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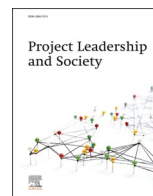
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Empirical Research Paper

Making sense of collaboration in major infrastructure construction projects

Christoffer Rönndahl^{a,*} , Petra Bosch-Sijtsema^a, Rasmus Rempling^b, Mats Karlsson^b^a Chalmers University of Technology, Technology Management and Economics, 412 96, Gothenburg, Sweden^b Chalmers University of Technology, Architecture and Civil Engineering, 412 96, Gothenburg, Sweden

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ABSTRACT

For complex and major infrastructure construction projects, relational governance and the importance of collaboration between project partners have led to the emergence of collaborative project delivery models. While collaboration has been studied from different perspectives, few studies focus on how collaboration is maintained and developed over time in major construction projects. Sensemaking is used as a theoretical lens to give more insight in how project actors give and make sense in relation to collaboration. Through a longitudinal case study with interviews (42) and observations, events, triggers and sensebreakers that stimulate sensemaking and sensegiving in the project are discussed. The study contributes with an empirical insight in how project actors make sense of collaboration through sensegiving, stimulating a sensemaking process while also exploring the influence of triggers and sensebreakers on this process. It underscores the dynamic and evolving nature of collaboration within the project context through sensemaking.

1. Introduction

In recent years, there has been a stronger research focus on major and complex construction projects and their organisational and performance challenges. As a response to these challenges, project delivery models focusing on both contractual as well as relational governance have been increasingly adopted (Chen et al., 2018; Nwajei, 2021) to navigate organisational intricacies effectively. Literature on inter-organisational relations (both permanent and temporary) has discussed how formal/contractual and informal/relational governance complement each other (Cao and Lumineau, 2015; Roehrich et al., 2020) and in construction project management literature this has been discussed in studies focusing on more collaborative project delivery models (CPDM) (af Hällström et al., 2025; af Hällström et al., 2021; Engebo et al., 2020). Within a CPDM project, there is a strong focus on collaboration between the involved actors. Collaboration has been discussed in this literature from a relational governance perspective (Chen et al., 2018) as well as formal and informal mechanisms and relations (af Hällström et al., 2021). While some studies have discussed the iterative and cyclical nature of formal and informal mechanisms in collaborative project delivery models (Bygalle et al., 2015; Nilsson Vestola and Eriksson, 2023), few studies give an empirical insight in the dynamic nature of how collaboration is developed over time in major construction projects with a CPDM.

In order to study how collaboration is developed over time, a sensemaking approach was adopted. Applying sensemaking theory to the study of how collaboration develops in collaborative project delivery in complex construction projects unveil a nuanced understanding of how project actors make sense of their surroundings, interpret information, and collectively navigate uncertainties. The social aspects of sensemaking (Weick et al., 2005) become particularly relevant when exploring decision-making processes, communication dynamics, and overall project outcomes within collaborative frameworks. Sensemaking (Weick, 1995) is a social process where actors adapt their action when faced with surprising or unexpected events during project implementation (Kutsch et al., 2021; Tukiainen et al., 2010) and try to make sense of these changes in the project environment to continue the project (Kutsch et al., 2021). Sensemaking as a theoretical lens can be especially insightful in the context of major infrastructure construction projects, like roads, bridges, railways, and airports as well as electrical grids and expansive pipelines (Chen et al., 2022) These major infrastructure construction projects are often characterised by multifaceted challenges, dynamic environments, and diverse stakeholders and require highly skilled technical expertise (Chen et al., 2018) and are often organisationally complex (Davies et al., 2019). In the realm of collaborative project delivery, where various parties with distinct expertise and perspectives come together, collective sensemaking concerning how to work together for a better project outcome becomes paramount.

* Corresponding author.

E-mail address: christoffer.ronndahl@chalmers.se (C. Rönndahl).<https://doi.org/10.1016/j.plas.2025.100178>

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Sensemaking involves the continuous interpretation of information, the development of shared narratives, and the construction of meaning within a collective context (Weick et al., 2005). This theory posits that individuals and groups engage in ongoing processes of sensemaking to comprehend their roles, responsibilities, and the evolving dynamics of collaborative endeavours. Sensemaking is an organisation theory that is not used much in project literature, but supports the research question of this study: how is collaboration enacted and made sense of by project participants in infrastructure construction projects using a CPDM?

The theory's emphasis on the cyclical nature of sensemaking (Weick, 1979, 1995; Weick et al., 2005) aligns with the iterative nature of CPDMs (cf. Bygballe et al., 2015; Nilsson-Vestola and Eriksson, 2023), where ongoing adjustments and adaptations are inherent. As such, using sensemaking as a theoretical lens can assist in investigating how sensemaking processes unfold over time, influencing project trajectories, and contributing to the overall success or challenges faced by collaborative efforts. Ultimately, this approach contributes to a deeper and more nuanced understanding of the challenges and opportunities associated with collaborative project delivery in the context of infrastructure construction.

