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Collaborative Project Delivery Models and the Interplay Between Collaboration and Sensemaking Processes in Major Infrastructure Projects

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ABSTRACT

Collaboration is increasingly recognised as critical to the success of complex infrastructure projects, facilitated by collaborative project delivery models. Despite extensive research, its evolution over time remains underexplored. Collaboration, though related to cooperation and coordination, is inconsistently defined in literature. This thesis examines how collaboration is described and explores mechanisms shaping it in infrastructure projects, using sensemaking as a theoretical lens to analyse how project actors interpret and foster collaboration. A systematic review of 137 articles identifies key components underpinning collaboration, cooperation, and coordination – trust, communication, culture, and contract – establishing a hierarchical relationship among these concepts. This study clarifies definitional ambiguities and contributes a conceptual framework illustrating how a collective sense of purpose emerges in projects. The framework advances theoretical understanding and offers practical insights into relational governance, addressing trust, contracts, cooperative goal-setting, and coordination mechanisms. Through a longitudinal case study of a major road tunnel renovation project, this research examines how project managers and experts shape collaboration using sensemaking processes. Data from 42 interviews and observations reveal that collaboration is instigated, maintained, and developed through sensemaking and sensegiving related to governance, decision-making, and information flow, with the client's approach playing a pivotal role. Events, triggers, and sensebreakers influence these processes, causing management teams to fluctuate between order and chaos, highlighting the dynamic nature of collaboration. Integrating empirical and theoretical perspectives, this thesis enhances understanding of collaboration in major infrastructure projects, offering implications for project management and relational governance research and practice.

Keywords: Collaboration, Collaborative Project Delivery Model, Sensemaking, Sensegiving, Sensebreaking, Infrastructure, Longitudinal Case Study

List of Appended Papers

Paper 1

af Hällström, A., Rönndahl, C. (2024) A Systematic Review on Collaboration, Cooperation and Coordination in Major Infrastructure Projects.

The peer-reviewed paper was presented at the European Academy of Management Conference 2024 in Bath on the 26th of June 2024. The paper was co-authored with Anna af Hällström. Research design, data collection, analysis and writing were conducted by both authors.

Paper 2

Rönndahl, C., Bosch-Sijtsema, P., Rempling, R., & Karlsson, M. (2025). Making Sense of Collaboration in Major Infrastructure Construction Projects. *Project Leadership and Society*, 100178.

The peer-reviewed paper was first presented at the European Academy of Management Conference 2024 in Bath on the 27th of June 2024, whereafter it was further refined and developed before being submitted to Project Leadership and Society where it was published on the 21st of January 2025. It was co-authored with Petra Bosch-Sijtsema, Rasmus Rempling and Mats Karlsson. The contributions of each author are detailed as follows:
Christoffer Rönndahl: Writing – original draft, Methodology, Formal Analysis, Data Curation, Conceptualisation. Petra Bosch-Sijtsema: Writing – review & editing, Methodology, Funding Acquisition, Formal analysis, Conceptualisation. Rasmus Rempling: Writing – review & editing, Supervision, Funding Acquisition. Mats Karlsson: Supervision, Funding Acquisition.

Paper 3

Rönndahl, C., Bosch-Sijtsema, P. (2024). Giving Sense to Collaboration in an Infrastructure Project: A Long-Term Case Study. *ARCOM Annual Conference,* 2-4 September 2024.

The peer-reviewed paper was presented at the Association of Researchers in Construction Management Annual Conference 2024 in London on the 4th of September 2024. It was co-authored with Petra Bosch-Sijtsema. Data collection was conducted by Christoffer Rönndahl. Research design, analysis and writing was done jointly by the authors.

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With deep appreciation,

Christoffer Rönndahl, Jönköping 2025

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Abbreviations

CPDM	Collaborative Project Delivery Model
SPM	Senior Project Manager
CM	Collaboration Manager

Introduction

Infrastructure projects form the foundation of modern societies, underpinning economic development, urbanisation, and public welfare. These projects are, by nature, highly complex undertakings that involve intricate technical, regulatory, and organisational interdependencies (Geraldi et al., 2011). The involvement of multiple stakeholders – including contractors, design consultants, governmental bodies, and local communities – further exacerbates this complexity. Managing these interdependencies is particularly challenging when infrastructure projects are delivered within public-sector settings, where competing institutional logics, regulatory frameworks, and accountability mechanisms shape project governance (Engebø et al., 2020; Nwajei, 2021).

Interogranisational collaboration is increasingly recognised as a critical success factor in infrastructure projects, facilitating more effective coordination, risk-sharing, and problem-solving across organisational boundaries (Brunet, 2019; Engebø et al., 2020). However, achieving and sustaining collaboration in large-scale construction projects is far from straightforward. Traditional project delivery models often rely on rigid contractual structures that fail to accommodate the dynamic and emergent nature of project environments (Rahmani et al., 2018). In contrast, Collaborative Project Delivery Models (CPDMs) have been introduced as an alternative approach, integrating contractual and relational mechanisms to foster cooperation, trust, and knowledge-sharing throughout the project lifecycle (Kadefors et al., 2024). CPDMs, including Early Contractor Involvement (ECI) and alliancing, represent a significant shift from conventional procurement approaches by embedding collaboration into both contractual frameworks and organisational practices (Rahmani et al., 2018). These models promote early-stage engagement between key stakeholders, enabling joint decision-making, risk-sharing, and the co-creation of project solutions. While CPDMs have demonstrated potential for enhancing project outcomes, collaboration within these models remains a complex and dynamic process, shaped by evolving relationships, power dynamics, and project uncertainties (af Hällström et al., 2025).

Much of the existing literature on CPDMs has focused on their structural and contractual dimensions, assessing how formal governance mechanisms – such as incentive structures and risk-sharing agreements – shape interorganisational relationships (Denicol et al., 2020; Poppo & Zenger, 2002; Zani et al., 2024). However, collaboration in infrastructure projects cannot be fully explained through formal structures alone. Informal and relational governance mechanisms, including trust, communication, and social ties, play an equally crucial role in sustaining collaboration over time (af Hällström et al., 2021; Cao & Lumineau, 2015; Roehrich et al., 2020). Research has shown that social ties within collaborative project networks significantly influence the effectiveness of partnerships and knowledge-sharing, highlighting the importance of relational mechanisms alongside formal governance (af Hällström et al., 2021). While these governance perspectives provide important insights into different aspects of collaboration, they often present fragmented and partial views of how collaboration unfolds across a project's lifecycle (Gao et al., 2022; Nikulina et al., 2022). Recent studies highlight that collaboration in infrastructure projects is inherently dynamic, requiring continuous adaptation to evolving project conditions and governance structures. The interplay between formal mechanisms, relational processes, and institutional constraints shapes how project stakeholders collectively respond to complexity and uncertainty (Walker et al., 2017).

Given the complex and dynamic nature of collaboration in infrastructure projects, it is essential to move beyond structural and static analyses towards a processual understanding of how collaboration is enacted in practice. A promising theoretical approach for capturing this process is sensemaking (Weick et al., 2005), which examines how individuals and organisations interpret, respond to, and shape unfolding events within uncertain and ambiguous environments (Gioia & Chittipeddi, 1991; Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2015). Sensemaking is particularly relevant to infrastructure project management, as it highlights how stakeholders construct shared understandings, negotiate meaning, and adapt to changing project conditions (Brunet, 2021; Brunet & Forgues, 2019). Complementing this perspective, sensegiving focuses on how actors actively influence others' interpretations, thereby shaping collective creation of meaning and guiding collaborative processes (Gioia & Chittipeddi, 1991). Recent studies have applied sensemaking to the study of collaboration in infrastructure projects, demonstrating how project participants navigate institutional and organisational complexities to sustain collaboration (Rönndahl et al., 2025). While prior research has explored relational contracting in public-sector infrastructure projects (Bygballe et al., 2015; Rosander & Kadefors, 2023), there remains a need for further empirical studies investigating how CPDMs influence collaborative processes and sensemaking within such contexts.

This study seeks to explore how collaboration is understood, enacted, and sustained in CPDM-based infrastructure projects by integrating insights from sensemaking theory and relational governance. Specifically, this thesis is guided by the following research questions:

1. How can collaboration in major construction projects be understood in the light of existing literature on infrastructure project management?
2. How do project participants and key managers shape and make sense of collaboration in CPDM-based infrastructure projects?

By answering these questions, this research contributes to both theory and practice. From a theoretical perspective, it advances understanding of collaboration as an emergent and dynamic process, highlighting the interplay between formal governance, relational dynamics, and sensemaking. From a practical standpoint, it provides insights for practitioners seeking to enhance collaborative effectiveness in complex infrastructure projects. The subsequent chapters will elaborate on the theoretical foundations of this study, outline the methodological approach, present the empirical findings, and synthesise the theoretical and practical contributions. Finally, the conclusions will discuss implications for both academia and industry, identifying directions for future research on collaborative project delivery and management.

Major Infrastructure Project Delivery: Challenges and Approaches

Characteristics and Challenges of Major Infrastructure Projects

Large infrastructure projects are among the most complex and resource-intensive endeavours within the built environment. They typically involve long planning horizons, high financial investments, regulatory oversight, and extensive stakeholder networks, including public agencies, private contractors, financiers, and local communities (Denicol et al., 2020; Flyvbjerg, 2017). Unlike smaller construction projects, infrastructure projects often span decades, requiring adaptive governance structures to respond to shifting political, economic, and technological landscapes (Geraldi et al., 2011). Their complexity can be attributed to several interrelated dimensions, including structural intricacy, uncertainty, socio-political influences, and the necessity for multi-organisational coordination (Engebø et al., 2020).

One of the defining characteristics of infrastructure projects is their high degree of uncertainty, which stems from both internal factors (e.g., evolving design requirements, unexpected site conditions) and external factors (e.g., regulatory changes and public opposition). Moreover, the extended duration of these projects increases the likelihood of scope changes, contractual renegotiations, and interorganisational conflicts, making project governance particularly challenging (Denicol et al., 2020). These conditions demand robust governance mechanisms that not only provide formal structures for risk allocation but also support adaptive collaboration, conflict resolution, and trust-building among project participants (Van Marrewijk et al., 2008).

Traditional procurement and project delivery methods, which rely heavily on transactional contracting, have often proven inadequate in managing these complexities, as they can lead to rigid legal disputes, misaligned incentives, and adversarial relationships (Peña-Mora & Tamaki, 2001). Recent research highlights the increasing role of integrated and collaborative approaches in infrastructure project governance, particularly in response to the complexities and uncertainties of megaprojects. These approaches enable project teams to navigate risks more effectively and enhance accountability through shared decision-making and innovation (Denicol et al., 2020). This shift has led to the emergence of CPDMs, which seek to address the unique governance challenges of large-scale infrastructure projects by embedding relational governance principles, early stakeholder involvement, and shared risk-reward mechanisms into project structures.

Collaborative Project Delivery Models

Collaboration has long been recognised as a critical success factor in infrastructure construction projects, particularly due to their inherent complexity, scale, and multi-stakeholder involvement (Suprapto et al., 2015). Over the past decades, scholars have explored collaboration from various perspectives, leading to diverse theoretical and practical approaches to its implementation. While early research focused on transactional governance mechanisms, contemporary studies highlight the importance of relational contracting and cooperative management strategies in achieving better project outcomes (Engebo et al., 2020; Nwajei, 2021). The evolving nature of collaboration is largely driven by the increasing technical and organisational complexity of infrastructure projects, necessitating the adoption of more

integrated and adaptive project delivery models (Davies et al., 2019). The complexity of infrastructure construction projects is a fundamental aspect that must be considered to fully grasp their intricacies. Complexity in projects can be viewed from two main perspectives: complexity within projects and complexity of projects (Geraldi et al., 2011). This study primarily adopts the latter perspective, focusing on how organisations and individuals involved in projects respond to and navigate project complexity, rather than strictly applying specific complexity theories as a framework. Geraldi et al. (2011) identify five interrelated dimensions of project complexity: structural complexity, uncertainty, dynamics, pace, and socio-political complexity. Each of these dimensions is particularly relevant in large-scale, long-term infrastructure projects, which tend to grow increasingly complex over time (Engebo et al., 2020). This growing complexity frequently results in cost overruns and delays, particularly in mega and major projects where budgetary constraints and schedule slippage are common (Flyvbjerg, 2014, 2017). To address these complexities, the construction industry has progressively shifted towards project delivery models that integrate relational governance principles. Traditional project delivery methods have historically been transaction-based, with contractual mechanisms designed to allocate risks and responsibilities clearly among project participants (Peña-Mora & Tamaki, 2001). However, as projects have grown in complexity, reliance on rigid contractual structures has often led to inefficiencies and adversarial relationships. In contrast, relational contracting has emerged as a more adaptive approach, incorporating principles of flexibility, mutual trust, and shared incentives to foster collaboration (Nwajei, 2021). Engebo et al. (2020) highlight the core components of relational contracting as commitment, trust, cooperation, communication, common goals, and a philosophy of mutual benefit.

