Norway's new National Museum, the PNN project, provides insight into how a large project has used comprehensive opportunity management. An anonymized large infrastructure project provided insight into the use of TVD. The two projects are very different in character. One is a building project, and the other is an infrastructure project. Therefore, a multiple case study was not conducted. Instead, the methodologies of the two given projects were investigated and compared.

The analyses of the infrastructure project are based on interviews with key actors from the client and contractor. The semi-structured interviews followed an interview protocol designed for this research and took approximately one hour each. In addition to interviews, project documents were scrutinized to obtain a better view of the project as a whole. This verified the author's understanding of the project.

The analyses of the PNN project are based on opportunities identified through several uncertainty management activities between 2016 and 2018. The opportunities were contemporaneously gathered in an uncertainty register. The uncertainty management activities and methods that were used by the project to identify opportunities were discussed in an interview with the client's appointed "risk and quality manager". One of the coauthors was hired by the project as a consultant on uncertainty management and was also present at many uncertainty management activities during the three-year study period. The PNN project granted the authors access to its uncertainty registers, and the characteristics of the opportunities in the log were later analyzed by one of the authors. The features of the registered opportunities were observed and compared to the same set of variables. After reviewing the uncertainty register, the author's analyses were presented to the project management at the superior level (level 1 construction managers) and construction managers on contract level for one or more contracts in the project (level 2 and 3 construction managers). The interviewees were given the same briefing at the start of each interview, which lasted approximately one hour. During this exercise, which was conducted in April

2019, each registered opportunity in the project was discussed. The construction managers confirmed whether the opportunities had been harvested, rejected, or should be removed from the register for different reasons (e.g., duplication). These meetings provided greater reliability and understanding of how the construction managers worked with the registers.

3. Results

3.1. Target Value Delivery in a Large Infrastructure Project–Empirical Evidence

The use of TVD has increased in Norway in recent years, and a large infrastructure project has been actively using TVD as a central part of their collaborative approach. The research from the case study is limited to the design phase. In that phase, the client and contractor worked closely and made decisions collaboratively.

The project uses "client's budget price", which works as the allowable cost in the project. Every decision is made with TVD in mind, and the objectives of the project guide what the project considers valuable. According to representatives from both client and contractor, the collaboration has worked smoothly with no conflicts.

Uncertainties in the project are written down in an uncertainty register using PIMS Web software. This is performed during formal uncertainty management meetings. In addition to this, low threshold uncertainties are registered in Jira, an issue tracking tool. A representative from the contractor claims that the desire to deliver within the client's budget price has been crucial to establishing a mindset of continuously searching for ways to improve the project. The formal uncertainty meetings and the less formal use of the Jira tool have helped reduce the threshold for suggestions. In addition, the excellent relationship between client and contractor was highlighted as important. Three factors were identified as crucial for the trust and transparency between the actors in the project:

- The client's mandate and their clear strategy;
- How the implementation of the process is described with contractual transparency;
- The people involved.

One learning point is that TVD creates a mindset where opportunity thinking happens spontaneously and not only during formal uncertainty meetings. According to a representative from the contractor, it is "common knowledge" that contractors work harder under pressure and that a target price creates this pressure from the start. The representative added that the possibility of earning more money if the project costs less than the client's budget price was a clear incentive for the contractor to find solutions to reduce the total cost. This has also been a driver for a mindset of continuous opportunity thinking. However, since the project has experienced some unforeseen events that affected the cost, the project is currently struggling to meet the client's budget price. This means that the incentive of increased earnings is not present for the contractor at the moment. However, it seems evident that TVD in this project helped to facilitate a mindset of looking for opportunities.

The environmental objectives in the project are the preservation of habitats, quality assurance of habitats where the knowledge base is limited, and sufficient competence of the decision-makers when choosing the route for the highway.