2. Theoretical framework

2.1. Collaborative project delivery

Studies relating to collaboration in construction projects have been conducted for decades with various approaches and perspectives. In their scoping review, Engebo et al. (2020) emphasise operational and procedural elements such as early involvement of stakeholders, transparent communication, risk and reward sharing mechanisms and collective decision making. Nwajei (2021) uses relational contract theory and links it to management strategies and project outcomes, and further explains collaboration through relational norms including mutual commitment, trust and flexibility. Collaborative aspects such as these have proven to be beneficial in infrastructure construction projects (Suprpto et al., 2015) as they have developed over time, in part due to the inherent and increasing organisational complexity of such projects (Davies et al., 2019). In their systematic review of complexities in projects, Geraldi et al. (2011) identified five dimensions of complexity, namely structural, uncertainty, dynamics, pace and socio-political, all of which being relevant to infrastructure construction projects. This is evident in mega and major projects, as the majority of such projects are considerably delayed and delivered significantly over budget (Flyvbjerg, 2014, 2017). In an attempt to deliver projects on budget and on time, a variety of project delivery models are utilised in the infrastructure construction industry (Engebo et al., 2020; Peña-Mora and Tamaki, 2001). Based on Miller et al.'s (2000) definition of a project delivery method, Engebo et al. (2020, p. 279) define a project delivery method (which in this paper is synonymous with project delivery model) as "a system used for organising and financing design, construction, operations, and maintenance services for a structure or facility by entering into legal agreements with one or more entities or parties". Due to increasing technical and managerial complexity in construction projects, new types of contractual models have emerged, such as relational contracts. Traditional contracts focused more on the transaction and divided risk and reward to a larger extent as opposed to the newer relational contracts as Nwajei (2021) points out. The same author further claims that essential elements of relational contracting include flexibility and adaptability, risk sharing and performance management. Engebo et al. (2020) acknowledge that relational contracting occurs as a conceptual idea in literature and include the following five core components: 1) commitment, 2) trust, 3) cooperation and communication, 4) common goals and objective and 5) a win-win philosophy. A certain group of relational contracts with a specific focus on collaboration are called CPDM. A CPDM revolves around the idea to integrate collaboration in the project delivery model in several ways, like shared risk and

reward, early involvement of the main actors, joint decision making and continuous improvement (Engebo et al., 2020; Nwajei, 2021). Commitment, trust, and collaborative co-learning as well as cooperation and communication, common goals and objectives and a philosophy of mutual gain is evident in the research as important elements of CPDMs (Yeung et al., 2012). For a management team to be characterised by these aspects and working according to them, it needs to be constituted of individuals with an adequate person-team fit both regarding supplementary fit and complementary fit (Hajarolasvadi and Shahhosseini, 2022). 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).

2.2. Sensemaking as theoretical lens

To further explore how collaboration is enacted in a CPDM in infrastructure construction projects, sensemaking theory will be applied as a theoretical lens. "Sensemaking involves the ongoing retrospective development of plausible images that rationalize what people are doing." (Weick et al., 2005, p. 409). Sensemaking theory provides a rich and insightful framework for examining the intricacies of how collaboration enacts collectively in collaborative project delivery models. At its core, sensemaking theory offers a lens which can be used to explore how individuals and organisations create meaning in ambiguous and complex situations (Weick et al., 2005) that cause the current state of the world to be different than expected (Cristofaro, 2022). Sensemaking has been a theory used more frequently in organisation theory and several review articles provide an overview of its development (Cristofaro, 2022; Maitlis and Christianon, 2014; Sandberg and Tsoukas, 2015, 2020). In sensemaking two theoretical approaches are adopted: (a) cognitivism focusing on the process of interpreting stimuli and constructing cognitive frames and (b) constructionism where sensemaking focuses on a language-mediated process of interpreting other's accounts and negotiating shared understandings (Maitlis and Christianon, 2014; Sandberg and Tsoukas, 2015, 2020). We focus on the constructivist approach in which socially embedded actors enact in a world through language (Sandberg and Tsoukas, 2015).

Many studies applying a sensemaking approach study specific, sometimes surprising events that trigger actors to adapt their action. Some studies focus on unexpected events, emergencies, or triggers (Sandberg and Tsoukas, 2015, 2020). These triggers can be either planned or unplanned, or a combination that occur when organisational activities are interrupted until the moment they are restored or changed into new activities (Weick et al., 2005). Sensemaking often discusses enactment (recognising a lack of a legitimate or collective sense), selection (social process to identify, shape and evaluate alternative stories to make sense of the new context) and retention processes (integrating the new sense in rules and action) (Weick et al., 2005; Cristofaro, 2022). Other processes that are discussed is the distinction between sensemaking and sensegiving (Gioia and Chittipeddi, 1991), in which sensemaking is perceived as meaning construction and reconstruction by the involved parties when attempting to develop a new meaningful framework to understand the changed circumstances. Sensegiving is 'the process of attempting to influence the sensemaking and meaning construction of others toward a preferred redefinition of organisational reality' (Gioia and Chittipeddi, 1991, p. 442). When meaning has been created through sensemaking and sensegiving, it is not indestructible or permanent, but is susceptible to change, remodification and destruction (Mantere et al., 2012). In literature, the process of breaking down or destroying meaning is referred to as sensebreaking (Pratt, 2000) and can be either deliberately sought to achieve (Schildt et al., 2020) or event-induced without intent (Kutsch et al., 2021).