CPDM, relational governance and relational contracting are three distinct yet interrelated concepts. Relational governance is a broad organisational and managerial approach that emphasises trust, cooperation, reciprocity, and informal mechanisms to govern inter-organisational relationships (Cao & Lumineau, 2015; Roehrich et al., 2020). It is based on the premise that not all contingencies in complex projects can be predefined contractually, making relational mechanisms critical for sustaining long-term collaboration and managing uncertainty (Gao et al., 2022). Relational contracting, on the other hand, is a formal contractual framework that embeds relational governance principles into legally binding agreements, incorporating elements such as flexible terms, shared risk-reward structures, and joint decision-making mechanisms (Bygballe et al., 2015; Poppo & Zenger, 2002). While relational contracting operationalises aspects of relational governance, it remains a contractual mechanism that seeks to balance formal control with adaptive collaboration (Rosander & Kadefors, 2023). Relational contracting always employ relational governance principles, but relational governance does not always require contracts. CPDMs integrate both relational governance and relational contracting by combining formal contractual structures with trust-based, cooperative management practices (af Hällström & Bosch-Sijtsema, 2024; Walker et al., 2017). CPDMs, such as alliancing and Early Contractor Involvement (ECI), rely on relational contracts to define legal and financial parameters while fostering an environment where relational governance mechanisms facilitate ongoing collaboration and adaptability. Thus, CPDMs represent a hybrid governance approach where contractual formalisation and relational dynamics are co-dependent, reinforcing each other to enhance project outcomes in complex and uncertain environments.

CPDMs have gained prominence as structured frameworks that embed collaboration into project governance. CPDMs are characterised by early stakeholder involvement, shared risk and reward mechanisms, and collective decision-making processes (Engebo et al., 2020; Nwajei, 2021). These models promote ongoing learning and continuous improvement, aligning project objectives with adaptive strategies to address evolving complexities (Li et al., 2001). Despite their advantages, the effectiveness of CPDMs is not inherently assured, as successful implementation depends on the capacity of project teams to navigate challenges associated with dynamic project environments (Chen et al., 2018). A key determinant of CPDM success lies in the composition and management of project teams. Effective collaboration requires a balance between individual competencies and team cohesion. Research underscores the significance of both supplementary fit, which ensures alignment between individual values and team culture, and complementary fit, which leverages diverse expertise to enhance project execution (Hajarolasvadi & Shahhosseini, 2022). Establishing such a balance reinforces the relational dynamics underpinning CPDMs, ensuring that collaboration extends beyond contractual agreements to interpersonal and organisational behaviours. In this study, a CPDM is defined as a project delivery model that involves close collaboration and mutual trust among project stakeholders, with the goal of promoting a more efficient and effective project delivery process through better communication, coordination, and integration, leading to better project outcomes (Chen et al., 2018; Engebo et al., 2020). Key features of CPDMs are illustrated in Figure 1.

By fostering collaboration as an embedded practice rather than a contractual obligation, CPDMs hold the potential to drive superior project outcomes in complex infrastructure environments. However, in order to not provide overly simplistic answers to the complexity regarding CPDMs and their influence on complex construction projects, there are still several questions in need for consideration and exploration as mentioned by Bresnen et al. (2024) in their framework on partnering. The authors mention questions regarding definition, formalisation, translation between theory and practice, and performance and how further studying these could aid the development and understanding of the role CPDMs play in the future of delivering complex projects, practically and theoretically. In line with how the authors describe their framework on partnering, CPDMs and its constituting concepts and ideas could be considered more like a map rather than a structured recipe for success, enabling navigation amongst collaborative features and to what extent they are to be implemented from project to project. Thus, the challenge for each project lies in creating (rather than simply finding) an efficient recipe for success given the project specific circumstances. This research further illuminates the understanding of CPDM definition, performance and translation between theory and practice, as will be described further down. As infrastructure projects continue to expand in scale and complexity, the role of collaborative governance models will become increasingly vital in ensuring effective project delivery and long-term industry resilience.

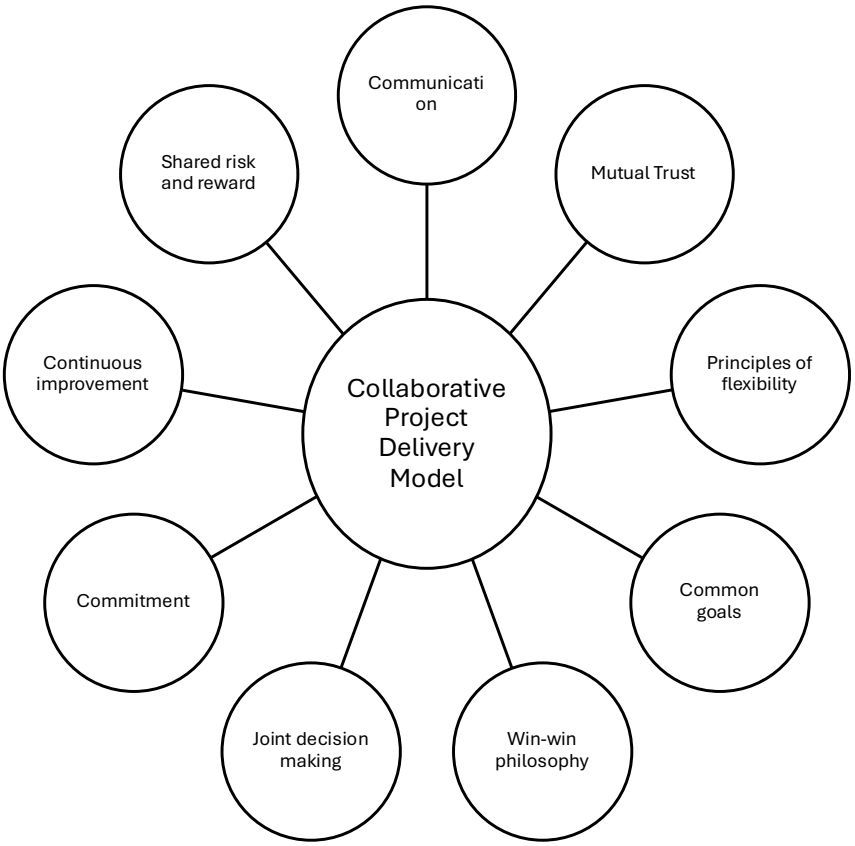

Figure 1 Diagram illustrating key features of a CPDM

Theoretical Framework

Sensemaking

Sensemaking has been introduced to and applied by numerous fields of research for decades and has since its conception been subject to development from various perspectives (Cristofaro, 2022; Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2020). Originally envisioned by Weick, the focus was shifted from static structures to the dynamic processes of organising, emphasising how individuals and groups construct meaning within organisations (Weick, 1979). Organisations are not static entities but are continuously constituted and reconstituted through the actions and interpretations of their members. This dynamic process, which Karl Weick conceptualises as 'enactment,' is fundamentally shaped by ecological changes – alterations in the perceived manifestations of reality that diverge from prior expectations (Weick et al., 2005). Such shifts necessitate ongoing sensemaking, as organisational actors seek to interpret and respond to an evolving environment. The connection and interdependency of ecological change and enactment are presented in Figure 2, alongside selection and retention as part of the sensemaking process. Selection refers to the process through which organisations filter and interpret environmental cues, enabling them to construct a coherent narrative that informs decision-making. Retention represents the institutionalisation of selected knowledge, allowing organisations to develop a collective memory that informs future sensemaking processes. In his seminal work, Weick (1995) provides a list of seven interrelated properties of the sensemaking process, which are also illustrated in Figure 2, namely identity construction, retrospection, enaction of sensible environments, social activity, ongoing processes, extracted cues and plausibility (Cristofaro, 2022).

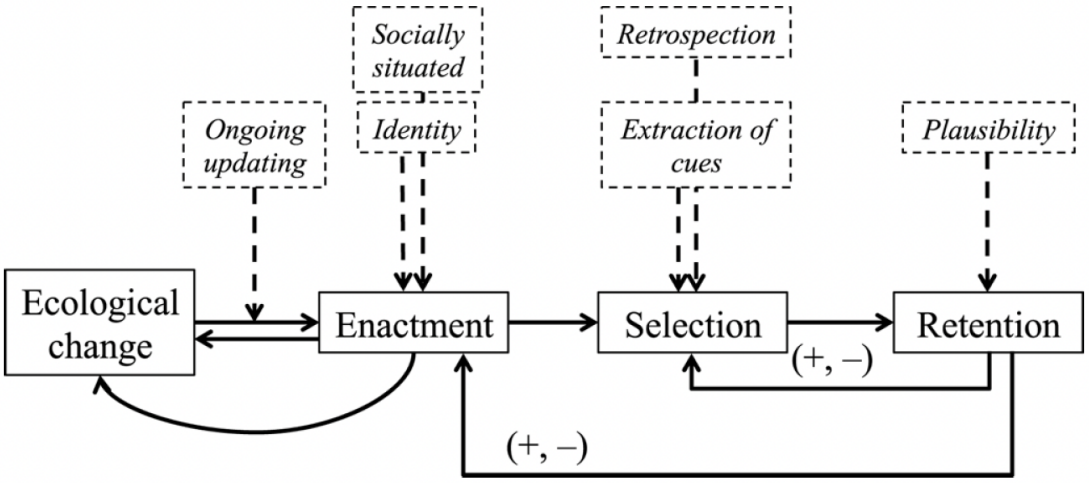

Figure 3 Sensemaking process as presented by Cristofaro (2022, p. 394), adopted from Weick (1979).

The first property, identity construction, highlights the intrinsic link between sensemaking and the self, emphasising that individuals define their identities through the narratives they create and the meanings they ascribe to their experiences (Maitlis & Christianson, 2014). This aligns with organisational identity theory, which suggests that how individuals see themselves within an organisation affects the sense they make of organisational events (Brown, 2000). The second property, retrospection, underscores the importance of past experiences in shaping present interpretations. Sensemaking occurs through reflection on prior events, meaning that cognition is inherently backward-looking (Weick, 1995). However, as Sandberg and Tsoukas (2015) argue, retrospection is not a passive recall but an active reconstruction, wherein individuals reinterpret past experiences to fit their current understanding. The third property, enactment,

differentiates sensemaking from passive perception by stressing that individuals do not merely interpret their environments but actively shape them through their actions. The fourth property, sociality, underscores the inherently social nature of sensemaking, where meaning emerges through interaction with others. Collective sensemaking, particularly in organisational contexts, is shaped by shared narratives, institutional norms, and cultural frameworks (Cornelissen, 2012). This perspective is supported by research on organisational discourse, which illustrates how language, symbols, and story-telling contribute to shared sensemaking processes (Brown et al., 2015). The fifth property, continuation, emphasises that sensemaking is an ongoing, iterative process rather than a discrete event. As organisations operate in volatile and uncertain environments, the process of constructing meaning never reaches a definitive conclusion but instead evolves with new information and experiences (Maitlis & Sonenshein, 2010). The sixth property, extracted cues, refers to the selective attention individuals pay to particular signals within their environment, which then serve as focal points for constructing meaning. These cues often derive from organisational routines, leadership messages, or external conditions (Maitlis, 2005), reinforcing the contextual nature of sensemaking (Gephart et al., 2010). Finally, the seventh property, plausibility, rather than accuracy, governs sensemaking. As Weick (1995) argues, sensemakers prioritise coherence, viability, and usability over objective correctness. In other words, people strive for interpretations that allow them to act effectively, even if those interpretations are not strictly factual (Sonenshein, 2007).