3.2. Opportunity Management in a Large Building Project–Empirical Evidence

In 2009, the Norwegian Directorate of Public Construction and Property Management (Statsbygg) started the project work on Norway's new National Museum (the PNN project). Located in Oslo, the building will be the largest Nordic Museum to date. The construction requires advanced alarm systems, monitoring systems, and sophisticated technical systems because of the valuable art exhibited and stored there. The facility will serve as a landmark for Norway's largest city, making the architectural design important. Co-operation between the client's project team and many stakeholders, among them a significant number of contractors and subcontractors, makes the project organizationally complex. The project is divided into 25 contracts with a designated construction manager.

As a response to being behind schedule and having a cost prognosis over budget, the PNN project decided in 2016 to initiate a comprehensive strategy to identify and

harvest opportunities in the execution phase. The project leaders identified two aspects that needed improvement: (1) to avoid the current neglect of searching for opportunities by implementing a new uncertainty management approach, and (2) to secure a commitment to the new uncertainty management approach at all organizational levels.

The project avoided the neglect of opportunity management by adding five concepts to the prior uncertainty management plan [68]:

1. Contract management, combining cost- and uncertainty management;
2. Introduction of opportunity studies on the project level and contract level;
3. Quarterly internal cost analysis–continuous focus and involvement of the four levels of the project management organization;
4. Improvement of the external cost analysis process;
5. Time analysis under uncertainty—focusing on critical time and optimization on schedule–using external facilitators in co-operation with project management and planners.

To secure commitment to the new uncertainty management approach, the project created 11 sources with activities that helped to identify new opportunities.

1. Workshops with a focus on opportunities on the project level. Methods in use: Silent brainstorming to identify opportunities, a triple estimate of cost consequences, and a percentwise estimation of the likelihood of the opportunities. The workshops have 12–15 participants, with one or two facilitators. Documentation: Duration of the meetings, small reports, and update of the uncertainty register on the project level.
2. Workshops with a focus on opportunities on the construction manager level. Methods in use: Silent brainstorming to identify the three most important opportunities, developing strategies to exploit the opportunities, and set time and responsibility. Documentation: Duration of the meetings, small reports, and update of the uncertainty register on the project level.
3. External uncertainty workshop (cost focus). Methods in use: Identifying and estimating opportunities and threats as part of the uncertainty management workshop, a triple estimate of cost consequences, and a percentwise measure of the opportunities' likelihood. The workshops have 15–20 participants, with two facilitators. Documentation: Large and formal reports and updates of the uncertainty register on the project level.
4. Internal uncertainty workshop (cost focus). Methods in use: Identifying and estimating opportunities and risks as part of the uncertainty management workshop, a triple estimate of cost consequence or savings, and a percentwise measure of the opportunities' likelihood. The workshops have 10–15 participants, with one facilitator. Documentation: Update of the uncertainty register.
5. External uncertainty workshop (time focus). Methods in use: Identifying and estimating opportunities and threats as part of the uncertainty management workshop, a triple estimate of cost consequences, and a percentwise measure of the opportunities' likelihood. The workshops have 15–20 participants, with two facilitators. Documentation: Large and formal reports and updates of the uncertainty register.
6. Workshops with a focus on opportunities on the contract level. Methods in use: Silent brainstorming to identify opportunities. The workshops have 12–15 participants, with one or two facilitators. Documentation: Duration of meetings, small reports, and update of the uncertainty register on project and contract level.
7. Cafe dialogue (workshop with predefined topics). Methods in use: Identifying and estimating opportunities on predefined topics. Four hours with two or three cases to solve. The workshops have 15–18 participants working on four areas. Each group works 20 min together with the host, who documents the input on each topic from all the groups. The results from the four groups are presented in the plenum at the end. Documentation: Duration of the meetings, small reports, and update of the uncertainty register on the project level.