Sensemaking is not a new theme in project management theory as it

has been applied and developed in management and organisation theory for decades. For example by the likes of [Fellows and Liu \(2016\)](#) who focus on national and organisational levels regarding cultural challenges and further emphasise the relevance of context, parameters and objectives as important components for improved sensemaking. However, sensemaking has only been used to a limited extent in project management literature. Some studies in project management have focused on unexpected events ([Kutsch et al., 2021](#); [Tukiainen et al., 2010](#)) or emergencies and disasters ([Gacasan and Wiggins, 2017](#)) in relation to how project managers make sense of this. [Brunet and Forgues \(2019\)](#) studied collective sensemaking for major project success. [Martinsuo and Geraldi \(2020\)](#) looked at possible theoretical lenses, one of which being sensemaking, to study project portfolios. [Sergeeva \(2014\)](#) applied a sensemaking perspective to understand labelling and sustaining of innovation in construction. However, in the field of collaborative project delivery models in which often formal/contractual and relational/informal governance complement each other, sensemaking has not been applied. By using this theoretical lens, it is possible to delve into the intricate interplay between individual and collective sensemaking, shedding light on the social interactions that shape the course of collaborative projects ([Weick et al., 2005](#)). Sensemaking theory also offers a valuable perspective on how project actors reconcile differences in understanding, align diverse interests, and adapt to unexpected challenges, which is highly relevant in major infrastructure construction projects.

3. Methodology

A longitudinal case study methodology has been used with a qualitative approach ([Siggelkow, 2007](#)). To gain more understanding of how collaboration is achieved and performed throughout the project, it is beneficial to consider the context and socially constructed meanings developed by project participants. Using systematic combining facilitated an abductive approach, enabling an iterative process of alternating between exploring the data and revisiting the literature ([Dubois and Gadde, 2002](#)). In line with other research applying a sensemaking lens, the study is interpretive in nature and focuses on rich and qualitative data from both interviews and observations ([Gioia and 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 and Tsoukas, 2015, 2020](#)). These triggers can be either planned or unplanned, major, or minor or a combination ([Sandberg and Tsoukas, 2015](#)). A certain focus is placed on the relation and collaboration between the main actors of the project, i.e., the client, the contractor, and the design engineers.

3.1. Study context

The project serving as the case for this longitudinal study, scoping 2021 to 2024, is a complex road tunnel renovation project in an urban area in one of the bigger cities in Sweden. In addition to being a major infrastructure project with a final cost of 1.3–1.4 billion SEK, the case was selected due to its organisational and contractual complexity. The tunnel stretches under a river and is approximately 0.5 km long, normally having 125,000 vehicles passing through every day. As the tunnel is frequently used by a significant amount of people each day, efforts were made to minimise the traffic disruption, partly by renovating one half of the tunnel at a time, allowing half of the tunnel to be left available for traffic throughout the construction phase.

The client and owner of the project is the main government body in Sweden in charge of infrastructure projects. One designer was procured for the entire project, which originally was intended to be considerably smaller than it ended up being. As the project grew larger, it was

eventually divided into three sub-projects with three separate contracts (see [Table 1](#)), all being subject to a high collaboration level contractually and organisationally. After awarding the tenders with the contracts, the remaining project process consisted of two phases. In phase one the focus was on planning, design and calculations, and phase two was the production phase in which the actual construction took place.

All project actors, including the design engineers, were to adhere to a collaborative agreement produced by the public client called “Contract Model Collaboration High Level”. It includes instructions regarding early contractor involvement, standard contracts and payment agreements. Furthermore, it explains and refers to further documents describing how to proceed in the following three stages of a project: the early stage, the procurement stage, and the production stage. It also covers general guidelines on collaboration to be observed in the project as well as more concrete and mandatory aspects expected to be followed, such as managerial matters, team-building activities, joint risk-management, and goal orientation etc.

3.2. Data collection

Collection of primary data was done with observations and conducting semi-structured interviews ([Pawson, 1996](#)) with managers, leaders and experts from all three main actor organisations, i.e., the public client, contractors, and design engineers. This allowed the respondents to more freely add what they consider to be important on the topics being discussed. The interviewees were purposefully selected as managers and leaders within the project that work and collaborate with representatives from other actors’ organisations within the project organisation. A list of the interviewees and their roles is presented in [Table 2](#). The first round of interviews amounted to 15 and was conducted during the design phase in the autumn of 2021 when only sub-project I had begun construction. An additional 15 interviews were held during the construction phase from November 2022–March 2023 when all sub-projects were active at the construction site. The third round of interviews was conducted in the first quarter of 2024, coinciding with the near completion of the largest sub-project, Sub-project II. All interviews were recorded and transcribed. 46 h of observations were performed during the production phase (see [Table 3](#)) through visits at the project offices and construction site, attending meetings and shadowing ([McDonald and Simpson, 2014](#)). Secondary data were collected from documents, project survey reports, contracts, and websites.

