How can we learn in projects? Improving cost estimation in Dutch road projects

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Abstract

The construction sector remains one of the most inefficient and unsustainable industries, due in part to the chronic failure to learn from past projects. Within infrastructure contracting, learning is further hampered by project isolation, staff shortages, and commercial pressures. These conditions make it difficult to evaluate past performance and embed lessons into future cost estimation. This study's objective is to explore how learning from previous projects can improve the accuracy of cost estimation, by analyzing current practices, identifying barriers and enablers, and recommending strategies. Drawing on 23 interviews in the Dutch road sector, the research identifies time pressure, leadership priorities, and fragmented responsibilities as key barriers. Teams consistently prioritize preparing new bids over evaluating completed work, leaving little room for structured reflection. Revenue targets and skilled personnel shortages further reduce the time and capacity available for learning. While an open and collaborative team culture enables informal knowledge sharing, such exchanges rarely extend beyond individual projects. The study examines how leadership influences this dynamic, finding that while managers express support for learning, operational pressures often override reflection. Learning remains spontaneous unless visibly prioritized & structurally planned. To analyze where and how learning breaks down, the paper applies the multi-level learning framework for project-based organizations (PBO's) treating projects as temporary organizations embedded in a wider coordinating structure. Based on this lens, the study introduces a seventh learning process; "Iterating", to capture dynamic loops of reflection, adjustment, and knowledge integration during project execution. The findings offer insight into what it takes to institutionalize learning in fast-paced project environments: leadership that creates space for reflection, routines that embed feedback into project delivery, and cultural trust that enables open exchange.

Keywords: organizational learning, cross-project learning, cost estimation, road construction, organizational leadership

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1. Introduction

Decades of research show that transport projects—roads, rails, bridges—often cost more than planned (Cantarelli, Molin, et al., 2012; Flyvbjerg et al., 2018; Hartmann & Dorée, 2015; Love et al., 2015; Molinari et al., 2023; Odeck, 2004, 2019). Improvements in planning methods have not solved this issue. Recent European studies report overruns in over 80% of projects, averaging 20–30% extra costs (Molinari et al., 2023). These persistent overruns suggest deeper organizational and behavioral problems. It is essential to define cost overruns precisely to understand their impact and address their prevalence. Dutch road projects follow this global trend, regularly exceeding initial budgets (Cantarelli, Flyvbjerg, et al., 2012). A key reason for ongoing overruns is poor learning from past projects. Construction teams often break up after completion, losing valuable knowledge. Reviews conducted post-project rarely improve future projects (Debs & Hubbard, 2023). Repeated mistakes like design errors and poor risk planning keep happening, showing a lack of learning and organizational memory (Durdyev, 2021).

Adding to this issue, the construction sector faces severe skilled personnel shortages. Over two-thirds of Dutch construction firms report workforce shortages, the highest among Dutch industries (Statistiek, 2025). According to the Economisch Instituut voor de Bouw (EIB), the construction workforce market is extremely tight, with high vacancy rates leading to delays, especially in infrastructure projects. This shortage disrupts learning, as fewer experienced workers mean less effective knowledge transfer, hindering accurate cost estimation and timely project completion (Bouw, 2024). Immediate project demands often overshadow long-term improvement efforts, further hindering accurate cost estimation. Despite decades of research on cost overruns, there remains a clear gap in understanding how organizations actually apply lessons from previous projects to improve cost estimation. While the phenomenon of overruns is well-documented, the use of cost-related knowledge from previous projects in practice is limited.

Although cost estimation and budget overruns are extensively studied in project management literature, less attention has been given to how organizational learning, particularly across project boundaries, might offer a missing link in improving estimation accuracy. Additionally, the attitudes and experiences of cost estimators, who may face pressure to underbid in the tender phase are rarely explored. Finally, practical strategies to embed learning into cost estimation remain underdeveloped, especially in the face of staffing constraints. Addressing this gap is crucial for enabling more accurate forecasting and reducing systemic overruns in construction projects. This gap results in the following main research question:

"How can learning from previous projects be strengthened to improve cost estimation accuracy of Dutch road construction projects?"

This study is situated within the debate on cross-project learning in project-based organizations, specifically in the context of cost estimation accuracy in Dutch road construction. While organizational learning provides the broader conceptual foundation, the study narrows in on how knowledge from past projects can be effectively transferred and institutionalized to improve estimating practices. In doing so, it examines the barriers, routines, and actor roles that shape learning continuity across temporary project boundaries.

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2. Literature Review

Cross-project learning is rooted in the broader domains of organizational learning and knowledge management. Crossan et al. (1999) argue that an organization truly learns only when individuals reintegrate their insights into the system and when supportive structures exist to embed this learning. In project based organizations (PBOs), however, learning often remains confined within projects because teams are disbanded at the project's end (Newell, 2004). A key theoretical perspective for understanding the difficulties of learning from past projects is the view of projects as temporary organizations. According to Lundin and Söderholm (1995), such organizations are characterized by being time-bound, task-oriented, team-based, and transitional in nature. Packendorff (1995) further conceptualizes projects as processes of temporary organizing, where short-term execution goals often conflict with long-term learning needs. As a result, insights gained during one project are frequently lost, underutilized, or disconnected from future efforts. Table 1 summarizes key learning approaches alongside their main critiques.