Although sensemaking has been developed in various directions, these original properties are the foundation upon which later sensemaking views build. Further developments by Weick et al. (2005) extend sensemaking into crisis management and high-reliability organisations, highlighting the enactment of meaning through organisational routines. Maitlis and Christianson (2014) elaborate on sensemaking as a dynamic and recursive process that links cognition with action, particularly in volatile project environments. Sandberg and Tsoukas (2015, 2020) critique traditional perspectives and advocate for a phenomenological approach that considers embodied cognition and lived experience in sensemaking. Adding to the Weickian views of cognitivist and language-based constructivism, the authors mention additional sensemaking views, such as intellectualist, embodiment and the body, perception and emotion. This suggests that sensemaking is not a static theoretical construct but an evolving body of knowledge that scholars continuously refine and expand. In this paper, sensemaking is viewed as the creation of meaning happening by ecological change, enactment, retrospective reflection and retention.

Sensegiving

Sensegiving is a fundamental process in organisational life, wherein individuals seek to influence how others construct meaning from their environment. Originally conceptualised by Gioia and Chittipeddi (1991), sensegiving refers to the deliberate effort to shape interpretations, particularly in contexts of ambiguity and change. This process is especially critical during strategic transformations, as it aligns individual and collective understandings with organisational objectives, fostering coherence and facilitating coordinated action (Maitlis & Lawrence, 2007). Sensegiving is often triggered by significant disruptions such as mergers, acquisitions, or strategic realignments, where collective meaning must be actively managed to reduce uncertainty and resistance (Bansal et al., 2022). Leaders engage in sensegiving by crafting compelling narratives that justify and legitimise change while providing interpretive frameworks for organisational members (Gioia & Chittipeddi, 1991). However, this process is not one-directional; rather, it is recursive and interactive, as employees and other stakeholders

interpret, negotiate, and sometimes contest the meanings being offered, thereby shaping the evolving discourse of change (Maitlis & Lawrence, 2007).

Sensegiving occurs through multiple mechanisms, including formal communication, symbolic actions, and relational interactions. Leaders commonly use speeches, reports, and strategic documents to frame organisational initiatives, while their behaviours and decisions serve as symbolic cues reinforcing particular interpretations (Bansal et al., 2022). For example, in acquisition processes, acquiring firms engage in structured sensegiving efforts to mitigate uncertainty and integrate newly acquired entities into the broader organisational culture. This process involves managing both internal and external stakeholders to ensure that the acquisition narrative aligns with organisational objectives and strategic vision (Bansal et al., 2022).

While leaders play a pivotal role in sensegiving, middle managers and employees also contribute to shaping organisational narratives through daily interactions (Maitlis & Lawrence, 2007). This micro-level sensegiving acts as a bridge between top management's strategic vision and employees' lived experiences, reinforcing or adapting meanings based on localised interpretations. Such a dynamic interplay underscores the iterative nature of sensemaking and sensegiving, wherein meaning is continuously negotiated within organisational contexts. The effectiveness of sensegiving depends on multiple factors, including the legitimacy of the sensegiver, the clarity and resonance of the message, and the receptiveness of the audience (Sonenshein, 2010). Research suggests that successful sensegiving extends beyond rational explanations to also appeal to the emotions and identities of organisational members (Gioia & Chittipeddi, 1991). By aligning narratives with employees' values, beliefs, and expectations, sensegiving fosters engagement and reduces resistance to change (Maitlis & Lawrence, 2007). Moreover, sensegiving is a socially constructed and bidirectional process. As individuals engage in sensemaking, they simultaneously participate in sensegiving, shaping the interpretations of their peers (Cornelissen et al., 2014). This interaction highlights the dynamic and co-constructed nature of organisational realities, where meaning is not imposed unilaterally but emerges through discourse and social negotiation (Rouleau, 2005). In this paper, sensegiving is considered to occur when purposeful and deliberate efforts are made to influnnce the sensemaking process of creating meaning.

Sensebreaking

Sensebreaking is the process of disrupting existing cognitive frames and compelling individuals to reconstruct their understanding of a situation (Pratt, 2000). Unlike sensegiving, which provides meaning, sensebreaking destabilises established interpretations, prompting individuals to question their assumptions (Weick et al., 2005). This process often occurs in response to crises, organisational transformations, or ethical dilemmas that challenge existing ways of thinking (Thurlow & Mills, 2015). A seminal example of sensebreaking is found in Weick's (2009) study of the Mann Gulch disaster, where firefighters faced a rapidly shifting environment that invalidated their existing sensemaking frames, leading to a breakdown in decision-making. This illustrates how sensebreaking can occur as a result of external shocks. However, sensebreaking can also be deliberately enacted by leaders seeking to disrupt complacency and foster new ways of thinking (Ashforth et al., 2008). One of the key mechanisms of sensebreaking is the introduction of contradictions, paradoxes, or inconsistencies that create cognitive dissonance, forcing individuals to re-evaluate their assumptions (Maitlis & Christianson, 2014). For example, in organisational change processes, leaders may engage in sensebreaking by exposing the misalignment between current practices

and desired future states, thereby creating urgency for transformation (Balogun & Johnson, 2005).

While sensebreaking is essential for fostering change, it can also provoke anxiety, confusion, and resistance, especially if individuals struggle to reconstruct meaning after disruption (Weick et al., 2005). Prolonged sensebreaking without sufficient sensegiving can lead to organisational fragmentation or paralysis. Therefore, sensebreaking is most effective when it is followed by sensegiving, providing individuals with an alternative framework for understanding the new reality (Maitlis & Sonenshein, 2010). Recent research has also examined sensebreaking in relation to identity work. In professions undergoing transformation, identity work involves self-reflection and reconstruction as individuals navigate changes in their roles and organisational expectations (Brown, 2015). This aligns with the concept of sensebreaking, wherein established meanings are disrupted, prompting individuals to re-evaluate their professional identity. By challenging established meanings, sensebreaking serves as a catalyst for transformation, enabling organisations and individuals to adapt to change. However, its effectiveness depends on the presence of subsequent sensegiving, ensuring that new meanings are constructed in the wake of disruption. In this paper, sensebreaking is considered the destruction of meaning as introduced by Pratt (2000).

Episodes and events

While the sensemaking process is often examined in relation to discrete events, it is increasingly recognised that sensemaking unfolds within broader episodes that provide a structured context for the interpretation of multiple interrelated occurrences (Hernes & Maitlis, 2012). This distinction is particularly important in complex organisational settings, where various actors engage in sensemaking, sensegiving, and sensebreaking in response to unfolding phenomena (Maitlis & Christianson, 2014). An event in the sensemaking literature refers to a discrete occurrence that disrupts existing cognitive frameworks and prompts actors to construct or reconstruct meaning (Cornelissen, 2012). Events can be routine or anomalous, anticipated or unanticipated, and can range from minor organisational shifts to large-scale crises (Weick et al., 2005). In particular, unexpected events – such as technological failures, regulatory changes, or strategic realignments – often function as triggers that necessitate sensemaking (Kutsch et al., 2021). Weick et al. (2005) propose that sensemaking is retrospective in nature, whereby actors interpret events after they have occurred. However, Maitlis and Christianson (2014) argue that sensemaking is not solely retrospective but also prospective, shaping future expectations and guiding organisational responses to emerging situations. This dual temporal orientation is crucial for understanding how individual events serve as catalysts for broader sensemaking episodes, linking past experiences with future strategic actions.

Events vary in their nature and impact, as they can be planned or unplanned, major or minor, and expected or unexpected (Sandberg & Tsoukas, 2015). Planned events include strategic initiatives such as mergers, leadership transitions, or product launches, where sensemaking occurs within a pre-existing interpretive framework. Unplanned events, by contrast, disrupt established structures and force actors to construct new meanings – these may include crises, accidents, or market disruptions. Similarly, some events may be expected, such as regulatory updates or seasonal sales fluctuations, whereas unexpected events – such as cybersecurity breaches or sudden political shifts – require more extensive and urgent sensemaking efforts. The magnitude of events also plays a critical role in determining the intensity of the sensemaking process; minor events may lead to small, localised adjustments, while major events can catalyse prolonged episodes of organisational change (Sandberg & Tsoukas, 2015).

Whereas events are discrete occurrences, episodes are broader, temporally structured sequences within which multiple events unfold (Hernes & Maitlis, 2012). Episodes encompass a set of interconnected events that collectively shape the sensemaking process over time. They are marked by a distinct beginning and end (Sandberg & Tsoukas, 2015), often framed by a particular organisational challenge, crisis, or strategic transformation (Cornelissen, 2012). Unlike isolated events, which may provoke immediate cognitive or emotional responses, episodes provide a structured context in which various actors engage in iterative cycles of meaning construction. Episodes frequently involve multiple moments of sensebreaking, sensegiving, and sensemaking as explained by Kutsch et al. (2021). The authors illustrate the significance of episodes in project management, demonstrating how managers navigate multiple events within a single project phase, each requiring distinct sensemaking strategies. Their study highlights how managers engage in episodic sensemaking, adjusting their interpretations as new information emerges. This iterative process underscores the importance of episodes as the overarching structure within which sensemaking occurs.

Furthermore, the nature of an episode is shaped by the temporal sequencing of events. As Maitlis and Christianson (2014) observe, sensemaking episodes are dynamic and evolve through the interplay of past experiences and future projections. For instance, in crisis management, a single triggering event (e.g., a financial scandal) may lead to a prolonged episode involving regulatory scrutiny, media narratives, and internal restructuring efforts (Weick et al., 2005). Similarly, in project management, a scope change may trigger an extended episode of realignment, negotiation, and strategic reframing (Kutsch et al., 2021).

Sensemaking, collaboration and project management

Sensemaking is a process that occurs continuously (Sandberg & Tsoukas, 2020; Weick et al., 2005) which aligns with the underscoring temporal significance in projects (Ika et al., 2025). Infrastructure projects, characterised by long durations and changing conditions, require constant reinterpretation of evolving situations. The concept of sensebreaking (Pratt, 2000), where established interpretations are disrupted due to external shocks, is highly relevant in these environments. Stakeholders must continually adjust their understanding to align with emergent realities, making sensemaking a cyclical rather than linear process, which at times includes the breaking down of sense due to unforeseen events. The sensemaking process occurs in individuals and collectively in groups (grounded in identity, and the social nature of sense that emerges through interaction), both of which serve as important elements of projects, considering group dynamics, leadership and culture. In other words, identity in interorganisational projects relates to the identity of the individual self (or selves) and the collective identity of the various groups and organisations involved in the project. Sensemaking is the foundational reasoning for actions (enactment of reality), driven by plausibility rather than accuracy, suggesting a strong connection with the heavy reliance on decision making in complex construction projects and the crucial importance of communicating about, reasoning around and executing actions (Weick, 1995; Weick et al., 2005).

Due to the numerous directions of the development of the sensemaking view, it is clear that the sensemaking perspective is not rigid but continuously developing, influenced by emerging empirical findings and theoretical advancements. Infrastructure projects provide fertile ground for expanding this theory due to their complexity and dynamic nature (Alderman et al., 2005; Brunet, 2019). The opportunity to integrate sensemaking with governance structures (Brunet & Forgues, 2019) highlights how multi-stakeholder collaboration influences knowledge creation. Sensegiving (Gioia & Chittipeddi, 1991) plays a key role in shaping these evolving

frameworks, allowing project managers and stakeholders to construct new narratives for decision-making. In construction projects, retrospective sensemaking is essential for learning from previous experiences and applying those insights to future decision-making. The Islamabad Airport case (Iftikhar et al., 2024) illustrates how retrospective framing helps stakeholders navigate crises. Additionally, Martinsuo and Geraldi (2020) highlight that lessons from past projects shape future project portfolio strategies, reinforcing the iterative nature of sensemaking in selection and retention, connected to construction environments.

Brunet and Forgues (2019) explore how collective sensemaking among stakeholders influences governance structures in megaprojects, demonstrating that iterative meaning-making is essential for addressing ambiguity and fostering strategic alignment. In cross-cultural project contexts, Fellows and Liu (2016) highlight how sensemaking mediates stakeholder interactions by helping project managers navigate diverse worldviews, expectations, and power dynamics. Ludvig et al. (2013) provide further insights by illustrating how communicative competence facilitates sensemaking in strategic decision-making processes. Their study of a public-sector client organisation navigating an energy efficiency directive highlights how key actors framed, contextualised, and anchored an ambiguous policy target within the organisation, ultimately shaping strategic outcomes. This underscores the role of discourse and communicative interaction in influencing sensemaking in construction and infrastructure governance.