3.3. Data analysis

Throughout the analysis and coding process, theory was revisited regularly in a dynamic interplay between theory building and empirical observation. Aligning with the concept of systematic combining and abduction as explained by [Dubois and Gadde \(2002\)](#), this iterative procedure proved suitable for the further development and refining of existing theory, rather than generating new. This abductive process is particularly valuable in case research as it allows for the discovery of novel insights and relationships that are grounded in real-world complexities. Two steps (see e.g., [Gioia and Chittipeddi, 1991](#)) are used to explain the results, showing an evolution perspective of the studied project. In the first step, analysis focused more on the interpretation of the data. Open coding and narratives were used in order to gain an insight in the development of collaboration in the project. Employing this interpretive and abductive approach enabled the discovery and emergence of interesting triggers ([Kutsch et al., 2021](#)) and critical events ([Gremler, 2004](#)) regarding collaboration, in which project members discussed and/or thought out loud about collaboration. Critical Incidents Technique (CIT) was used in the process of identifying events and triggers of interest. Critical incidents can be referred to as events, processes, incidents or issues that individuals remember as considerably positive or negative ([Gremler, 2004](#)) and can be gathered through interviews and observations. Events and triggers fitting within that

Table 1
Overview of the contractual agreements in the project.

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 A	Design of the entire project (all sub-projects) including calculations, producing blueprints and drawings	Cost-Plus Contract	High

Table 2
List of interviewees.

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 during the production phase.

Type of observation	Object	Organisations	Duration (h)
Meeting observation	Collaboration meetings (9), project survey review meetings (9), construction meeting (1), financial meeting (1), coordination meeting (1)	Client, Contractor, Design Engineer	27
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			46

description were selected for content analysis as part of the second step, which was to apply sensemaking theory to the data and narrative. In the second step the data were first coded per event on a thematic basis (first order coding), then we continued with second order coding supported by sensemaking theory. Inspired by CIT (Gremler, 2004), sensemaking was chosen as a general frame of reference to describe the events and triggers, and abductively (Dubois and Gadde, 2002) generate categories and subcategories on events and triggers influencing the project. Emergent themes from the analysis are presented in Fig. 1 above.

4. Findings

This chapter describes certain sensemaking triggers and events that were discovered when going through and analysing the data. These are presented in the timeline below (Fig. 2) which illustrates the progression of the project from project setup and design to production and opening up for traffic. The triggers and events are summarised in Table 4 at the end of the chapter.

4.1. Project setup

Selection of client management team: It was important for the public client to have a team representing the client with likeminded individuals in place at the start of the procurement of contractors, and subsequently introduce the contractors and design engineers to the same idea about collaboration and how to work with it in the project. This was particularly important as the senior project manager had to report the project progress to various internal and external stakeholders, some of whom were also the clients of the public client. Thus, it was considered crucial with a collective understanding of the collaborative approach and a way of communication that was both clear and open.

Selection of the management team and tender process: The focus on having the right project management team also came up during the procurement phase.

“In all procurements for construction managers, we have been very, very careful to describe the project as a purely collaborative project. We have had interviews with them about added value, just to ensure everything from leadership to collaboration skills.” - Deputy Project Manager (Client)

In the procurement process, tenders were interviewed with a focus on both collaboration as well as added value supporting collaboration and the quality of the project. The added value is used by the client in the quality evaluation of the project and is based on eight focus areas listed in the collaboration guidelines from the client. They include delivery reliability, proposed solutions and financial management to name a few. If a tenderer had a good additional value, they had a stronger chance to win the contract. If the additional values are not met during the project, the actor would receive a penalty and if expectations were surpassed, bonuses would be awarded to the high performing organisations. This creates an incentive of both having something to aim for and chase, and something to run away from. The different sub-projects have certain challenges, which were specifically addressed in the tender request, asking how the tenderers proactively would plan for and handle the challenges, which in turn also potentially generated points in the bidding evaluation.

The client team felt that it was important that the full project management team was also aligned. The project managers expressed that people are of utmost importance as they lead and carry out the work and the individuals in the project management group shape the project and have a meaningful influence on the project. Like the Deputy Project Manager said “What has generated the contract model is actually the individuals in the project. The leadership ... of the individuals in the project.” There is consensus among the project managers regarding the fortunate constellation of individuals in the management teams in the project. Managers from all three main actors have said the same, namely that they are pleased with their fellow managers and consider themselves lucky to be part of such a group of managers.