Table 1, Learning from past projects approaches

Approach	Description and Key Features
Lessons learned reviews	Formal reviews at project milestones to capture actionable insights. Require follow-up to be effective (Newell, 2004).
Knowledge repositories	Centralized databases for project knowledge. Need consistent data entry and user engagement (Flyvbjerg, 2006).
Data-driven learning	Quantitative methods like reference class forecasting. Depend on quality and contextual fit of data (Flyvbjerg, 2006).
Project Management Office (PMO)	Central unit standardizing methods and sharing knowledge. Works best with strong team support (Julian, 2008).
Communities of practice	Informal peer groups that share tacit insights. Require cultural support (Wiewiora et al., 2010).
Staff rotation	Moves people across projects to share knowledge. Effective but may reduce team cohesion (Paver & Duffield, 2019).

Critiques of Cross-Project Learning Approaches

Despite widespread efforts to institutionalize learning, several commonly used mechanisms face persistent challenges. Lessons learned reviews are often conducted but subsequently archived without meaningful integration into future projects (Newell, 2004; Paver & Duffield, 2019). While knowledge repositories can be underutilized and may struggle to capture tacit knowledge (Bush & Tiwana, 2005) , they can also support innovation, particularly in interorganizational and multi-level environments like construction projects (Ninan et al., 2022). Data-driven learning approaches are frequently hindered by inconsistent data quality and difficulties in adapting insights to specific project contexts (Cai & Zhu, 2015). Project Management Offices (PMOs), though designed to coordinate learning, are sometimes seen as overly bureaucratic and disconnected from on-the-ground project realities (Pemsel & Wiewiora, 2013). Similarly, communities of practice often struggle to maintain long-term engagement and deliver structured, organization-wide impact (Probst & Borzillo, 2008). Finally, staff rotation, while intended to promote knowledge diffusion, can unintentionally disrupt productivity and diminish specialized expertise (Casad, 2012).

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While these approaches offer valuable pathways for cross-project learning, their effectiveness depends on several enabling conditions. First, active leadership support and psychological safety are essential to encourage open reflection and critical feedback. Second, knowledge-sharing must be integrated into formal routines, instead of treated as a standalone exercise. Third, digital tools and repositories must be user-friendly and embedded in everyday workflows to overcome resistance and ensure uptake. Finally, aligning incentives, so that sharing knowledge is rewarded. Without these conditions, even well-designed learning strategies risk becoming symbolic rather than substantive. Table 2 highlights the key barriers that constrain learning from past projects and presents corresponding enablers identified in the literature.

Table 2, Barriers & Enablers for learning from past projects.

Barrier	Enabler
Project uniqueness and temporality	Standardization and comparability through consistent frameworks and cost structures (Flyvbjerg, 2006; Hartmann & Dorée, 2015)
Lack of formal knowledge capture	Implement institutionalized reviews and centralized repositories (Ahiaga-Dagbui & Smith, 2014; Eken et al., 2020)
Cultural and motivational barriers	Promote a culture of learning with incentives and open forums (Ahiaga-Dagbui & Smith, 2014; Eken et al., 2020)
Knowledge accessibility and quality	Invest in user-friendly systems and training to improve data usability (Hartmann & Dorée, 2015)

Despite these insights, a clear gap remains between theory and practice, particularly in knowledge transfer in cost estimation. The literature indicates that while tools for capturing "lessons learned" exist, project-based organizations struggle to actually reuse knowledge in new projects. The reviewed studies address what causes cost overruns and why (theoretically) but offer less on how to ensure that future projects internalize these lessons. This gap is clear in the limited improvement in forecast accuracy and repeated mistakes across projects. In practice, organizational and cultural barriers impede effective knowledge transfer. Consequently, there is a disconnect between the academic frameworks that advocate cross-project learning and the on-the-ground reality where such learning is minimal. This gap in applying theory to practice forms the focus for further inquiry.

3. Methods

This study uses a qualitative case approach at a prominent Dutch road contractor. Data were collected through semi-structured interviews with 23 professionals involved in project estimating and execution. This method strikes a balance between structured guidance and openness, allowing key topics such as estimating practices, use of historical data, and cultural factors to be addressed while remaining responsive to emerging insights (Adeoye-Olatunde & Olenik, 2021). Participants were purposively sampled to reflect a range of roles (Table 3). This diversity ensured that both operational and strategic perspectives on learning were captured.

Table 3, Overview of the Interview Participants

Participant	Role	Duration
1	Cost-estimator	1h 20 min

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2	Cost-estimator	1h
3	Cost-estimator	55 min
4	Cost-estimator	40 min
5	Tender Manager	50 min
6	Tender Manager	1h 15 min
7	Project Manager	50 min
8	Project Controller	1h 20 min
9	Project Manager	45 min
10	Operations Manager	50 min
11	Business Controller	1h 20 min
12	Operations Manager	55 min
13	Project Manager	55 min
14	Operations Manager	1h
15	Project Manager	1h 20 min
16	Project Manager	1h 10 min
17	Head of Contract Management	1h 10 min
18	Site Manager	30 min
19	Operations Manager	1h
20	Site Manager	45 min
21	Head of Project Office	1h 40 min
22	Site Manager	45 min
23	Managing Director	45 min

Interview questions were informed by the literature, with follow-up prompts designed to elicit concrete examples and reflections. For example, participants were asked “Where would you start improving knowledge sharing if you were in charge?” and “How does your organization share knowledge or lessons learned from completed projects?” All interviews were recorded and transcribed verbatim. The transcripts were analyzed using an inductive thematic coding process (Gioia, 2021). First-order codes were assigned to participants’ phrases and statements, keeping close to their original language. These codes were then iteratively grouped into second-order themes that represented broader patterns.