Sensemaking occurs both individually and collectively, deeply embedded in social contexts (Maitlis & Lawrence, 2007). In inter-organisational collaborations, sensemaking is mediated by group dynamics, leadership styles, and cultural differences (Fellows & Liu, 2016). National and organisational cultures, which are often relevant in large infrastructure projects, influence sensemaking processes, as seen in cross-cultural project management scenarios where differing worldviews create interpretive challenges (Fellows & Liu, 2017). Leadership plays a crucial role in sensegiving, as project managers and executives actively shape interpretations to align stakeholders' perspectives (Gioia et al., 1991). Sensemaking emphasises plausibility over accuracy (Weick, 1995). In major infrastructure projects, where uncertainty is high, decisions must be made quickly based on reasonable interpretations rather than exhaustive data (Kutsch et al., 2021). The reliance on plausibility aligns with the urgency of construction project timelines, where teams must act based on the best available information. Sensegiving processes further reinforce this, as dominant actors frame narratives that guide decision-making (Thurlow & Mills, 2015). This perspective underscores the critical role of communication, discussion, and execution in project management. Sensemaking is a critical process in inter-organisational collaboration within major infrastructure projects. Recognising sensemaking as a dynamic and iterative process, this study reinforces its role in shaping the interactions, structures, and governance mechanisms that drive major construction projects forward.

Methodology

This methodology chapter outlines the research methods and approaches used in three interconnected articles that form the basis of this licentiate thesis. The chapter details the methodological framework, data collection techniques, and analytical strategies used in these studies, providing a comprehensive overview of the research design. The research is based on two main streams of research designs, namely a systematic literature review and qualitative case studies. The systematic literature review offers a structured and comprehensive understanding of the research domain, while the empirical study, grounded in case study methodology, provide in-depth insights into real-world applications of collaborative project delivery. Together, these approaches contribute to a holistic understanding of collaboration in infrastructure construction projects.

Research Philosophy and Approach

Ontologically and epistemologically, the approach of this paper leans towards interpretivism and a constructivist position That being said, I am not convinced there is a need to profess unwavering, eternal loyalty to a specific ontology or epistemology. My view on these approaches are as foundational sets of tools, where they are more or less suitable choices depending on the research intended to be conducted. As living human beings who are thinking, reasoning, experiencing and acting in the world, all that is perceived has to pass through our senses and be cognitively processed by our minds, as von Glasersfeld (1984) stated when explaining radical constructivism. Although not quite as radical, this paper is based on the position that the perceived reality experienced by humans is the foundation upon which the individually constructed world is built. When studying social aspects and phenomena including human interaction, this consideration is difficult to justifiably dismiss completely, as constructivism can be viewed as the study of any social relation (Onuf, 2012). Sensemaking as explained above, fits well within such a constructivist position, as it considers retrospective reflection of lived experiences, the creation of meaning and how language and human interaction may be interpreted. Furthermore, large infrastructure projects with numerous actors and participants involved usually face challenges related to communication, culture and language, emphasising the relevance of a constructivist position together with sensemaking concepts. Aligning with this research philosophy, an abductive research approach was adopted through systematic combining (Dubois & Gadde, 2002), allowing interesting findings to emerge from the data while continuously revisiting theoretical concepts and literature during the collection and analysis of the data. This was applied in the systematic literature review, as well as in the empirical case study which are described further on. The research presented in this paper is qualitative and builds on rich descriptions from semi-structured interviews and observations which is in line with other research employing a sensemaking lens (Gioia & Chittipeddi, 1991).

Furthermore, the study follows a processual view (Langley et al., 2013) to explain the results, showing an evolution perspective of the studied project. The study focuses on specific events that influence the project development. In sensemaking literature, sensemaking is often confined to specific events that trigger sensemaking (Sandberg & Tsoukas, 2015, 2020). These triggers can be either planned or unplanned, major, or minor or a combination (Sandberg & Tsoukas, 2015).

Systematic Literature Review

The first study employed a systematic literature review to investigate collaboration, cooperation, and coordination in infrastructure construction projects. Systematic literature reviews are rigorous methodologies designed to synthesise existing research systematically and transparently (Grant & Booth, 2009; Wee & Banister, 2016). The review process began with a planning and development stage, where the researchers conducted a brainstorming session to define the research aims and identify relevant keywords. These keywords were informed by prior knowledge and validated by external experts. The study focused on peer-reviewed journal articles in English published between 1980 and 2024, with keywords such as "collaboration," "infrastructure construction," and "project" refined through iterative searches in Scopus and Web of Science (WoS). To ensure relevance and quality, the researchers applied exclusion criteria that filtered out non-English texts, conference papers, and books.

During data collection, the final keyword searches in Scopus and WoS initially yielded 9,580 results. After applying exclusion criteria (such as only considering articles from a list of the more influential journals in the field, and dismiss conference proceedings), including journal and screening titles, abstracts, and full texts, the dataset was narrowed down to 137 articles. This selection process involved both independent and collaborative evaluations by the authors. The subsequent data analysis was conducted using NVivo software through an iterative two-step coding process. In the first step, definitions and attributes of collaboration, cooperation, and coordination were mapped. The second step identified dimensions and relationships among these concepts. Intercoder reliability was ensured through independent coding and cross-checking, supported by consultations with external experts. To validate the findings, the researchers engaged in internal workshops, discussions with external stakeholders, and a conference presentation. The review followed best practices to mitigate biases by employing systematic selection criteria and seeking external input to refine search terms. Through this rigorous approach, the study ensured the reliability and comprehensiveness of its findings on collaboration, cooperation, and coordination in infrastructure construction projects.

Case Study

The two empirical papers are based on a longitudinal case study approach, focusing on a road tunnel restoration project in the Nordics from 2021 to 2024. Case studies are particularly suited for exploring complex, socially constructed phenomena within real-world contexts (Dubois & Gadde, 2002; Siggelkow, 2007). Choosing a single case study approach enables deep exploration of phenomena through rich and descriptive data (Eisenhardt & Graebner, 2007). It enables research and conceptual development to explain reality in a way that evokes interest in both practitioners and theorists (Siggelkow, 2007). The study aimed to understand how collaboration evolves and is enacted throughout the project lifecycle. Moreover, this study places a pronounced focus on the interrelationships and collaborative dynamics among key project stakeholders, specifically the client, the contractor, and the design engineers. By examining these interactions, the research aims to illuminate how the engagement between these primary actors influences interorganisational collaboration and contributes to the overall sensemaking process within the project's evolution. Apart from being a major infrastructure project, the specific case was selected due to its organisational complexity (Geraldi et al., 2011) and its use of a CPDM, demonstrating a considerable focus on collaboration.

Case Context

The studied project involved the renovation of a major urban road tunnel in a major city in the Nordics, divided into three sub-projects managed under distinct contracts but governed by a unified collaboration framework. The contractual model emphasised joint risk management, co-location, transparency, and collaborative goal setting among project stakeholders, including the public client, contractors, and design engineers. The subject of this longitudinal study, spanning from 2021 to 2024, is a complex road tunnel renovation and reinforcement project located in a major urban area in Sweden. The tunnel, stretching approximately 0.5 km beneath a river, serves as a critical logistical passage for both the region and the country, accommodating an average daily traffic volume of 125,000 vehicles. Given its strategic significance, minimising construction time and ensuring the tunnel's swift return to full operational capacity has been a high priority for the client. Nevertheless, as more stakeholders became aware of the fact that the tunnel was to be closed for renovation, they wanted to cease the moment and make use of this valuable yet rare opportunity. More and more suggestions and plans for the tunnel were added, which considerably increased the scale of the project. The project's final cost is estimated at 1.3–1.4 billion SEK, a cost significantly larger than what was included in the original budget, reflecting both its infrastructural importance and organisational complexity. To mitigate traffic disruption during construction, a phased approach was adopted, allowing one half of the tunnel to remain open while work progressed on the other. The logistical significance of the tunnel passage motivated the keeping of the tunnel in operation during the restoration, which also stressed the timely aspect of finishing the project quickly in order for the tunnel to return to full capacity as soon as possible.

The client and owner of the project is Sweden’s principal public government body responsible for the planning, construction, and maintenance of national transport infrastructure, including roads and railways. Initially conceived as a relatively small-scale renovation, the project expanded significantly during the planning phase due to the identification of additional restoration and modernisation needs. Consequently, the project was restructured into three sub-projects, each governed by a distinct contract and managed by an appointed project manager. A senior project manager (SPM) was assigned overarching responsibility for the entire tunnel project, ensuring coherence across the sub-projects. Additionally, a designer was procured under a separate contract to contribute to the design phase across all three sub-projects. All four contracts, while differing in scope and specific responsibilities, adhered to a unified CPDM, mandated by the public client under the framework "Contract Model Collaboration High Level." This contractual arrangement prescribed a structured yet flexible approach to collaboration, encompassing early contractor involvement, different contractual and payment agreements for the different sub-projects. Furthermore, it provided a framework for project execution across three key phases: early-stage planning, procurement, and production. It also established collaborative guidelines and requirements, including joint goal setting, risk management, co-location of teams, conflict resolution mechanisms, continuous follow-ups, and transparency on matters of shared interest. Although these principles were outlined in the contractual framework, their implementation required further interpretation and refinement by the project managers, necessitating the development of a more detailed collaboration strategy.

Table 1 Organisational structure and contract agreements of the tunnel project (Rönndahl et al., 2025).

Part of Project	Organisation	Project responsibility	Type of Contract	Contractual Collaboration level
Sub-project I	Contractor A	Groundworks and Traffic: Preparing areas in close proximity to the entrances of the tunnel, like the preparing of the ground, constructing the roads etc.	Design-Bid-Build without target price	High
Sub-project II	Contractor B	Tunnel Construction: Load-bearing and non-load-bearing structural elements such as concrete pillars, steel beams etc.	Design-Bid-Build with target price	High
Sub-project III	Contractor C	Installations and ITS: Includes lighting fixtures, cables and intelligent transportation systems etc.	Turnkey Contract	Basic with features of high
Design	Design Engineer	Design of the entire project (all sub-projects) including calculations, producing blueprints and drawings	Cost-Plus Contract	High

Following contract allocation, the project planned to proceed in two principal phases. The first phase encompassed planning, design, and technical calculations, while the second phase focused on production and on-site construction. The contractual framework also included provisions for team-building activities, managerial coordination, and structured collaboration mechanisms to facilitate effective interaction among the key stakeholders, namely the client, contractors, and design engineers. By ensuring a high level of collaboration at both organisational and contractual levels, the project aimed to enhance efficiency, mitigate risks, and achieve its overarching goal of restoring and modernising a critical infrastructure asset with minimal disruption.

Data Collection

Semi-structured interviews were conducted in three rounds as can be seen in the timeline in Figure 8. Round 1 was conducted in 2021during the design phase when only one of the sub-projects had started construction. Round 2 was conducted in the end of 2022 and the beginning of 2023 during the construction phase. Round 3 was conducted during 2024 at the end of the construction phase. Thus, it was possible to interview project participants in different phases of the project; the preconstruction phase where design, planning and project set-up occurred. The second round occurred in the middle of the hectic construction phase, with many people, machines and building material on the construction site, which mostly was the confined space of the tunnel. During the last round of interviews the construction was about to end and the atmosphere was not as hectic as during the second round of interviews. A total of 42 interviews were held with project managers, collaboration managers, and other key stakeholders. The

interviews were conducted in person or via a digital video call platform depending on the preference of the interviewee. All interviews were recorded. Interviewees were purposefully selected as experts or members of management teams working and collaborating with other organisations within the project organisation. As table 2 shows, project participants from all three main actor organisations, i.e. client, design engineer and contractor, participated in the study. This enabled a collection of data containing important insights from various views and perspectives, providing a body of data which holistically represents the project. A summary of the observations is presented in table 3. Non-participatory observations, totalling 50 hours, included shadowing senior project managers and attending meetings such as collaboration and construction reviews. Continuous note taking was used during the observations, and in instances where permission was granted, the meetings which were being observed were audio recorded. Secondary data such as project documents, contracts, survey reports, and relevant websites provided additional insights and context.

Table 2 List of interviewees from the tunnel renovation project (Rönndahl et al., 2025).