“I have managed to procure really good people around me. I am so happy with the staff I have.” -Senior Project Manager (Client)

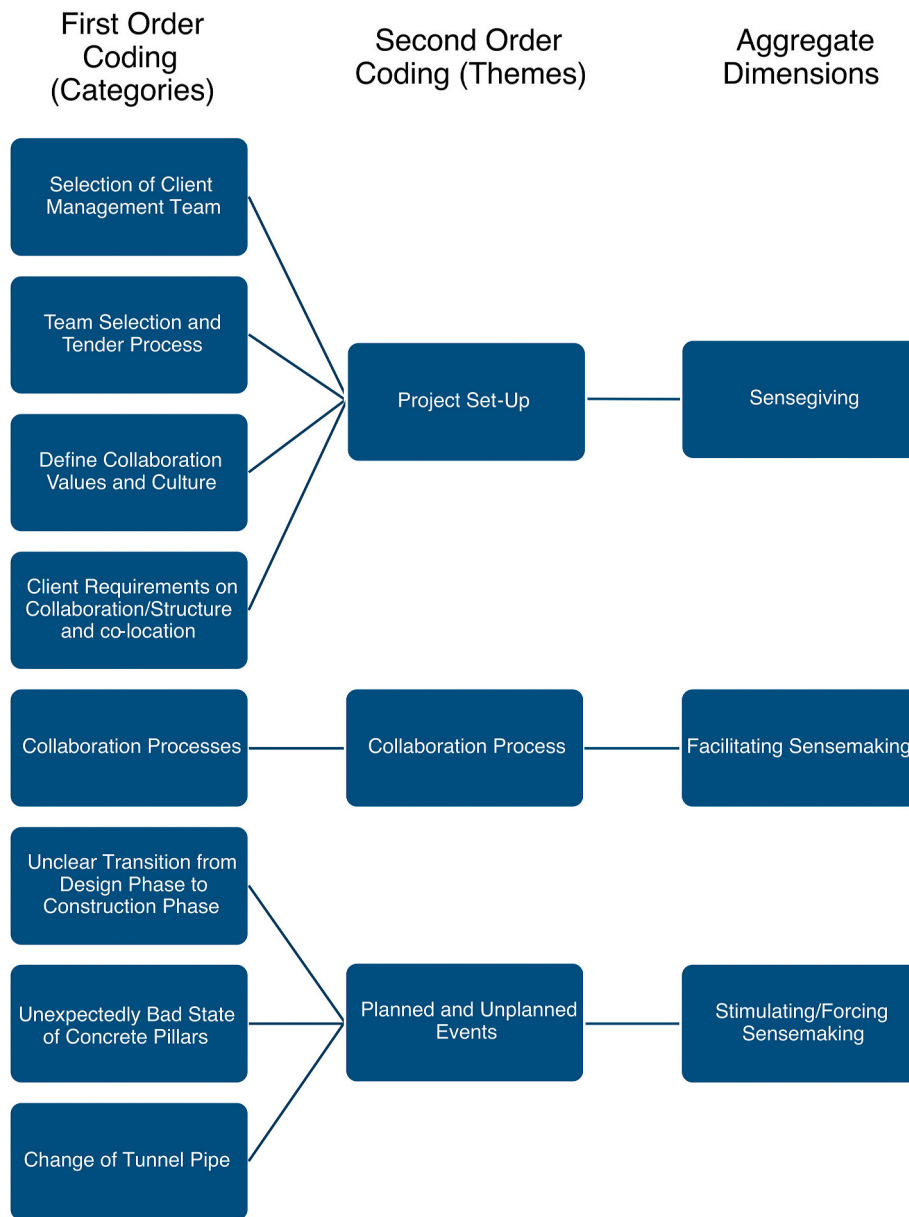


Fig. 1. Coding tree depicting emergent themes from the analysis.

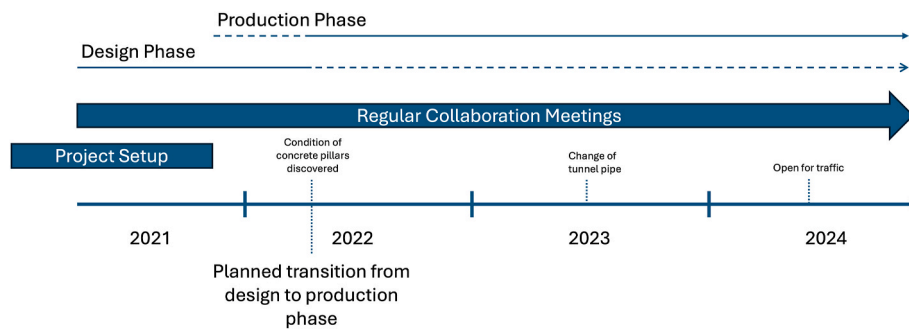


Fig. 2. Timeline of the project illustrating the project progression and the triggers and events.

“Our leadership in the happy coincidence of ... interlacing generates a leadership, a knowledge, a security, an understanding that makes us generate these contractual documents that make us run the project the way we run [it]. We are confident in ourselves and have high ceilings. We

dare to have high ceilings. We, without thinking about it end up focusing a lot on having fun. Joking ... teasing each other. But still caring. And it will spread. So what you put into the project from the beginning, the core, the

Table 4
Summary of findings.