8. Lessons learned and follow-up meetings three months after opportunity workshops on the contract level. Methods in use: The client or contractor for each of the contracts presents the top three opportunities exploited, actions completed, and positive consequences. Workshop to identify more opportunities and actions. Documentation: Presentations and opportunity registers.
9. Update of the opportunity register on the building contract. Methods in use: Risk personnel and construction manager on levels 1 and 2 go through all the identified opportunities and actions completed, and they identify new opportunities based on opportunity workshops, other contracts, or changes. Probability and cost, time, and quality consequences are estimated for both updated and new opportunities. Documentation: Update of the opportunity register.
10. Uncertainty management follow-up meetings. Methods in use: In advance, all uncertainty owners send updates of the project's main uncertainty register. In the meeting, the status of all identified opportunities is discussed, and new actions are added. New opportunities are registered. Documentation: Update of the main uncertainty register. Top five opportunities and threats reported monthly.
11. Monthly follow-up meetings (economy) as part of reporting. Methods in use: In advance, the opportunity register is updated. The result is presented, and new opportunities are suggested and added to the record. Documentation: Updated opportunity register and contract status.

In 2019, a study of the uncertainty register was conducted. As of April 2019, the result of implementing the opportunity management strategy was a balanced uncertainty register, with attention paid to both opportunities and threats. The new approach resulted in cost savings and shortened time. The PNN project personnel identified and exploited considerably more opportunities in the construction phase than in the design phase, contrary to the established literature on the subject. The project management team has been successful in exploiting opportunities that saved the project both time and cost. In the project, 246 opportunities were identified and 175 of them were harvested, while 71 were rejected for different reasons. The 175 harvested opportunities gave the project estimated savings of about USD 65 million. Of the 25 contracts involved, 10 failed to identify any opportunity. Among the 15 other contracts, the number of identified and harvested opportunities varied greatly. The most prominent representation on the opportunity register came from the major contractors that took part in workshops. It seems evident that the workshops facilitated better terms for opportunity identification.

Among 175 harvested opportunities, only seven opportunities had second-order consequences with properties that benefit the end customer and user [17]. Most harvested opportunities were aimed at fulfilling the project objectives within the project constraints, which is of interest to the project management team and contractors.

Two of the studies conducted were related to making the project more sustainable and "greener". The project management team analyzed if the use of biofuel to transport stones could emit less transport-related CO_2 and if buying CO_2 quotas as compensation for the large use of steel and concrete in the construction phase would change the overall climate effect of the project. Both opportunities were abandoned. The project management team concluded that the long-term climate effect of the two opportunities was small, and the short-term cost could not be defended.

Overall, there was little attention paid to opportunities with third-order consequences during the execution phase. However, the project did have environmental objectives associated with reduction of CO_2 emission (50 percent reduction), reduced energy consumption, and choosing robust and sustainable materials. The project management team performed at least two studies that had this as the main objective.

4. Discussion

The findings from the PNN project show that there are many benefits from harvesting opportunities. The results suggest that implementing uncertainty activities gave the

stakeholders involved in the opportunity activities a more positive orientation toward flexibility in the execution phase. Contrary to the general rule in projects, project managers and contractors are negatively oriented to flexibility in the execution phase, mainly because of a lack of incentives. A question to be asked is whether this positive orientation toward opportunities came because of enlightenment regarding opportunity management benefits or whether project management was "forced" to participate in a series of opportunity activities through the new uncertainty approach. The workshops ensured that the PNN project did not neglect opportunity management, but it is unclear whether it increased the project management teams' incentives for change. The results of the case studies show that most opportunities were found among the largest contracts involved in several opportunity management activities. In contrast, as many as 10 other contracts did not register a single opportunity. This suggests that, even with a new uncertainty strategy implemented for the whole project, the project management in many contracts still lacked incentives to hunt for opportunities on their initiative. Additionally, it could be argued that project management teams will not jeopardize their budgets and take responsibility for the cost of buying CO_2 quotas. Instead, the responsibility for enacting this should be placed on the project owners.

One could also argue whether the uncertainty management approach conducted in the PNN project is sustainable in other, smaller projects. The PNN project is a relatively large construction project with enough resources to hire a "risk and quality manager" with specific responsibility for uncertainties. Smaller projects may lack these kinds of resources, and they could be forced to approach uncertainty management differently.