To ensure trustworthiness, transcripts were reviewed against the audio recordings to confirm accuracy, for instance, an early first-order code such as "no time for evaluation" was later split into more specific codes like "time pressure from new tenders" and "evaluation not planned upfront", as more nuanced patterns emerged across interviews. Sampling continued until thematic saturation was reached, which occurred at approximately the twentieth interview, as no major new themes emerged after that point, despite some additional instances being identified in later interviews. Ethical research practices were upheld throughout the study: participants provided informed consent, and identifying details have been anonymized.

4. Results and Discussion

First the results from the interviews will be presented followed by the framework and recommendations.

Informal Learning Culture and Practices

Interviewees consistently acknowledged the importance of structured reflection for improving cost estimation accuracy. While most could recall only a few formal evaluations, the need for such learning moments was widely endorsed.

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"If I count my years in execution, it's been about ten years. In that time, I've experienced just one formal project evaluation. That's it." (Interview 15)

This remark typifies a broader sentiment: although people recognize the value of evaluations, they remain rare in practice. Others echoed this, explaining that formal reviews are often forgotten once a project ends, especially when teams move quickly to new tenders.

Nevertheless, several participants emphasized that informal, mid-project feedback is often more relevant and actionable than formal end-of-project reviews. These spontaneous interactions allow lessons to be directly applied in ongoing tenders. For example, one cost estimator (Interview 2) described how he adjusted trench productivity figures in a new bid after discussing actual site performance with a site manager. This form of real-time learning, although effective, often remains undocumented. The same interviewee acknowledged that such moments of reflection typically stay confined to individual projects, lacking a structured mechanism for wider organizational learning.

Informal Open Learning Culture Within Teams

A notable theme across the interviews was the presence of an open, approachable, and collaborative team culture. Many professionals described a flat organizational structure in which knowledge sharing happens freely and without hierarchy. One cost estimator (Interview 1) explained that within the cost-estimation team, people feel equal and are comfortable approaching colleagues directly to ask questions and exchange insights. Weekly cost estimation team meetings were described as important spaces for peer learning, where colleagues often share past experiences and suggest alternative approaches to current estimation challenges.

Importantly, this openness extends beyond day-to-day collaboration. Cost estimators described an atmosphere of psychological safety, which is critical for honest learning. As one cost estimator put it:

"Openness ensures that people stay honest. If that openness wasn't there, people would stop speaking up. But because it is, and people expect it, things stay healthy. If someone doesn't behave collegially, it gets noticed." (Interview 1)

This no-blame culture supports transparency and builds the trust needed to acknowledge and learn from mistakes. Learning is also encouraged across functions. Interviewee 2 noted that cost estimators are supported in reaching out to site managers and project staff to validate or refine their assumptions, especially when similar types of work have been previously executed.

Estimating Tools and Infrastructure

Several structured tools facilitate learning from past projects, with the most prominent being the *moederbegroting* — a centralized cost library containing standardized items based on previous projects (Interview 19). While this system is technically formalized, its maintenance and use are dependent on individual initiative. Interviewees noted that the cost library is regularly updated based on new quotes and estimator feedback, often carried out informally by those using it. This practice reinforces a self-driven learning culture in which estimators actively contribute to

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maintaining knowledge systems. Quality assurance is further supported through a basic four-eyes principle, whereby estimates are reviewed by a second colleague before submission, ensuring internal consistency even in the absence of formal review protocols.

Informal Knowledge Sharing Mechanisms

Beyond formal tools, informal routines play a crucial role in supporting knowledge sharing. Operational managers frequently guide team members toward colleagues who possess relevant experience with similar challenges, helping to sustain awareness of previously evaluated topics (Interview 14).

Cost assumptions are also openly debated in key decision-making moments, such as final tender pricing meetings. As one participant noted:

> *"You can say whatever you think — especially in the final tender pricing meeting. Everyone listens seriously, and we have open discussions."* (Interview 5)

This informal, people-based system enables teams to remain adaptive, even in the absence of fully standardized procedures. Over time, estimators become familiar with each other's expertise areas and naturally seek out colleagues with relevant knowledge when needed (Interview 2).

Turnover Targets Drive Behavior

KWS Infra operates under revenue targets set by its parent company, VolkerWessels. The Rotterdam–Zwijndrecht branch also has its own turnover target. Projects carry a percentage of overhead costs (Algemene Kosten or AK), which include expenses such as office space, lighting, etc. These additional costs are covered under the condition that there was sufficient project turnover. Furthermore, the regional director is evaluated against these targets. Similarly, regional business managers each oversee their own area and strive for high turnover, as their performance is also judged accordingly.

This tension helps explain why learning is often deprioritized: turnover targets drive daily decision-making more strongly than long-term improvement. The first instances and second-order themes in the aggregate dimension of culture & current practices can be found in Table 4.

Table 4, Aggregate Dimension: Culture & Current Practices

#	1st Order Instances	2nd Order Themes
1	Formal project evaluations are crucial to learn and optimize but happen too rarely	Shared belief in importance of evaluation
2	Learning from projects is essential to avoid falling behind	
3	Open, honest environment; cost-estimators walk freely into each other's offices to ask questions	Informal open learning culture
4	Cost estimators are encouraged to talk to the site managers	
5	Mid-project feedback provides more concrete lessons than only post-project reviews	
6	Weekly cost-estimation meetings to share experiences and advice	Structural learning

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7	Central standard cost library used for the cost-estimation process and is updated regularly (pre-filled cost items as starting point)	Estimating tools and infrastructure
8	Every estimate checked by an experienced colleague (four-eyes principle)	Informal sharing
9	Team debates and aligns on contested assumptions (e.g., production rates) in final tender pricing meeting	

Barriers to Cross-Project Learning

Although the previous section revealed a strong willingness among professionals to reflect and learn from project experience, this ambition is frequently undermined by systemic and cultural barriers within the company.