	Events and/or triggers	Planned/ Unplanned	Description	Influencing factors
Start setup and structure	Project setup	Planned activity	Sensegiving. PM and client define the project as collaborative and apply selection procedures and interviews to select the right management team. PM and client define the collaborative vision based on contract. Sensemaking within the management team. Sensegiving from the management team to the rest of the project. Clear requirements on the decision-making charts, co-location and the role of a collaboration leader which were continuously pushed by the PM.	Team fit, contract, client's requirements
Process	Collaboration process	Planned process	Sensegiving and sensemaking activities in which collaboration is both steered and the process (meetings) are a platform for sensemaking	Supporting tools Team survey
Event	Lack of clear transition from the design phase to the production phase	Partially planned event	Sensebreaking and sensemaking: planned but due to delays, and unforeseen circumstances they have to re-think. Design and construction are done parallel. Designs are not yet done before construction starts making it difficult for construction to plan ahead	Time pressure Organisational complexity
Event	Bad state of top of concrete pillars	Unplanned event	Sensebreaking and sensemaking: unplanned event that had a major impact on the way of working and collaboration efforts. Enactment - collective sense is lacking and there is a need to rethink. Selection of the right approach is defined in the management team	Time pressure, unplanned event, uncertainty
Event	Change of tunnel pipe	Planned event	Sensebreaking and sensemaking: planned event, based on lessons learned from the unplanned event, the change of the tunnel pipe was carefully planned in detail. Collective sense of how to do this and how to collaborate to perform this well.	Knowledge transfer Previous events

origin, the embryo, has an opportunity to grow further towards something good.” -Deputy Project Manager (client)

Define a collaborative culture: From the very start of this project, the Senior Project Manager has been consistently and convincingly working to define and establish a collaborative culture wherein project participants may work together towards the same goal (sensegiving). He claims this has been the case in other projects he has managed prior to this as well.

From the beginning, the senior project manager a clear idea on what collaboration is and focused much on clarity, transparency, and openness.

“Collaboration for me is a tool that allows us to effectively and efficiently ... carry out our contracts. Ultimately that's really what I fall back on.”
-Senior Project Manager (Client)

The collaboration vision was shared by the deputy project manager who also represented the client. In the quote below, the deputy manager further describes the idea of collaboration and elaborates on what the meaning and purpose was of using a collaborative approach in the project.

“But we have pursued what lies behind the wording ‘collaboration’. That is, cooperation and stimulate collaboration. And then you have to look and understand the driving forces that stimulate collaboration. And partly there is a balance in actions - by that I mean the contractual balance between client and contractor. So that the client does not sit on a throne but sits next to the contractor. In a legal sense. But also, that you open up to communicative forms of cooperation, such as forums. You open up to an economic regulation that ... to some extent removes the deadlocks that exist in the ... otherwise contractual incentive to meet your budget.”
-Deputy Project Manager (Client)

Important was that a joint collaboration vision for the whole project was discussed and developed jointly within the project management team so that the team could spread and communicate this vision that emphasises common goals, a sense of belonging and transparent communication. The collaborative approach and culture were discussed in the project management team and came up in the interviews as something the team had worked on. The project management team worked with making sense of what collaboration meant for their project and developed joint vocabular within the team. The project management team was positively inclined towards collaborative ways of working and this enabled the implementation and creation of

collaboration for the rest of the project. The project management team used sensegiving to implement this collaborative approach and culture further to the rest of the project organisation. Even though collaboration and processes for collaboration were decided by the senior project manager and client, there is also room for the managers to decide how the collaborative aspect is to be executed as it is not described in detail in the document from the public client, especially the part pertaining to the production stage.

“Because true collaboration for me, it's when you put an affiliation aside. And then you solve a problem the way you would have solved it regardless of which of the actors you belonged to. According to me, that is the noblest form of collaboration.” -Coordinating Project Manager (Design Engineer)

Organisational Structure: The public client has stated a number of collaboration requirements in the project contracts, which is mandated for large and complex projects. One aspect that is specifically mentioned as mandatory in the client's high collaboration guideline document is that the communication plan is to be visually depicted. At the beginning of the project, a considerable amount of time and effort of the senior and mainly the deputy project manager went into creating an organisational structure of the project organisation including the various streams of communication, decision making structure and chain of command. Embedded in the structure was also information on what meetings were to be held, what was to be done in the meetings, what kind of decisions that could be made, who was meant to participate in the various meetings and so on. A visible organisational chart was developed on the structure which was placed at a couple of walls around the office. From the client's perspective, this was a useful document to have visible around the office areas to visually communicate the project organisation structure to both newly recruited project participants, and to those having worked with the project for some time as a reminder.

Co-location: Co-location is another specifically mentioned point in the contract to be followed. The requirement for co-location has partly been a response to a request from the industry from 2000, that the client is never there, does not see and does not understand the project as it develops and unfolds with all its related challenges. Co-location is continuously discussed and mentioned in several forums and meetings, such as the collaboration meetings and Project Survey follow ups. The senior and deputy project managers from the client expressed a desire to have the contractors in the office more than they had been previously. Most interviewees agreed that co-location was a positive aspect to the

project.