Actor	Role	Round 1	Round 2	Round 3	Total
Client	Project Manager	3	4	4	11
	Expert adviser and traffic strategist	1	1	-	2
	Owner	1	1	-	2
Design Engineer	Project Manager	1	1	1	3
	Task Manager	3	4	3	10
	Work Environment Coordinator	1	-	-	1
Contractor	Project Manager	4	3	3	10
	Collaboration Manager	1	1	1	3
	Total	15	15	12	42

Table 3 Summary of observations conducted at the tunnel renovation project

Type of observation	Object	Organisations	Duration (h)
Meeting observation	Collaboration meetings (11), project survey review meetings (11), construction meeting (1), financial meeting (1), coordination meeting (1)	Client, Contractor, Design Engineer	31
Shadowing	Senior Project Manager, Deputy Project Manager, Project Manager for sub-project I	Client	14
Observation	Project office, construction site, site office	Client, Contractor, Design Engineer	5
Total			50

Data Analysis

The analysis followed an abductive approach (Dubois & Gadde, 2002), characterised by systematic combining of empirical observations with existing theoretical frameworks. Consistently moving back and forth between literature and the empirical material enabled continuous matching of existing theories and empirical observations. This iterative process allowed for changes in direction and adjustments in theoretical focus, data collection and analysis throughout the process. One result of this was the adoption of the sensemaking view, which emerged after visiting practice theory and organisational routines. The longitudinal design facilitated iterative refinement of themes as data collection progressed. All interviews were transcribed verbatim. Interview transcripts and notes from the observations were imported into NVIVO which was the software used for the coding. A two-step coding process, inspired by Gioia and Chittipeddi (1991) was used, consisting of open coding and second order thematic coding. In the open coding, key activities and events influencing collaboration were identified. The data from the interviews and observations were read through which resulted in various codes to emerge. In the second order thematic coding that followed, sensemaking theory was applied to interpret critical incidents and triggers for collaboration. The second order coding process focused specifically on assigning particular portions of text to codes related to sensemaking concepts. The following step included connecting the sensemaking codes with the collaborative activities as explained by the interviewees and as observed on site. Critical Incident Technique (CIT) was employed to identify significant events and processes that shaped collaborative practices (Gremler, 2004). By studying the interview transcripts and identifying incidents that were expressed as having a significant impact (positive or negative) on the project and the interorganisational collaboration within the project organisation, a number of revealed events qualified as critical events. These incidents were analysed for their influence on collective sensemaking and sensegiving processes related to the collaborative efforts in the project.

Research Validity and Reliability

Several measures were made to ensure robustness. Triangulation of various data sources (interviews, observations, and documents) and methods to increase validity, reliability and credibility in the results. It also ensures a more balanced view, reducing the risk of introducing unnecessary bias, and ultimately enhancing the understanding. Similarly systematic cross-checking of codes and themes by independent researchers in the systematic literature review helped to increase validity, reliability and improved transparency. Iterative validation of findings was also used, through discussions with project participants and external experts. By integrating a systematic literature review with longitudinal case studies, this research bridges theoretical constructs and practical applications. The systematic review provides a comprehensive conceptual foundation, while the empirical studies offer rich, context-sensitive insights into collaborative practices.

Ethical considerations

Ethical considerations are a fundamental aspect of qualitative research, ensuring the protection of participants, the integrity of the research process, and the credibility of the findings. This study adhered to The European Code of Conduct for Research Integrity (ALLEA, 2017), which governs research ethics at Chalmers University of Technology. In addition, the research complied with the Swedish Ethical Review Act (2003:460) and the General Data Protection Regulation (GDPR, 2016) to safeguard participants' rights. Given the sensitive nature of the data collected, including names, email addresses, phone numbers, job titles, and organisational

affiliations, strict ethical measures were implemented to ensure confidentiality, informed consent, and secure data handling. Informed consent is a cornerstone of ethical research involving human participants (Bryman, 2016). In accordance with The European Code of Conduct for Research Integrity, participants were provided with an explanation of the study's aims, data collection methods, and intended use of the data. Written or recorded consent was obtained after allowing participants the opportunity to ask questions before agreeing to take part. Furthermore, explicit consent was sought to record and transcribe the interviews, ensuring transparency in the data collection process. Participants were informed that their involvement was voluntary and that they could withdraw at any stage without providing a reason or facing any negative consequences, in line with ethical best practices (Flick, 2022).

Confidentiality is a key ethical principle in qualitative research, particularly in case studies where participants may be identifiable due to their professional roles (Wiles et al., 2008). In this study, all personal data, including names, contact details, and job titles, were handled with strict confidentiality. To ensure compliance with GDPR and Chalmers' research integrity guidelines, all data (such as digital audio, recordings and interview transcripts) were securely stored on encrypted drives, with access restricted to authorised researchers only. Identifiers were removed from transcripts and anonymised in reports. GDPR (2016) mandates that personal data be processed lawfully, fairly, and transparently. This study followed these principles, ensuring that participant data were only used for the stated research purposes and were not shared beyond the research team. The study also prioritised anonymity in the presentation of data, an important step to protect participants from potential professional or reputational risks (Saunders et al., 2015).

Interview responses were attributed to general roles such as "Senior Project Manager" or "Coordinating Project Manager " rather than to individual names. Direct quotes were reviewed to remove any contextual identifiers that could inadvertently reveal the identity of participants. Reflexivity is also an ethical consideration that plays a key role in ensuring the ethical integrity of qualitative research, as researchers inevitably influence data collection and interpretation (Finlay, 2002). Given the close interaction between the researcher and participants, steps were taken to critically reflect on potential biases and power dynamics. Reflexivity was maintained through regular peer discussions and self-evaluation to minimise researcher influence on the findings. By adopting these reflexive practices, the study aligned with the principles of honesty and transparency outlined in The European Code of Conduct for Research Integrity (ALLEA, 2023). Another key ethical principle considered in this study was minimising harm to participants. The principle of non-maleficence, which dictates that research should not harm its participants, is fundamental to ethical research (Orb et al., 2001). In this study, potential risks were mitigated by avoiding intrusive or sensitive questions, ensuring that participants' responses would not be used in ways that could negatively impact their professional standing, and considering organisational sensitivities when reporting findings. Finally, transparency in the research process is essential for maintaining ethical integrity (Tracy, 2010). Participants in the study were fully informed about their rights and the ways in which their data would be used. The methods applied in collecting, storing and organising data are accounted for, including rich descriptions of the data. Academic conferences have served as an outreach platform through which the research has been presented, reviewed and discussed. Table 4 lists the ethical considerations and measures taken.

Table 4 List of ethical considerations and measures taken

Ethical Consideration	**Measures Taken**
Informed Consent	Written and/or recorded consent obtained; participants informed of study aims, data use, and voluntary participation
Confidentiality	Personal data anonymised in transcripts and findings; access restricted to authorised researchers
Data Protection	Data stored on encrypted drives and secure servers; GDPR compliance maintained
Storage and Handling of Data	Secure storage; data retention limited
Anonymity in Data Presentation	Job roles used instead of names; identifying details omitted from reports and quotes
Researcher Reflexivity	Peer discussions and self-evaluation conducted to reduce bias
Minimising Harm	Sensitive questions avoided; organisational sensitivities considered
Transparency	Participants informed of their rights; methods and research design explained, participation in conferences

Appended Papers

This thesis is based on three articles, all of which have been presented at conferences. One is published in a journal (*Project Leadership and Society*), one has been submitted to a journal, and one is a work in progress. All papers relate to infrastructure construction projects and collaboration. Paper 1 describes how the terms collaboration, cooperation, and coordination are used in literature, providing a theoretical foundation for understanding the complexities of collaborative efforts in infrastructure projects. Paper 2 explores how collaboration is developed and maintained over time in major infrastructure construction projects using a sensemaking approach to understand the dynamic and evolving nature of CPDMs. Paper 3 delves into the practical aspects of collaboration by examining how project managers and facilitators shape and give sense to collaboration through a longitudinal case study of a road tunnel renovation project, highlighting the roles of sensemaking and sensegiving in fostering effective collaboration.

Together, these three papers, in combination with the overarching text in the thesis, create a more comprehensive understanding of collaboration in infrastructure projects by bridging theoretical concepts, processual development, and practical implementation. The first paper establishes a conceptual framework by critically reviewing how collaboration is defined and operationalised in existing research, forming a necessary foundation for the empirical studies. The second paper builds on this by investigating how collaboration emerges and evolves over time, offering insights into the fluid and adaptive nature of CPDMs in major projects. The third paper adds depth by examining the agency of project actors in shaping and reinforcing collaboration through sensemaking and sensegiving processes. By integrating these perspectives, the thesis provides a holistic understanding of how collaboration can be fostered and sustained in infrastructure projects, accounting for both structural and human-centric dimensions. The connections between the research questions and the papers are illustrated in Figure 3.

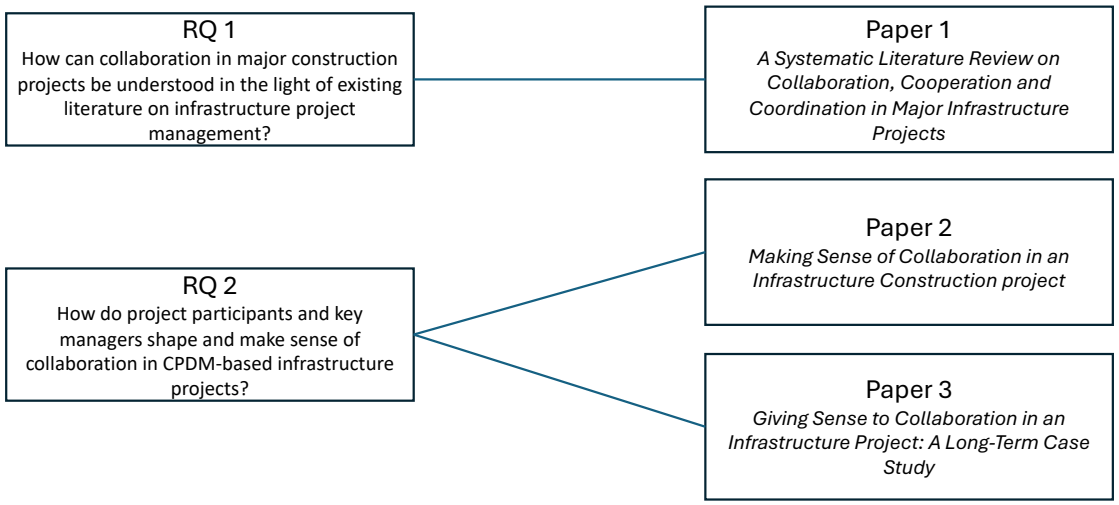

Figure 4 Connection between the research questions and the papers.

Paper 1: A Systematic Literature Review on Collaboration, Cooperation and Coordination as used in Relation to Infrastructure Projects

This study addresses the ambiguity surrounding the terms collaboration, cooperation, and coordination within the field of infrastructure project management. While these terms are frequently used, their definitions and applications vary significantly across different theoretical perspectives, creating inconsistencies in research and practice. The study aims to clarify these concepts and examine their interrelationships by identifying key components influencing them, such as trust, communication, culture, and contracts. Drawing upon literature in project management, construction management, and relational governance, the study builds on theoretical perspectives related to inter-organisational collaboration, stakeholder management, and contract-based governance in infrastructure projects. The concept of relational governance, which integrates formal contractual mechanisms with social trust and interaction, serves as a foundation for understanding how collaboration, cooperation, and coordination function in large-scale, multi-stakeholder projects.

A systematic literature review was conducted following best practices in review methodology. The study involved a structured search in Scopus and Web of Science databases, covering publications from 1980 to 2024. The selection process applied rigorous inclusion and exclusion criteria, narrowing down from 9,580 initial results to a final set of 137 articles. The articles were coded and analysed using NVivo software, focusing on how collaboration, cooperation, and coordination are defined and operationalised in the literature. The study also examined theoretical frameworks used in the field and synthesised findings into a conceptual model. The study identifies four key components influencing collaboration, cooperation, and coordination: trust, communication, culture, and contracts. These elements shape how these concepts are enacted in infrastructure projects. Collaboration is described as a dynamic and evolving process that requires mutual commitment, trust, and shared project goals. It involves deep interpersonal relationships and flexible project structures. Cooperation is seen as a less intensive form of collaboration, characterised by independent decision-making and a willingness to align interests, often guided by contractual agreements but also influenced by social relationships. Coordination is the most structured of the three, relying on predefined processes, sequencing of tasks, and contractual clarity rather than relational factors. It is more transactional and less dependent on trust or interpersonal relationships. The study establishes a hierarchical relationship between the three concepts, with coordination as the foundation that enables cooperation, which in turn facilitates collaboration. This progression reflects increasing levels of relational complexity and interdependence. Despite the growing interest in these concepts in infrastructure project management research, definitions remain inconsistent, with some studies using them interchangeably and others positioning them as distinct constructs.