Time and Resource Constraints Further Limited by Turnover Targets

The most frequently cited barrier to learning from previous projects was time. Project teams operate under significant pressure to meet deadlines, manage logistics, and respond to real-time execution challenges. In this high-paced environment, post-project evaluations are often perceived as secondary or non-essential. One cost estimator (Interview 2) explained that field staff often express skepticism about the utility or feasibility of evaluations, viewing them as an additional burden rather than a core project task.

This prioritization becomes even more pronounced when new tender opportunities arise. Several interviewees explained that contributing to upcoming bids is not only seen as more urgent, but also more valued by the organization. For example, one project manager (Interview 7) described how preparing tenders is perceived as a direct contribution to securing future revenue, whereas evaluations are often seen as optional or backward-looking.

A further structural constraint is the persistent shortage of key support roles, such as project controllers. According to one interviewee (Interview 8), the scarcity of qualified staff in this function means that existing employees are stretched thin, limiting their ability to support evaluation processes. For example, one respondent (Interview 23) noted that their company was operating with approximately eight vacant site manager positions at the time of the interview, increasing the workload for existing staff. Although executing fewer projects could theoretically relieve the pressure and create space for learning, commercial demands and turnover targets constrain such decisions. As one operational manager (Interview 23) remarked, downsizing project volume is not always feasible due to top-down financial expectations for branch performance.

Cultural Resistance and Negative Perceptions

In addition to time pressure, learning is hindered by cultural perceptions that frame evaluation as a blame exercise rather than a tool for improvement. This mindset creates reluctance to engage in open reflection. One participant (Interview 14) noted that evaluations are frequently treated as formalities, often stored away without follow-up or visibility. As a result, there is little organizational awareness of which evaluations have been completed or what their outcomes were.

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Others expressed concern that evaluations risk becoming judgmental, leading to interpersonal friction instead of constructive dialogue. This association limits the psychological safety needed for open and honest conversations about what went wrong and why. One participant observed:

"You only end up with hassle about what did or didn't go well. And who did a good job and who didn't." (Interview 6)

This quote reflects a broader pattern, echoed in several interviews, where the absence of a clear learning culture makes people hesitant to speak openly. Instead of surfacing valuable insights, evaluations risk reinforcing defensiveness and disengagement.

Lack of Formal Structures and Ownership

A further barrier lies in the absence of formal mechanisms and clear ownership for learning. Many interviewees described learning as an ad hoc activity with no dedicated coordinator or process. As one cost estimator described this clearly when asked who is responsible for learning, noting that no single person is explicitly responsible for learning—rather, it is spread thinly across many individuals. This, they explained, is problematic because when responsibility is shared by all, it effectively belongs to no one (Interview 1). This absence of clear accountability creates confusion and inertia. Several others noted that when learning is not someone's explicit job, it becomes deprioritized, especially during busy project phases. In one case, a planner described how evaluations are postponed indefinitely simply because "no one really drives it."

Even when evaluations are conducted, their outcomes are rarely documented in a consistent manner. One participant (Interview 12) pointed out that while the head of the project office holds valuable knowledge, much of it remains in his own possession or in individual memory. Without structured documentation and feedback loops, lessons fail to travel beyond individual teams or projects.

Fragmented Collaboration Between Roles

Several interviewees pointed out that cross-role collaboration, especially between cost estimators and execution teams, is limited or inconsistent. Some estimators maintain strong ties to the field, while others rarely visit construction sites:

"There are also cost estimators who've never been out on site." (Interview 7)

This statement illustrates a broader trend noted by multiple participants: those without site exposure often rely on assumptions rather than lived experience. One field manager recounted that in such cases, estimators "miss important practical nuances," which can lead to unrealistic pricing or planning.

This creates a disconnect between those who plan and those who execute, limiting opportunities for mutual learning. A similar disconnect exists with project controllers. One participant (Interview 8) noted that these roles have become increasingly absent from evaluation processes in recent years. These organizational silos limit the depth of feedback and hinder the learning that could emerge from collaboratively interpreting project outcomes.

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Neglect of Financial Learning

Financial performance receives limited attention during evaluations. The financials are often only superficially discussed in evaluations (Interview 8). This superficial treatment of cost performance raises questions about financial awareness among project managers. As one participant (Interview 19) wondered, while some site managers are well-informed about their financial standing, others appear more focused on managing daily operational tasks and may lack a clear view of their project's budget status. The first instances and second-order themes in the aggregate dimension of Barriers for learning can be found in Table 5.