“... Like meeting each other more and asking these little questions that you don't do otherwise. You might shy away from sending this email just because it's a little question.

And when we started to sort of come in here at the project office, everyone met a little more, it creates a good togetherness ... We have a very good dialogue at all levels, and it also means that you get to know the people in a different way.” -Project Manager sub-project III

The Deputy Project Manager considers co-location to be more about availability rather than being physically at the same office or geographical location. During the initial stages of the project, he explained that the word location is simply part of something bigger, or “part of a bigger cake”, meaning that it is not just about sharing the same space and offices, but also about being available and mentally present. Later on in the project, the Deputy Project Manager seems to have slightly shifted to an even more mentally focused co-location interpretation, and the idea to be physically present became even less important than before. On more than one occasion this idea is expressed in meetings, influencing the sensemaking process of other project participants, attempting to give sense to the situation.

4.2. Collaboration process

To increase the chances of having the client, the contractors and the design engineers side by side and on board with decisions and au courant with the schedule and plan in general, and perhaps above all, hold them accountable to the contracts and the additional value agreed upon during the procurement, continuous evaluations were made and discussed during collaboration meetings. The client had these meetings with the design engineers and all sub-project's contractors separately. Before the meeting, the client grades their organisation's performance in certain areas, and also grades the corresponding contractor or design engineer, who in turn grade themselves and the client. Nevertheless, rather than focusing on the number representing the grade, the point with the grading was, according to the collaboration manager, to invite the parties to raise and discuss important matters. These meetings were led by the collaboration manager. She was also responsible for sending out the project quality survey and collect the answers and present them in project survey review meetings. All project participants have the opportunity to answer the survey where questions regarding the project are posed, for example about work environment, planning, collaboration etc.

“We go through if we need to update something in the collaboration plan or if it feels good and evaluate. We have also taken the opportunity to go through it more thoroughly with new ones and about how we work. And so that's what we have adapted the way of working to. That's the motive, that it works well, collaboration ... we don't want to lose the routine of recurring meetings in case something happens, so that you could feel that there is ... a recurring routine with the meetings.” -Collaboration Manager (Consultant)

4.3. Planned and unplanned events

Lack of clear transition from design phase to production phase.

Being a project with an ECI contract type, the contractor has been involved in the design phase but is significantly more involved in the production phase. In this case however, these two phases are not completely separated. There is an overlap between the two, meaning that the design engineers still continue to produce blueprints, drawings and documents long after the construction stage started. From the beginning, the idea was to have somewhat of an overlap between these two phases, but it ended up being a larger overlap than planned, which has been continuously and repeatedly expressed, particularly by the

contractors. Preparatory groundwork in front of the two openings of the tunnel was meant to start before the design phase was ended and blueprints completely finished, which it did, but the design stage turned into a longer phase than anticipated. This resulted in a longer overlap between the two phases, the project complexity became more noticeable and the challenges of time constraint more severe, throwing the entire project in a more chaotic state. Constantly having to consider changes in the design, quite often with short notice, the contractors found it difficult to adhere to the original plan and deliver on time. In such a stressful environment, an incumbent need to make sense of the situation was evident. However, the Deputy Project Manager claimed that this delivery issue was known beforehand, and that they had considered this during the procurement stage. That was an important reason as to why determined efforts were made to work on the establishment of a collaborative culture. It was considered a useful and sometimes even necessary tool to use in stressful situations such as when deliveries are delayed. These challenges were clearly visible in the project survey results.

“... it's dangerous, when you run phase 1 and phase 2 at the same time. We have tried anyway - we were not completely unaware of this. We still tried to time the design engineers' delivery package so that they arrived according to the building order. But that doesn't help, because - the contractor actually needs to have the whole to be able to make the purchases for the whole. So, it was a small ... defeat ... That process ... I didn't take it seriously enough, you could say.” -Deputy Project Manager (Client)

Unexpectedly bad state of the concrete pillars.