The study makes important theoretical and practical contributions. It provides conceptual clarity on collaboration, cooperation, and coordination in infrastructure project management by differentiating their definitions and interrelationships. A conceptual framework is developed to illustrate how these three concepts interact and how they are influenced by trust, communication, culture, and contracts as illustrated in Figure 4. Additionally, it highlights gaps in existing literature, particularly the lack of longitudinal studies and inconsistencies in theoretical perspectives. In practice, the study offers a structured understanding of which elements drive each concept, helping practitioners determine where to focus efforts in infrastructure project delivery. It demonstrates that coordination can be effectively defined

through contracts, whereas collaboration requires both formal agreements and informal relational mechanisms. The findings support project managers in choosing appropriate governance mechanisms by showing how different levels of collaboration, cooperation, and coordination should be integrated to achieve project goals.

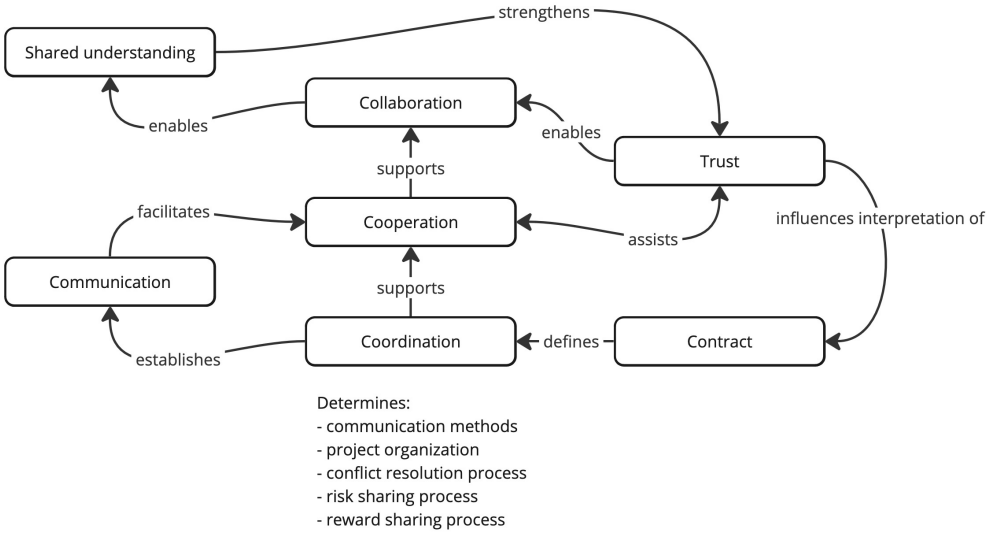

Figure 5 The continuum of collaboration, cooperation and coordination

Paper 2: Making Sense of Collaboration in Major Infrastructure Construction projects

This study explores how collaboration is enacted, maintained, and developed over time in major infrastructure construction projects using collaborative project delivery models (CPDMs). While previous research has examined collaboration from various perspectives, limited empirical insight exists on its dynamic evolution. To further explore the creation and development of collaboration, the study applies a sensemaking approach to examine how project actors interpret and shape collaboration throughout the project lifecycle. The research question specifically asks: How is collaboration enacted and made sense of by project participants in infrastructure construction projects using a CPDM?

The study is grounded in sensemaking theory, which examines how individuals and groups construct meaning in complex and uncertain environments. Drawing on Weick's work, the study considers sensegiving as an attempt to shape others' interpretations and sensebreaking as the disruption of existing understandings. By applying these concepts, the study explores the interplay between contractual governance and relational mechanisms in CPDMs. A longitudinal case study was conducted on a large infrastructure project, involving 42 semi-structured interviews across different project phases, 46 hours of observations, and secondary data from project documents. The abductive analysis identified key events and triggers influencing collaboration, tracing its evolution over time.

The findings highlight that collaboration is shaped by both structured governance and emergent interactions. At the outset, project managers engaged in sensegiving by embedding collaboration principles in contracts and ensuring management team alignment. However,

several sensebreaking events disrupted established collaborative practices, requiring actors to reconstruct their understanding. For example, unexpected structural defects in concrete pillars forced the team to prioritise problem-solving over contractual disputes, demonstrating the importance of adaptability and trust in maintaining collaboration. Similarly, the transition from design to production phases, which did not transpire according to plan, became a major challenge due to delays, necessitating renewed sensemaking among project participants. The study illustrates the cyclical nature of collaboration and sensemaking, showing how project actors continuously navigate between order and chaos. While structured collaborative strategies provide stability, unplanned challenges demand flexibility and relational trust. The research extends sensemaking theory in project management by demonstrating how collaboration evolves through continuous interpretation and adaptation. Practically, the study underscores the importance of establishing a shared collaborative vision early, fostering structured communication, and ensuring flexibility in contracts to accommodate unexpected challenges. It highlights the need for regular reflection forums, such as collaboration meetings, where project actors can engage in structured sensemaking to align expectations and strategies.

By integrating sensemaking theory with CPDM research, this study provides a deeper understanding of how collaboration develops in large-scale infrastructure projects. It concludes that while governance structures set the foundation, the success of collaboration ultimately depends on project actors' ability to interpret, adapt, and collectively make sense of their interactions.

Paper 3, Giving sense to collaboration in an infrastructure construction project: A Long-term case study

This study explores how collaboration is shaped and maintained over time in complex infrastructure projects, focusing on the role of key stakeholders in facilitating collaboration. While previous research has examined the benefits of collaborative project delivery models (CPDMs), little is known about how collaboration evolves throughout a project's lifecycle. The research investigates how the senior project manager and the collaboration manager influence collaborative processes through sensegiving and seeks to answer the question: How do the project manager and the collaboration manager facilitate collaboration through sensegiving processes? The study applies sensemaking and sensegiving theory to understand how project actors interpret and reinforce collaboration. Sensemaking is an ongoing process where individuals construct meaning, particularly in response to unexpected challenges, while sensegiving refers to the deliberate shaping of others' interpretations. The theoretical framework also incorporates perspectives on project complexity, highlighting how collaboration is influenced by structural and organisational challenges in large-scale projects.

A qualitative, longitudinal case study was conducted on a road tunnel renovation project in a major Nordic city from 2021 to 2024. The project, divided into three sub-projects under a common CPDM framework, was managed through a structured collaboration model. Data were collected through 39 semi-structured interviews with project managers, contractors, and designers, as well as non-participatory observations at project offices and construction sites. Secondary data from project reports and contractual documents complemented the analysis. A two-step coding process identified key activities related to collaboration and examined how sensegiving influenced the sensemaking of project participants.

The findings show that the senior project manager and the collaboration manager played critical roles in facilitating collaboration through structured and ongoing sensegiving efforts. The project manager developed and communicated a clear collaborative vision, embedding it into procurement and management structures to ensure alignment among project participants. A formalised collaboration framework, including decision-making and communication processes, helped maintain clarity in roles and responsibilities. The collaboration manager focused on sustaining and adapting collaborative efforts throughout the project. Regular collaboration meetings, performance assessments, and structured feedback processes ensured that collaboration remained central despite evolving project dynamics. Periodic surveys and discussions allowed project participants to reflect on their practices and make necessary adjustments.

The study highlights key mechanisms that reinforced collaboration, including establishing a shared vision, structuring decision-making and communication, facilitating regular evaluation, and adapting collaboration to emerging challenges. Sensebreaking moments, such as leadership transitions and unexpected project complexities, required renewed sensegiving efforts to maintain alignment and cohesion. The study makes both theoretical and practical contributions. Theoretically, it extends the application of sensemaking and sensegiving theory to collaborative project management, demonstrating how key actors actively shape and sustain collaboration. It highlights the interplay between formal governance structures and emergent, actor-driven sensemaking processes. Practically, the findings offer insights for project managers and public clients seeking to implement CPDMs effectively. Establishing a clear collaborative vision early, maintaining structured communication, and fostering continuous reflection are essential for sustaining collaboration. While initial sensegiving efforts provide a foundation, long-term collaboration depends on continuous adaptation and engagement. The study concludes that successful collaboration in large-scale infrastructure projects is not solely a product of contractual agreements but is actively constructed and reinforced by key facilitators throughout the project lifecycle.

Discussion

The following chapter will expound further on findings from the three papers and provide a discussion on collaboration in major infrastructure projects, heavily based on collaboration and sensemaking processes studied in the case. Illustrating the project from a process view, the chapter is structured around the two research questions. The view on collaboration in major infrastructure projects will be discussed, followed by a discussion on how key project participants make sense of collaboration in infrastructure projects employing a CPDM.

The multidimensional nature of collaboration

This chapter relates to the first research question (How can collaboration in major construction projects be understood considering the current literature on infrastructure project management?). It will discuss the systematic literature review and how collaboration, cooperation and coordination can be viewed in relation to infrastructure projects.

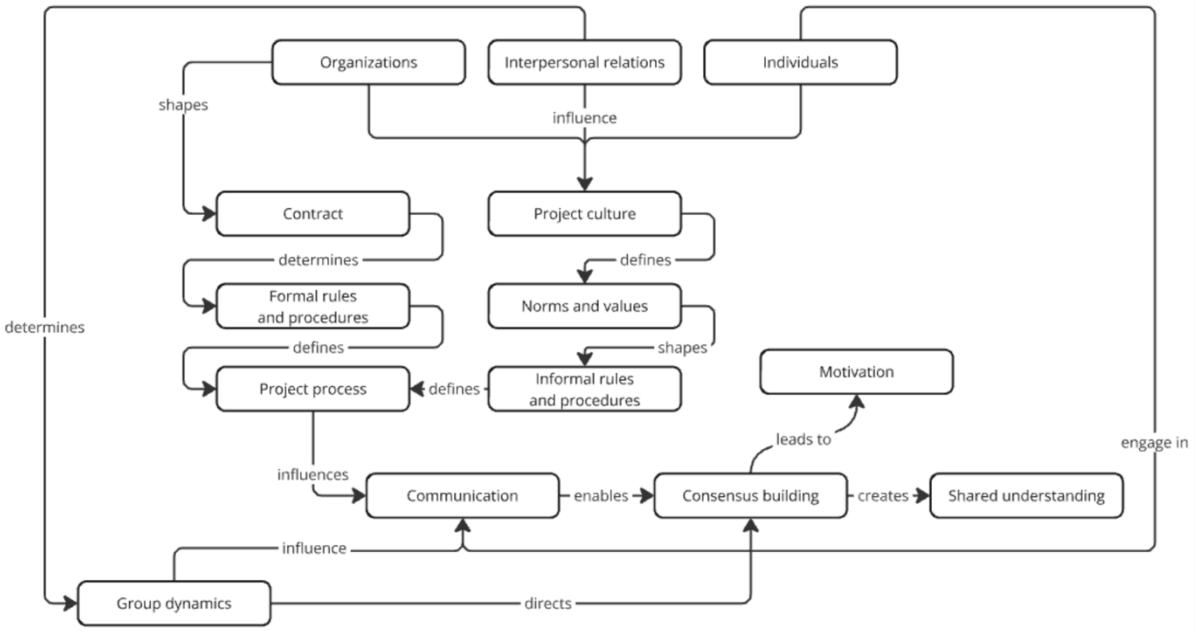

Figure 6 The creation of a collective sense of purpose

A conceptual framework of features influencing collaboration and the process to create a shared understanding and motivation in major construction projects is illustrated in Figure 5. Numerous features and influencing aspects emerged during the review process, emphasising the multidimensional nature of collaboration, cooperation and coordination in major infrastructure projects. The main topics that emerged are presented in Figure 5, which also illustrates the connection between the topics. As with most frameworks, this is a simplified model of reality, highlighting important aspects to consider when managing complex construction projects. At the very top of the framework are three levels; organisations, individuals and interpersonal relations. Individuals are the organisational agents (Cristofaro, 2022) acting in or on behalf of an organisation. The interpersonal relations are the relational bonds created through personal interaction between organisational agents. From the literature reviewed it was derived that all three of these are connected to the middle stream which includes project culture, norms and values and informal rules and procedures. These terms consider the emerging and developing social aspects in a project. A project culture is not produced the instant the project organisation is formed but rather grows and evolves throughout the project process as different actors join the project organisation. In this process, actors bring

ideas, norms, beliefs, values and assumptions from various backgrounds, merging with and forming the project culture. In other words, in a large project organisation, both individual and organisational cultures from various sources are brought together, over time creating a unique, project specific culture in which the project actors operate.