Table 5, Overview of Instances about Barriers for learning

#	1st Order Instances	2nd Order Themes
10	Feeling of low priority from top management	Time and resource pressure hinders learning
11	Staff shortages in cost estimation and execution	
12	Knowledge isn't systematically shared across projects or departments	Lack of formal learning structure
13	Evaluations are seen as a burden and are often seen as superficial "checkbox" exercises	Negative association with evaluations
14	Fear of negative judgment (sharing risk)	
15	Cost-estimators without field experience stay desk-bound, hesitant to engage with execution teams	Limited estimator-execution collaboration
16	Lack of feedback loop from execution to estimating for too high estimates	
17	Uncontrolled cost bookings by support departments reduce site manager's financial control	Neglect of financial learning
18	Reliance on gut feeling over tender data leads to missed opportunities in execution	
19	Financial aspects get only brief attention in evaluations	
20	Execution team's mistakes rarely addressed in evaluations (focus is on calculation and external factors)	Organizational silos
21	Each branch has its own estimating approach; minimal sharing or standardization across branches	
22	Experiential learning sticks, paper knowledge transfer is problematic	
23	Distrust between units limits collaboration and knowledge exchange	

Strategies to Embed Learning

The interviews revealed that, while structural and cultural barriers inhibit cross-project learning, professionals are not short on ideas for how to overcome them. Across roles and regions, respondents demonstrated a clear willingness to improve learning practices and offered pragmatic strategies for embedding learning into the project cycle.

Creating the Conditions to Make Learning Possible

Beyond specific tools or processes, several interviewees emphasized that learning requires an enabling environment. Without structural time, team continuity, and visible leadership support, even strong intentions to reflect and improve will not materialize. One recurring suggestion was

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to create deliberate overcapacity in project teams, offering a buffer that enables professionals to step back and reflect. For instance, one interviewee (Interview 22) explained that teams are often so structurally overloaded that mistakes occur simply due to a lack of time. Providing more space for individual and collective evaluation could, in their view, substantially accelerate learning.

Participants also stressed that leadership must visibly endorse learning — not just in principle but through daily routines and operational priorities. One proposed strategy was to assign a project administrator to large projects, thereby relieving site managers of some administrative burden and freeing up mental space for reflection (Interview 23). This point was clearly articulated by the managing director, who emphasized the symbolic and practical role of leadership in prioritizing learning:

> *"Management should emphasize and support the importance of learning…. Encourage that through the operations manager. If the organization shows that it values this, it really helps."* (Interview 23)

These reflections underscore that learning depends not only on individual behavior but also on how roles, expectations, and workflows are designed and resourced across the organization.

Embedding Evaluation Early and Lightly

A frequently mentioned strategy was to reinstate project evaluations as a routine and structured activity — not as an administrative add-on, but as an integral part of project delivery. Several interviewees called for evaluations to be planned in advance, ideally at the moment a project is awarded, to avoid being sidelined by other priorities later on. There was broad agreement that evaluations had lost their central position in recent years, with one project manager remarking that they had really fallen by the wayside and needed to be re-emphasized (Interview 4). Some participants suggested including dedicated financial reflection moments as part of the evaluation process, particularly to benefit cost estimators. Several also stressed the importance of storing evaluation insights in a central, accessible location. One interviewee suggested that although evaluations are carried out, there is much room for improvement in how findings are shared, and that having a centralized database for lessons learned would be a valuable step forward (Interview 12).

Simplifying Data for Learning

While formal evaluations remain important, many professionals emphasized the value of simple, data-informed reflection. One branch manager argued that the current cost-booking system is too detailed and that what really matters is tracking high-level production figures, such as tons of asphalt per day (Interview 19).

Rather than measuring everything, interviewees advocated for selecting a few key performance indicators (KPIs) that could be tracked and discussed across projects:

> *"Don't try to measure everything... pick the most important things that drive progress. That should be decided during the kick-off or handover."* (Interview 19)

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Others proposed a more consistent use of post-calculation analysis to systematically compare planned and actual costs (Interview 1). A post-calculation (or *nacalculatie*) is a cost-analysis performed once a project is finished. It involves comparing the original budget or estimate with the actual costs incurred.

Strengthen Execution–Estimator Interaction

A major theme across interviews was the need to bridge the gap between cost estimators and execution teams. Many interviewees emphasized that informal conversations, not necessarily formal meetings, are often the most effective way for knowledge transfer.

"It's already incredibly useful when a cost estimator just spends a morning in the site cabin. It feels much more natural than a formal evaluation with a form. These conversations should just happen organically." (Interview 2)

Despite this, such interactions remain the exception rather than the rule. Several participants noted that time constraints are a persistent obstacle, even though brief visits or check-ins could already add value (Interview 2). Others pointed to emerging practices, such as project controllers conducting site visits to gather financial insights. One interviewee (Interview 18) expressed hope that these insights would be routinely shared with cost estimators.

To further reduce the disconnect between cost estimation and execution, some interviewees proposed a more regionalized structure. Assigning cost estimators to fixed regional teams could help speed up communication and promote stronger working relationships (Interview 23). This approach was also suggested as a way to accelerate onboarding and build organizational cohesion, for instance by rotating new employees through fixed regional teams (Interview 23). These reflections underscore that learning is not a detached activity but deeply embedded in the relational dynamics of daily project work. The first instances and second-order themes in the aggregate dimension of strategies for learning can be found in Table 6.

Table 6, Overview of Instances about Strategies for learning

#	1st Order Instances	2nd Order Themes
24	Make project evaluations a standard step, scheduled at the start of each project to ensure follow-through.	Institutionalize evaluation
25	Need for a central lessons-learned database	
26	Need for informal interim project evaluations	
27	Ensure there is real follow-up on evaluation outcomes, in a culture of learning rather than blaming	
28	Proper cost coding is a prerequisite for meaningful evaluations	
29	Management should visibly prioritize learning by deliberately creating overcapacity and providing resources for learning.	Create overcapacity
30	Do detailed post-calculation of actual vs estimated costs to find patterns (data-driven learning)	Data-driven learning improvement

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31	Strengthen estimator–execution interaction through site visits and mandatory transfer meetings.	Strengthen execution-estimator interaction
32	Assign estimators to specific regions and project teams to strengthen their connection with execution	

Multi-Level Learning framework

A framework helps explain not just where learning occurs, but how it is transferred, or fails to be transferred, throughout the organization over time.