Based on the positive results from implementing the 11 sources of opportunity identification, it is evident that the contractors that took part in one or more activities benefitted from the approach. This suggests that the opportunity management activities are meeting their purpose. However, it still seems like the project management lacked some incentives to perform opportunity management on their own initiative. Ultimately, this calls for a method where the incentives for flexibility are inherent in the approach. That is, the project management is motivated to perform opportunity management activities. When the project management looks at uncertainty as an undesirable situation, they will miss out on the project's opportunities and will often not further analyze them [2]. The TVD approach can contribute to a boost of incentives for the project management team. With this approach, identifying and exploiting opportunities can lead to reduced cost, ultimately leading to profit for the contractors, while the owner still maintains value for the users. The experiences from the infrastructure project substantiate this. The results from that project showed that the contractor felt more motivated to search for opportunities because of the TVD approach. This would arguably create a desire to explore opportunities through one or more of the 11 sources for opportunity identification from the PNN project. As a result, this could create more openness to flexibility in the execution phase of project management.

In addition to a suspected lack of motivation in the project management team, it is evident that most opportunities found in the PNN project had first-order consequences. Among the 175 harvested approaches, only seven opportunities were registered as opportunities with benefits for the end customer or user. Most harvested opportunities were aimed at fulfilling the project objectives within the project constraints, which is of interest to the project management. Since the project organization conducted the uncertainty management activities in the PNN project, it is no surprise that most opportunities were beneficial for them. This is aligned with the earlier proposed theory by Krane et al. [54], which implies that project management teams tend to overlook strategical risk and focus on operational risk. The theory described earlier in the paper shows that what an actor considers valuable depends greatly on the actor's viewpoint. The TVD approach highlights the importance of value for the customer and end-user. In addition, collaboration is crucial for the TVD approach to work. When project participants are working to find solutions, the value of each participant is better maintained. When the project objectives guide the decisions, with value at the core of every decision, strategic risks are less likely to be overlooked.

5. Conclusions

The purpose of this paper was to increase knowledge of how TVD can facilitate opportunity management. Based on this, the paper set out to answer this research question: "How can TVD and opportunity management complement each other to generate and maintain value in projects?" To answer this question, research on relevant literature on opportunity management and Target Value Delivery was conducted. The researchers also conducted case studies of two projects where opportunity management and TVD were central elements of the project approaches, respectively.

The PNN project implemented a new uncertainty management strategy with increased attention to opportunities early in the execution phase. The research shows that 11 different sources for opportunity identification had been identified at the point of analysis. The project's 25 contracts were involved to varying degrees in these informal and formal meetings, workshops, and dialogues. The contracts that were most involved in the activities also found the most opportunities. Ten of the contracts failed to identify a single opportunity. The results showed that the project achieved a balanced uncertainty register, with both opportunities and risks identified. The project also estimated savings of about USD 65 million at the point of analysis. Although the results were positive, the approach seemingly had some potential for improvement, with an emphasis on three aspects:

- The project management lacked motivation/incentives to conduct opportunity management activities on their own accord.
- The approach is resource-demanding and may be unsustainable for smaller projects.
- The opportunities were mainly related to first-order consequences, and they lacked attention to value for the customer and the end-users.

This paper discusses how the TVD approach complements the opportunity management strategy by dealing with these three aspects.

First, the client's budget price, a part of the TVD approach in the infrastructure project, gave the project management more incentives to look for potential opportunities. The lean construction mindset, with TVD at the core, secured more substantial incentives to implement change for the stakeholders who experience the disadvantages of flexibility. With a cost target, the project management may increase their profit by reducing work costs, unlike traditional delivery, where the profit is decided in advance. This created incentives to look for opportunities of their own initiative.

Second, with TVD, this inherent motivation may make it superfluous to hire a full-time dedicated risk manager or risk management team. For smaller projects, this can be costly and exceed the resources available. It should be noted that most of the research that promotes relational contracts and lean construction principles is aimed at larger, more complex projects. The level of complexity and size increases the need for collaboration. Ultimately, this means that more research is needed on opportunity management and TVD in smaller projects before a conclusion can be made.

Lastly, TVD focuses more attention on customer value, as this is the core of the approach. This is shown in the infrastructure project, where the project objectives were at the core of every decision. However, when the project was struggling to stay within the budget price, opportunities related to cost were still important for the project management team.

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