The stream on the left illustrates features that are more connected to institutional, formal governance like contracts, formal rules and procedures. These features shape the project process together with the more informal and social features of the right-hand stream. Even though these two streams and their included features are perhaps not quite as separated in reality as they are in the Figure 6, the literature is quite consistent in discussing governance and collaboration dichotomously, like formal and informal, relational or traditional, justifying the two streams in the model. Of these two streams one is emphasising formal governance mechanisms and contractual obligations, and the other focuses on relational governance and informal coordination. Formal governance structures, such as contractual agreements and predefined coordination mechanisms, provide legal and procedural frameworks to mitigate risks and define accountability (Adami et al., 2019; Antillon et al., 2018). In contrast, relational governance is grounded in trust, shared norms, and long-term partnerships, fostering a more flexible and adaptive approach to collaboration (af Hällström et al., 2021; Benítez-Ávila et al., 2018). However, rather than being mutually exclusive, these governance approaches often coexist in infrastructure projects. Barutha et al. (2021) highlight that formal structures alone are insufficient to manage the complexity of infrastructure projects, requiring the complement of informal relational mechanisms to enhance adaptability and stakeholder engagement. Similarly, Benítez-Ávila et al. (2018) demonstrate that relational governance can mediate the effectiveness of contractual governance by fostering trust and cooperation among stakeholders. Thus, rather than a strict dichotomy, infrastructure projects operate within a hybrid governance model where formal and informal mechanisms interact dynamically to shape project outcomes. This underscores the importance of adopting a balanced approach that integrates both governance perspectives to ensure efficient collaboration and successful project delivery.

Sensemaking, Sensebreaking and Sensegiving: The Evolution of Collaboration

This chapter relates to research question two (How do project participants and key managers shape and make sense of collaboration in CPDM-based infrastructure projects?). It will discuss collaboration among project participants and key actors in the tunnel renovation project from a sensemaking perspective and how fluctuations between states of order and chaos were handled. Episodes, events and triggers will be presented along the project timeline and discussed, illustrating the management of collaboration and how the collaborative efforts are connected to sensemaking processes such as sensegiving and sensebreaking.

Construction projects are inherently collaborative; however, the nature and extent of collaboration can vary significantly. In the context of large-scale, complex infrastructure projects, the necessity of collaboration is self-evident, given the multiplicity of stakeholders, the breadth of expertise required, varying levels of experience, role differentiation, time constraints, logistical complexities, cultural diversities, and often divergent project goals (Denicol et al., 2020). Despite this recognition, collaboration is approached in markedly different ways, ranging from traditional, transactional project agreements to explicitly structured CPDMs. Even within CPDMs, degrees of collaboration vary, underscoring their inherent flexibility (Nwajei et al., 2022). Understanding this flexibility is crucial for determining the appropriate application of CPDMs and maximising their potential benefits. It

would be an oversimplification to assume that a single rigid, universally applicable solution exists for all complex construction projects, procurement strategies, contractual frameworks, and compensation structures. Instead, project-specific conditions and the unique interplay of complexities necessitate a diverse array of tailored approaches. CPDMs should thus be regarded not as an outright replacement for traditional methods but as a valuable complement within a broader spectrum of viable project delivery strategies.

The necessary flexibility in creating a collaborative contractual framework for the process of delivering complex projects was demonstrated in the tunnel renovation case. It manifested itself in two ways; first when various solutions for how to work with collaboration were discussed and organised at the very beginning of the project setup, and second, how the CPDM enabled flexible solutions to be discussed and implemented throughout the project process. This second point was particularly important when challenges arose and compromised the current sense and collective understanding of project participants, i.e., when sense was broken (Pratt, 2000). Just like this case demonstrates, sense was broken on several occasions and with a variation in severity and impact, forcing actors to cope with situations at times characterised by chaos and at times more characterised by order (Rönndahl et al., 2025). The chaotic state refers to situations when the environment is changed and the collective understanding becomes unclear due to triggering unforeseen events and uncertainty (Sandberg & Tsoukas, 2015), which obscure the current meaning and reasoning of how to act. States of order refer to situations in which the environment remains foreseeable and predictive enough for the collective understanding of what, how and when project actors are to do things is aligned and according to plan. However, even though some of the challenging events that occurred could not be foreseen and consequently could not be included in the original plan, a plan and strategy was made for how to act when such unforeseen events took place. Having this strategy in place enabled the project to bounce back from states of chaos to more orderly states, as project participants made sense of the challenges and acted accordingly (Rönndahl et al., 2025). Thus, the project managed to counteract challenges that introduced higher degrees of chaos and remain in states of sufficient order. The fluctuations between these operational states are illustrated in Figure 6.

Oscillation between order and chaos

Figure 7 presents four different degrees of project order. At the very top is perfect order, which refers to an unachievable level of planning, structure and prediction. It entails a state in which all project participants know exactly what to do, how to do it and when to do it. No unforeseen events can occur because all potential challenges have been considered and planned for. Communication is flawless and every actor has access to correct information at the correct time, and the flow of information between the client, contractors and design engineers is impeccable. Even though this may not be achievable, this is the aim toward which project management strives with its allocated resources. The unattainability of the state is indicated by the solid straight line just below the words “Perfect Order”. Generally, the highest degree of order project managers and project participants will achieve is operational order. This is a state in which things go according to plan, project actors have enough information and understanding to carry out each specific task without major disruptions such as major unplanned events (Sandberg & Tsoukas, 2015). Sensemaking processes occur within the scope of the planned tasks. Operational chaos is realised when challenges and unforeseen events disrupt the work of project participants, breaking the collective sense and triggering sensemaking processes for tasks not included in the plan (Rönndahl et al., 2025). However, the strategy to deal with such unforeseen events is still powerful enough to regain a sense of order

in the project. By making sense of the critical situation through retrospectively and collectively reasoning together on how to enact the changed environment (Weick et al., 2005), sense managed to be created again, and order was sufficiently restored to continue with the project (Sandberg & Tsoukas, 2015). The lowest degree referred to in the illustration as irreversible chaos is a state from which there is no return. At this state challenges have occurred which cannot be counteracted enough for the project to bounce back into operational order or even operational chaos. Challenges have arisen to such a degree that unsolvable conflicts prevail, contracts are cancelled, and the project itself is dissolved and ceases to exist. A complete collapse of sensemaking and permanent sensebreaking (Weick, 2009). In other words, this is a state which must be avoided in order for the project to be successfully delivered or delivered at all.

From left to right at the bottom of Figure 6 there is a timeline indicating the progression of time of the project, including the project set-up at the beginning and a number of events that took place during the project. It does not depict a complete overview of the entire timespan of the project but includes a number of selected events. Positioned around the graph indicating the perceived level of project order are three sensemaking facilitators (α) and four event-induced sensebreakers (θ). Similarly as to the timeline, the illustration does not present all activities facilitating sensemaking or all event-induced sensebreakers, but a selection of these presented in the order in which they occurred in relation to each other. The sensemaking facilitators are activities that enable collective creation of meaning to occur among the management teams in their specific constellations (client, contractor, design engineer and combinations of them in which some or all actors are represented). During the project set-up, the importance of sensegiving and sensemaking processes in fostering collaboration was made clear. With a willingness and conviction of the collaborative way of working, the SPM strongly encouraged and by example showed commitment to intra- and interorganisational collaboration. The SPM gave sense by influencing the discussions on how collaboration was to be understood and what it was supposed to mean for the project participants (Gioia & Chittipeddi, 1991; Maitlis & Lawrence, 2007). By taking the necessary time to discuss this topic as early as in the procurement of contractors and designers and further discussing with the procured actors at the project set-up, created a collective understanding acting as a foundation upon which the collaborative procedural structure could be built. Organising and structuring the collaboration process was heavily influenced by the CM. With considerable experience in structuring, managing and leading collaborative efforts in complex projects the CM gave sense to the management team and suggested how the collaborative structure should be organised. The result of their joint sensemaking and sensegiving efforts was the collaboration plan, which took into account the project specific circumstances such as actors, project scope and time. In addition, the client's own requirements on collaboration were included in the process of creating the collaboration plan. These requirements can be seen as the result of past projects' sensemaking processes which have been retrospectively selected and institutionalised, i.e., retained, and consequently reintroduced in a new sensemaking loop in this tunnel renovation project (Weick et al., 2005). The client organisation thus gave sense to the discussion of how to view, understand and work with collaboration both institutionally through its requirements and through the SPM representing the client organisation (Bansal et al., 2022). These two sensegiving sources are connected as the SPM's understanding of collaboration is shaped by the collaboration requirements from the client but given their inherent flexibility and the differences in project managers, much relies on the SPM on how the collaborative requirements are implemented and understood.

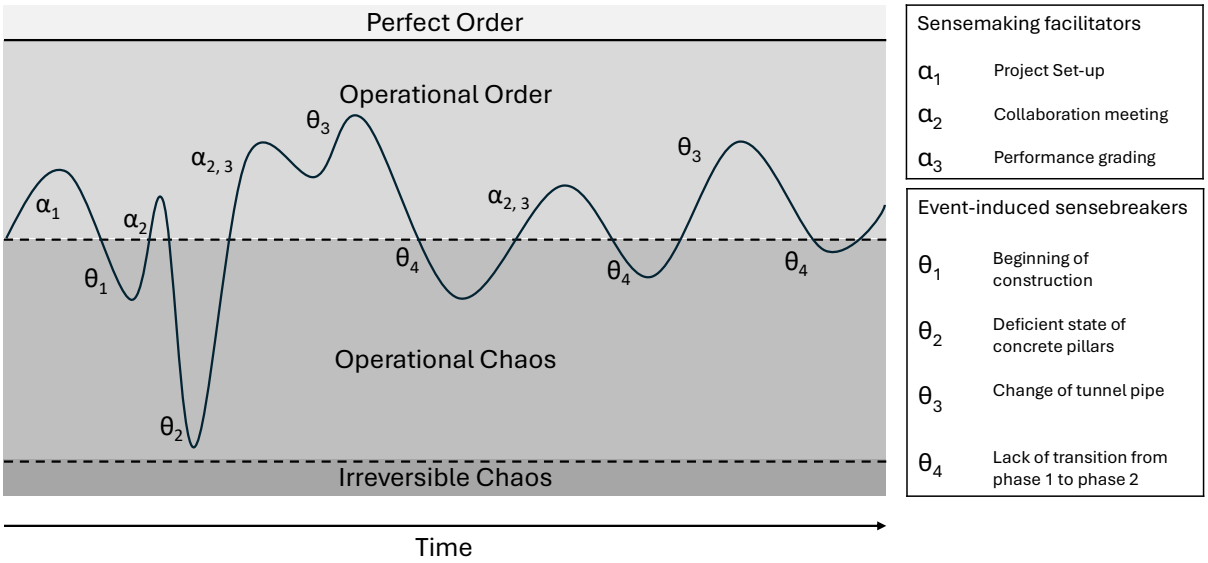

Figure 7 Fluctuation between states of order and chaos with event-induced sensebreakers and sensemaking facilitators (Rönndahl et al., 2025).

It was important for the SPM and CM to create an environment and culture in which everyone felt they could speak up and make their voices heard. They wanted a work environment where challenges and solutions could be discussed openly, without unnecessary blame and thus keeping a focus on the progression of the project. Several aspects contributed to the realisation of this collaborative vision. For example, the use of certain terminology emphasising clear communication and goal alignment. Instead of using the Swedish term for obvious ("självklart") which includes the word for "self", another made up word was used in which the self is replaced with we ("viklart"). The idea of modifying the word in such a way was based in the fact that certain things are naturally obvious to certain project participants, while at the same time being not at all obvious to others. When something important was considered obvious, the SPM and other managers wanted participants to reflect and consider the view from other project organisations and their participants and making sure it is "viklart", i.e., obvious to everyone, not just obvious to yourself. Another phrase that was used to an even larger extent by all project managers from all actors was "The Project Ltd." ("Projektet AB). This phrase was used to emphasise the alignment of goals and view all sub-projects as one big project. It signified a sense of belonging and a collective sense of purpose pointing all efforts from the sub-projects in one common direction. This aligns with Brown et al. (2015) in exemplifying how language and symbols contribute to shared sensemaking processes.