From 4I to 6I: Foundations of the Learning Framework

This study builds on a progression of organizational learning models. (Crossan et al., 1999) propose four learning processes—Intuiting, Interpreting, Integrating, and Institutionalizing—that connect individual, group, and organizational levels. (Jenkin, 2013) introduces a fifth process, Information Foraging, emphasizing how individuals actively seek data before meaning-making. (Wodnik et al., 2024) add Interaction and Incorporation, highlighting learning across organizational boundaries. These extensions (except Interaction) inform this study's multi-level framework, which focuses on how learning unfolds within and between temporary project teams and the wider firm.

Visualizing Learning Flows: Introducing the 7th I

The framework (Figure 1), integrates insights from the 4I, 5I, and 6I models, mapping both forward learning flows and feedback loops. To capture learning within ongoing projects, the framework introduces a seventh process: **Iterating**. This refers to internal cycles of reflection and adjustment during execution, including mid-project reviews, team debriefs, and cost-assumption updates. Unlike earlier models focused on learning between levels, Iterating emphasizes real-time adaptation. It responds directly to empirical findings that structured feedback during execution was often lacking.

Projects as Temporary Organizations

Each project is functions as a temporary organization: it operates with a high degree of autonomy, assembles its own team, delivers within a specific contractual scope, and disbands once completed (Lundin & Söderholm, 1995; Packendorff, 1995).

The Coordinating Body: The Construction Firm

In this framework, the construction company acts as the coordinating body overseeing multiple projects. The coordinating body plays a critical role in maintaining organizational memory and enabling continuous improvement in cost estimation over time.

Propositions

To clarify the contributions from this research to the existing literature, a series of propositions is presented that extend the core multi-level learning model (Figure 1). Each proposition specifies a presumed mechanism by which practices at one level (group, project, or coordinating body) influence learning outcomes at another level. These statements (P1–P7) enhance the framework's explanatory capacity and highlight key areas for empirical validation or targeted intervention. All propositions are grounded in the patterns that emerged from the interview coding and Gioia analysis:

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P1: Group → Project, "Integration" Knowledge developed within functional groups, such as the cost estimation team, enhances project assumptions and planning when it is incorporated into new tenders and execution strategies.
P2: Project → Group, "Institutionalization" Lessons learned during project execution contribute to strengthened collective practices when they are routinely shared at the group level, for example, through project manager meetings.
P3: Project → Coordinating Body, "Incorporation" Insights from structured mid- and post-project evaluations support continuous learning and policy refinement when they are systematically transferred to the organizational level.
P4: Coordinating Body → Project, "Institutionalization" Centralized tools and guidelines, informed by previous learning, lead to more consistent application of best practices when they are embedded into new projects and tenders.
P5: Group → Coordinating Body, "Incorporation" Insights from recurring group-level activities, such as weekly cost estimation meetings, influence the development and refinement of standardized tools and procedures.
P6: Coordinating Body → Group, "Institutionalization" Synthesized lessons, data, and tools distributed by the coordinating body enable more informed decision-making at the group level when shared through structured formats like estimation meetings.
P7: Within the Project, "Iterating" Mid-project reflection and informal communication lead to continuous adaptation during project execution by prompting re-evaluation of assumptions and decisions, especially as new team members join.

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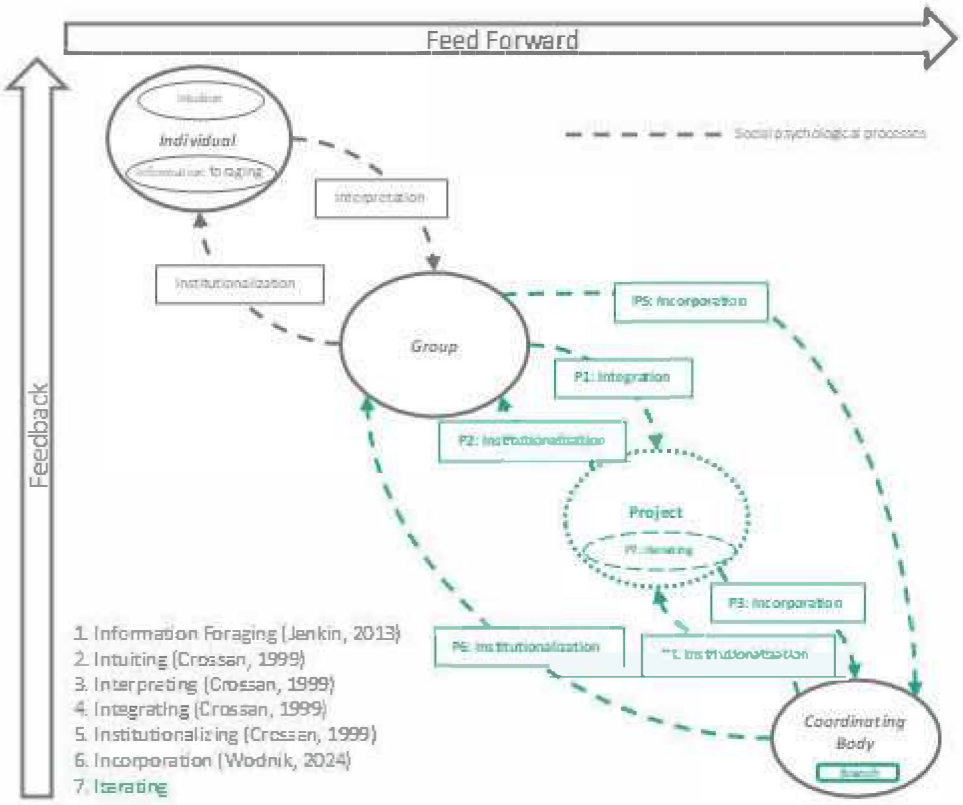

Figure 1, 7I Multi-level Framework

Individual Level – Information Foraging, Intuition, and Interpretation

Employees recognize the value of learning from past projects but are often too constrained by operational pressures to reflect or share knowledge systematically, reinforcing a persistent 'knowing–doing' gap. While many express a willingness to engage in evaluation, they lack the time, structure, and support to follow through. Low-effort routines, such as mid-project check-ins or brief handovers, can offer meaningful insight without adding burden.

However, time alone may not be sufficient. Without supportive culture, clear routines, and managerial reinforcement, extra time often gets absorbed by other priorities. Individuals may see reflection as a distraction rather than a benefit, especially under deadline pressure. This imbalance between individual investment and organizational gain helps explain why learning is frequently deprioritized.

Group Level – Integration and Interaction

At the group level, informal interactions, such as peer conversations and mentoring, play a crucial role in integrating knowledge. This aligns with the idea of communities of practice described by

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(Wiewiora et al., 2010). Although these interactions facilitate tacit knowledge sharing, formal systems for capturing and embedding this knowledge are often weak or missing.

Project Level – Institutionalization, Iterating, and Integration

Projects function as autonomous, temporary organizations, where efforts to institutionalize learning are often disrupted by their short-lived nature (Lundin & Söderholm, 1995; Packendorff, 1995). As projects near completion, time pressure increases, leaving little room for structured evaluations or reflection before teams disband. This disbanding leads to a break in continuity and limits systematic knowledge transfer. However, because of the temporary setup and the lack of mechanisms to retain and share these lessons, insights usually stay within the project where they emerged and are not passed on. A further complication is the disconnect between financial performance and learning practices—projects may meet budget targets without reflecting on the estimation errors or near-misses that occurred, reducing the perceived urgency for post-project learning.

Coordinating Body Level – Incorporation, Institutionalization

At the coordinating body level, the organization must embed learning across projects by setting priorities, supporting shared systems, and institutionalizing routines. While tools like QHSE oversight and central databases exist, they are underused due to fragmented access, low visibility, and weak incentives.

A core challenge is the absence of mechanisms to distinguish between estimation errors caused by poor data and those resulting from deliberate underbidding. Without processes to classify these decisions, post-project reviews risk misattributing causes, which leads to flawed lessons and ineffective follow-up. Theory emphasizes the need for formalized routines and clearly defined knowledge leadership roles (Crossan et al., 1999; Julian, 2008).

To improve this, the coordinating body should adopt an iterative learning cycle. Lessons from evaluations should inform the themes and priorities of the next cycle. This approach, similar to established safety policy routines, would help transform evaluation from a retrospective formality into an adaptive organizational process.

Bridging the Temporality – Institutionalizing Learning

A major challenge is bridging the gap between project cycles. Informal insights often remain undocumented and fail to inform future practice, weakening organizational memory. This aligns with critiques by (Hartmann & Dorée, 2015) and highlights the need for stronger coordination and clear knowledge management roles.

Leadership is essential. If the management team does not visibly prioritize reflection alongside performance, learning is easily deprioritized. Reflection lacks short-term payoff, making it less visible than monthly financial targets. The framework shows that learning must occur across individual, group, project, and organizational levels. Both formal systems and informal practices are required to embed lessons across projects.

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One of the clearest findings is that project managers play a pivotal role. Their daily actions, like scheduling reviews, enabling dialogue, or surfacing deviations, determine whether lessons are shared or lost. They translate strategic intent into practice.

Ultimately, bridging temporality requires not just structure but active leadership. The framework explains why systemic learning remains rare and supports the need to design feedback loops that reinforce knowledge use over time.

Practical recommendations

The following recommendations are structured using the Plan–Do–Check–Act (PDCA) cycle (Taylor et al., 2014) and through multiple decision-making, distinguishing between short-term (1 year) subjects such as improving staff cost data collection and long-term (3–5 years) themes such as improving overall cost booking accuracy.

Decision Matrix for Thematic Learning

To support adaptive implementation, a decision framework (Table 7) is proposed to assess whether annual interventions have achieved meaningful progress on the selected topic. These topics fall within broader themes that span a three- to five-year horizon. Only when a topic shows tangible improvement will the organization move to the next topic within the same overarching theme.