Of the event-induced sensebreakers included in Figure 6, the majority triggered a decline in level of order from a more orderly to a more chaotic project state, followed by a restoration of order (Cornelissen, 2012). The most intense sensebreaker was the realisation that the concrete pillars were in much worse condition than expected, resulting in a significant dip of the project order, dangerously close to irreversible chaos (Rönndahl et al., 2025). However, breaking sense does not always have to result in a negative impact on the project order but can in some cases have the opposite effect (Balogun & Johnson, 2005). One example would be the considerable amount of time that was saved prior to the tunnel pipe change. Initially it was believed that work could only be performed in one tunnel pipe at a time, leaving the other pipe untouched until the switch about midway through the construction phase. As work progressed in the first tunnel pipe, it became clear that workers actually had access to some of the second tunnel pipe in the adjacent areas between the pipes. The understanding, interpretation and meaning of the situation thus changed, and after retrospective reflection (Weick et al., 2005) the plan changed to more effectively use the time by executing the work of both tunnel pipes in the adjacent area

at the same time. This is a clear example of the continuous sensemaking process which is crucial for the delivery of complex projects characterised by uncertainty. The physical or structural circumstances of the actual tunnel had not changed, but rather the collective understanding and interpretation of it, thus sense was broken and reconstructed into a new configuration (Maitlis & Sonenshein, 2010). Even though the tunnel was the same and no change occurred in the structure itself, an ecological change triggering a sensemaking process did in fact take place, which brought forth considerable time savings and enabled project order to prevail. Having access to adequate and relevant information previously concealed in uncertainty, showers the project in new light and brings about a new illuminated perspective, i.e., an ecological change that could positively trigger the enactment of the sensemaking process towards successful project delivery, which it did in this case. Nevertheless, bringing hidden structural information to light could also cause significant sensebreaking in a direction that would disrupt order considerably as in the case with the concrete pillars (Rönndahl et al., 2025).

Defining moments: Episodes and events in major infrastructure projects

In this case, no disruption was too great to conquer. Despite the constant flow of challenges, some more prominent and influential than others, the tunnel renovation was completed without ever diving into the irreversibly chaotic state. Having a clear collaborative framework in place and a collective understanding of what it means to work collaboratively enables an alignment of goals and the constant steering of meaning creation in a certain direction. To further illustrate the management and organisation of the unceasing collaborative efforts facilitating sensemaking towards successful infrastructure project delivery, some defining moments arranged as episodes, events and triggers are listed in table 5 below.

Table 5 List of defining episodes, events and triggers in the tunnel renovation project.

Episode	Events	Triggered Sensemaking Process	Planned or Unplanned
Preconstruction	Project Set-Up	SM, SG	Planned
	Collaboration Structure	SM, SG	Planned
	Communication Structure	SM, SG	Planned
Early Construction	Construction Start	SB, SM	Planned
	Bad State of Concrete Pillars	SB, SM	Unplanned
	Simultaneous Production and Design	SM	Planned
	Collaboration Meetings	SB, SG, SM	Planned
Gradual Phase Change	Extended Simultaneous Production and Design	SB, SM	Unplanned
	Collaboration Meetings	SB, SG, SM	Planned
Intermediate Closure	Change of Tunnel Pipe	SB	Planned/Unplanned
	Collaboration Meetings	SB, SG, SM	Planned
Late Construction	New Senior Project Manager	SG, SM	Unplanned
	Open for Traffic	SB, SG, SM	Planned

SM = Sensemaking, SG = Sensegiving, SB = Sensebreaking

Dividing the project process into episodes (Kutsch et al., 2021) constituted of one or more interconnected events that trigger or otherwise influence sensemaking processes of project participants, reveal the relation of certain events to the different phases of the project. A timeline of the project is presented in Figure 7 illustrating events and interview rounds (IR1, IR2 and IR3). This division insinuates a differentiation between episodes and events which is relevant to consider in this context. One distinction between these two concepts is the temporal aspect in that episodes are stretched over longer periods of time compared to events. However, this statement alone could cause unwanted ambiguity. Simply stating that an episode is longer than an event could lead to bewilderment regarding just how much longer an episode would need to be in order for it to be considered an episode and not (just) an event? Where would you draw the line? Perhaps a really short episode would be synonymous with an event? Or a lengthy event could be mistaken for an episode? Even if events are shorter, they are not infinitely short only occurring in an instant, but a certain amount of time is passed during the occurrence of an event. In an attempt to clarify and mitigate this potential ambiguity or at least bringing the reasoning in the direction of increased understanding, episodes in this paper are not only longer in terms of time than events, but also contain more than one event. Even though this does not necessarily completely solve the issue at hand, it does emphasise a categorical and labelling quality when dividing and presenting events in episodes.

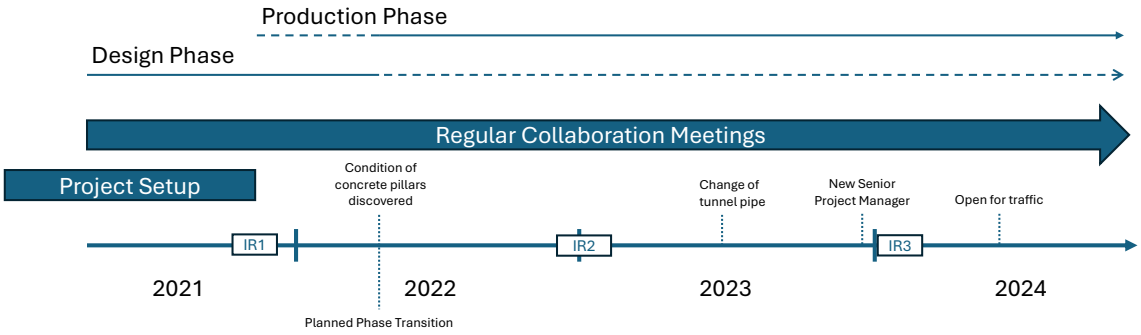

Figure 8 Timeline of the tunnel renovation project, adapted from Rönndahl et al. (2025).

One example of how episodes have been used in literature is provided by (Kutsch et al., 2021) who divide their results into five episodes connected to each of the five interview rounds of the study and the events that took place in those episodes. In other words, the episodes are strictly connected to the temporal aspect and processual proceeding, dividing the sensemaking that takes place by the structure of the study and interview schedule. Sandberg and Tsoukas (2015) view episodes as periods in which organisational activities are disrupted and subsequently restored, or in some cases perpetually thrown into chaos, insinuating an episode ought to constitute one full sensemaking circle from ecological change to restored sense (Weick et al., 2005), or the complete collapse of sense from which there is no return (Rönndahl et al., 2025; Weick, 2009). This view focuses more on the sensemaking process itself rather than the temporal and schedule-wise circumstances. However, the development and evolution of the sensemaking perspective currently makes room for episodes to be used in different ways when presenting and analysing sensemaking processes. Clarity regarding the contextual usage of episodes and how they are adopted in analysing and presenting data and findings is more relevant than attempting to find a universally applicable definition of the term. The sensemaking episodes listed in table 4 above should be regarded as temporal project sections in which several interconnected events triggered and influenced sensemaking processes related to the episode.

The table also indicates the type of events that occurred in terms of planned or unplanned, or a hybrid of the two (Sandberg & Tsoukas, 2015). From the interview data it was derived that even though unplanned events occurred in the preconstruction episode, only planned events stood out as considerably influencing the collaboration and sensemaking processes in this phase. Sensemaking and sensegiving were the prevalent sensemaking triggers in the preconstruction episode. Unplanned events tended to have a rather heavy influence on the collaboration and the sensemaking processes, and began to emerge early after construction began, i.e. in the Early Construction Episode. Sensebreaking was triggered by both planned and unplanned events in this episode. Sensemaking, sensebreaking and sensegiving were thereafter triggered more or less frequently throughout the project by planned, unplanned and hybrid events, continuously influencing the sensemaking process. One particular event is recurring in most of the episodes, namely collaboration meetings in different constellations. Some collaboration meetings included representatives from only two main actors, and other collaboration meetings included representatives from all main actors, i.e. the client, the contractors and the design engineers. Those meetings generally triggered all three of the included sensemaking processes when issues of collaboration were discussed.

Collaboration in CPDM-based infrastructure projects is not a static or predefined process but rather one that is actively constructed and reconstructed by project participants as they respond to evolving conditions (Maitlis & Christianson, 2014; Weick et al., 2005). A key mechanism in shaping this collaboration is sensegiving, where key managers play a pivotal role by providing structured interventions that foster alignment, build trust, and reinforce a shared project vision (Gioia & Chittipeddi, 1991; Cornelissen, 2012). However, collaboration is also tested by disruptive events that challenge established structures, necessitating sensebreaking as a catalyst for adaptation. These moments of disruption require stakeholders to reframe their approach through iterative sensemaking and sensegiving efforts, ensuring that the project remains on course despite uncertainties (Weick, 2009; Sandberg & Tsoukas, 2015). Ultimately, the effectiveness of CPDMs relies not only on their formal governance structures but also on the continuous interplay between these frameworks and relational mechanisms. Success depends on the ability of project participants to negotiate, adapt, and make sense of emerging complexities, integrating structured processes with the flexibility needed to navigate dynamic project environments (Brunet & Forgues, 2019; Roehrich et al., 2020).

Conclusion

This study has underscored the critical role of collaboration in major infrastructure projects, particularly through the lens of sensemaking. The ability to influence the sensemaking process in the early stages proved essential in establishing a coherent vision and structure alongside the management team and the CM. Furthermore, the findings highlight the necessity of continuous communication and reflexivity to navigate the complexities inherent in large-scale infrastructure endeavours. Sensemaking emerges as a valuable theoretical lens for understanding the dynamic and evolving nature of collaboration in such projects. Given the multiplicity of actors involved, collaboration necessitates the continuous interpretation of information and the development of shared narratives to align diverse perspectives. While CPDMs provide structured approaches to project execution, the fluid and emergent nature of collaborative interactions requires ongoing sensemaking and sensegiving efforts to sustain alignment and coherence. The study provides a nuanced understanding of both the challenges and opportunities associated with these models, offering practical insights for project managers and stakeholders seeking to enhance cooperative efforts in similar contexts.

The pivotal roles of the SPM and CM in initiating, developing, and sustaining collaboration further underscore the importance of leadership in shaping collective sensemaking. Their capacity to construct, communicate, and reinforce a shared vision significantly influences the cohesion and effectiveness of project teams, enabling alignment across organisational and professional boundaries. The findings also highlight the necessity of integrating formal and informal governance mechanisms to foster effective collaboration among diverse stakeholders. In particular, the interplay between formal contracts and relational governance within different cultural contexts presents a promising avenue for further research, with potential implications for enhancing collaboration in global infrastructure projects.

Several intriguing research avenues have emerged from this study. Future investigations should delve deeper into the iterative processes of collaboration, examining how sensemaking evolves over time and its impact on project outcomes. Of particular interest is the role of collaboration meetings as sites of meaning-making, where the creation and development of interorganisational collaboration take shape. Further research should seek to identify additional events within these meetings that influence sensemaking processes, contributing to a more comprehensive understanding of collaborative dynamics. Additionally, exploring event-induced sensebreakers and sensemaking facilitators presents valuable opportunities for both theoretical advancement and practical application. Understanding how to identify sensebreakers swiftly and how sensemaking facilitators can be leveraged—both reactively and proactively—would offer significant contributions to industry practice. Although the study acknowledges the inherent presence of power in the processes of sensemaking, sensegiving, and sensebreaking, this dimension has only been briefly touched upon. Investigating the influence of various contractual frameworks and compensation strategies, and their relationship to the development of collaboration and the successful delivery of complex infrastructure projects, presents another promising avenue for future research. Further research will explore the intricate interplay between power dynamics and sensemaking in collaborative infrastructure projects including the consideration of knowledge and competence balance between the actors and organisations involved in the project. A possibly connected research avenue would be to consider drivers from the different actors and stakeholders involved in infrastructure projects and how they relate to interorganisational collaboration and the sensemaking processes. Additionally, future inquiries will delve deeper into the individual and

identity aspects of sensemaking, examining their implications for organisational and national cultures. By exploring how individuals, each with distinct identities and interpretations, collectively construct a shared social reality, such research could provide deeper insights into the mechanisms through which enactment occurs in project environments. Through these avenues, this research contributes to an enriched theoretical and practical understanding of collaboration in infrastructure projects, paving the way for more effective and resilient project delivery strategies.

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