Table 7, Decision Matrix

Condition (if...)	Decision (then...)
The interventions in the annual plan were successfully implemented and adopted	Proceed to the next topic within the overarching 3–5-year theme
Only partial implementation or strong team dependency	Prioritize standardization and leadership involvement to support broader adoption
No visible improvement on the selected topic	Extend the annual focus and introduce deeper interventions (e.g., additional support or KPIs)

Balancing Immediate Project Goals and Long-term Learning

Turnover targets are fixed, and management cannot sidestep them. However, learning should not remain optional. While short-term reflection may reduce profit margins or require added capacity, these costs are strategic investments. Although reflection and evaluation may initially reduce profit margins or require additional capacity, these should be viewed as strategic investments rather than optional extras. To strike this balance, senior management must actively endorse and revisit evaluation outcomes, ensuring that follow-up is visible and aligned with broader strategic objectives. Recognizing and rewarding employee-led learning initiatives helps reinforce a culture where knowledge sharing is seen as valuable. Cross-regional learning events and exchanges among project managers can facilitate broader dissemination of insights and reduce siloed knowledge. Regular interaction between office and field staff, such as quarterly site visits, fosters mutual understanding and helps bridge operational divides. Pilot projects can be used to trial lightweight learning routines, allowing teams to scale up based on early, tangible successes. Formal mentorship roles should be established and incentivized, rewarding experienced employees who support knowledge transfer. Finally, evaluation findings should directly inform strategic planning so that recurring insights guide future tools, priorities, and thematic focus areas.

Theoretical Contribution

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This study demonstrates that leadership plays a central role in enabling or constraining organizational learning. While prior research has acknowledged the importance of leadership support in general terms, this study shows in detail how specific leadership behaviors influence the institutionalization of learning from past projects. These behaviors include the visible prioritization of learning, consistent allocation of time and resources for learning activities, and the alignment of incentives to support knowledge sharing. The findings suggest that learning systems, such as evaluation routines or cost feedback loops, only become embedded when leaders actively support their use, follow up on outcomes, and communicate their strategic value. This advances current theory by linking organizational learning not only to formal processes, but also to the day-to-day actions and priorities demonstrated by leadership in fast-paced, delivery-focused project-based organizations.

Limitations

Role diversity in the interview participants improved triangulation and thematic consistency, however some roles, such as senior leadership, were underrepresented, which may have constrained insights into strategic decision-making. All interviewees came from a single organizational branch, limiting generalizability to other firms or sectors. The researcher's dual role as an intern may also have influenced responses. While this position facilitated access and rapport, it could have led to social desirability bias, particularly when discussing sensitive topics like blame culture or management performance.

Moreover, while the study focused on cost estimation processes, it did not systematically distinguish between inaccuracies caused by cognitive or organizational learning gaps and those resulting from deliberate strategic pricing decisions. Several interviewees noted that final tender prices are sometimes intentionally lowered to remain competitive, regardless of past project insights. This distinction between learning-related errors and strategic business behavior was outside the analytical scope of this study but may have significant implications for interpreting deviations in estimation accuracy.

Finally, the research relied on people's memories and opinions about learning from past projects, by interviewing 23 professionals a most complete image of the situation was assessed.

Recommendations for Future Research

Future studies should test interventions, like structured reviews or improved knowledge systems, across multiple projects or firms. Long-term studies could measure how estimation accuracy and learning culture develop over an extended period. Additional research should explore how staffing levels, time pressure, and workload affect an organization's capacity to support structured learning. Another important area of inquiry is understanding whether providing teams with more time leads to better learning outcomes. Studies could compare teams with time alone versus those with embedded reflection routines, supported by leadership and structure.

While patterns were consistent, future research could benefit from complementary methods such as document analysis or observational studies to validate behavioral claims. In particular, direct observation of evaluation practices or cost booking behavior could help distinguish between reported intentions and actual routines. Further inquiry should also address the difference between estimation errors from limited learning and those from strategic underbidding. Clarifying this distinction could improve the use of lessons learned and avoid misattribution in reviews.

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Future work might explore how team composition, leadership style, and peer dynamics influence learning capacity, and test whether assigning roles such as "learning coordinators" improves estimation accuracy and knowledge transfer. Comparative studies across sectors and contract types could reveal how external context influences learning behavior and transferability of strategies.

5. Conclusion

This research concludes that improving learning requires making reflective practices a normal part of how the organization works. While estimators are motivated to improve, learning still happens on a spontaneous basis due to time pressure, missing routines, and a lack of priority. Bridging this gap between intention and action needs clear, structured efforts from the organization.

Therefore, improving cost estimation is not just a technical issue; it is a learning challenge. Organizations must institutionalize lessons learned, support them with simple tools and clear processes, and build trust between estimators and execution teams. Over time, this approach will reduce repeated mistakes and make estimates more reliable.

This research also extends organizational learning theory by treating the project not just as a site of execution, but as a temporary learning organization in its own right. While most learning models focus on individuals, groups, and permanent organizational structures, this study introduces the project as a distinct level within the learning process. By embedding the project level into the framework, the study helps explain why learning often stalls after project completion: teams disband, roles dissolve, and insights remain trapped in temporary structures.

This perspective has implications beyond the Dutch road construction sector. In any project-based environment, whether in engineering, consulting, or IT, the temporary nature of teams creates barriers. Recognizing projects as temporary organizations helps clarify where learning is likely to break down, and which interventions can improve continuity.

In conclusion, the study finds that the key to improving cost estimation accuracy in Dutch road construction lies in **prioritizing learning**. Learning must be built into the daily routines and valued by the wider organization. Only then can the industry move toward more predictable and effective project delivery.

Biography

Ing. Pelle Limburg holds a bachelor's degree in Civil Engineering from Avans University of Applied Sciences and is currently completing his master's in Construction Management and Engineering (CME) at Delft University of Technology (TU Delft). His study, conducted in collaboration with KWS Infra, investigates how learning from past infrastructure projects can enhance cost estimation practices in road construction.

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