During the production phase the Senior Project Manager was asked about how collaboration had changed as time had passed and the project progressed. He said that it was more difficult to collaborate in the midst of the production phase with increased stress and time constraints as opposed to previously in the design phase. However, he also stated that this is the time when they really benefit from collaboration. All the efforts they had put in beforehand to establish a collaborative environment paid off. An example of how the collaborative culture paid off is the case of the concrete pillars. As the demolition of the old parts of the tunnel began, and the removal of cladding exposed structural elements that were not accessible for examination and assessment before this stage, it became clear that a considerable number of concrete pillars were in much worse shape than formerly presumed. In order to fix this, it would require a significant amount of additional work to an already tight schedule. It was a challenge that had to be overcome quickly and that was handled swiftly with an immediate focus on solving the problem as opposed to discussing or quarrelling about who is responsible and should pay for the additional labour, and how to contractually administer the issue. According to the managers of the project, this instance alone could have resulted in a serious halt of the project, and tens of millions of dollars in extra costs, which could ultimately have overthrown the entire project, and thus led to a failed project delivery. In this case however, the challenge did not turn out to be insurmountable, but rather conquerable, despite the seriousness, the size and urgency characterising the problem. Much of the success in dealing with this particular incident is accredited to the collaborative approach to the project and the cost contract set up, for instance the fact that some of the sub-project contractors received payment continuously as work was executed. The project team needed to rethink how to deal with the bad shape of the pillars. With a solution-oriented mindset, all relevant project actors gathered to discuss and make sense of how to deal with this issue and could straight away focus on the problem at hand as there were no conflicts regarding payment and cost. Emphasis was on the work that needed to be performed, and how to fit it in the plan in such a way that the important milestones of the project could still be met on time, and consecutively the entire project be delivered on time. Had a more traditional procurement and project organisation been used, the project would most likely have failed according to several of the more

experienced project managers in the project.

“You had to think how to reinforce and so on, so it was a very messy phase then ... but we solved it amazingly well.” -Project Director sub-project II (Contractor)

Change of tunnel pipe.

This event was carefully planned but occurred a few weeks later than according to plan. Despite the delay, a sense of anticipation and motivation was evident right before and after the tunnel pipe change. Even the project survey result done close to the time of the switch displayed a little bump signifying higher project quality. The managers expressed a sense of relief that the first pipe was done, but more so because they were aware of the condition of the pillars this time and therefore had been able to plan accordingly. They felt as though there were not as many uncertainties for them to handle. This project has presented challenges related to work that was new to many of the project participants, which enabled them to learn a lot working on the first tunnel that was useful when switching to the second tunnel. Some of the construction work for the second tunnel pipe was actually carried out when working on the first tunnel pipe, more specifically in the area adjacent to the second tunnel pipe. In this adjoining space, the construction workers noticed that they had access to areas in the second tunnel pipe as well. Thereby they could complete the work currently being done for the first tunnel pipe and for the second tunnel pipe, thus significantly saving time and preparing for a smoother transition from the first to the second tunnel pipe.

5. Discussion

For complex and major infrastructure construction projects, collaboration has been viewed as an important factor for delivery success. Project delivery models focusing on collaboration and relational governance complementing contractual governance have increasingly been adopted in infrastructure construction (cf. (af Hällström and Bosch-Sijtsema, 2024; Chen et al., 2018; Engebo et al., 2020; Nwajei, 2021)). While there has been a strong focus on relational governance for CPDMs, there is little research that studies the process of how collaboration is developed and maintained in a CPDM. In this study a collaborative infrastructure project was followed over a longer period of time to study collaboration through a sensemaking perspective. In the project we followed several events and triggers that are either planned or surprising and unexpected events during project implementation and that influence sensemaking. Based on the processual and chronological order

we can follow the social processes through which actors adapt their actions to make sense of what happens in the project (af Hällström and Bosch-Sijtsema, 2024; Kutsch et al., 2021; Tukiainen et al., 2010).

While earlier research has discussed the importance of both formal and informal communication and governance for CPDMs (af Hällström et al., 2025; Bygballe et al., 2015; Nilsson Vestola and Eriksson, 2023), our study focused primarily on sensemaking in relation to more formal communication and there was less attention to the informal processes. The sensemaking perspective focused on how making sense of collaboration in these types of projects unfolds over time, what events trigger a sensemaking process and how these events influence the cyclical processes of sensemaking. The events and triggers underscore the dynamic and evolving nature of collaboration within the project context and its cyclical process, demonstrating project participants and their teams constantly moving between stages of order and confusion, structure and chaos, sensemaking and sensegiving as illustrated in Fig. 3. For sensemaking in projects, the article contributes with different events and triggers that influence sensemaking, i.e., sensemaking and sensegiving activities, facilitation of sensemaking processes and finally triggers and sensebreakers stimulating sensemaking. Below these three types of activities are discussed in more detail.

5.1. Order and chaos

Perfect order is the theoretical and unachievable level of order the project’s management team aims for. It signifies a state in which all participants know exactly what, how and when to do everything in the project. All information would be conveyed not just efficiently but with complete accuracy in terms of timeliness, interpretation, modes of communication, quantity, structure etc. Fig. 3 illustrates the management team’s levels of order and chaos and the sensemaking process between them. A straight line below perfect order signifies its unattainability, and separates it from the other three attainable levels, namely operational order, operational chaos and irreversible chaos. A significant difference between perfect order and irreversible chaos is the fact that irreversible chaos is attainable and must be avoided in order for the project to deliver according to the contracts. This state is entered into when complexities and challenges (Gerald et al., 2011) arise to such a degree that sensemaking collapses (Sandberg and Tsoukas, 2015) and the project is terminated. From this state there is no return as contracts are cancelled, and the project organisation is dissolved. When unexpected events or challenges throw the project into a chaotic state, but the challenges are either not severe enough or are sufficiently addressed and

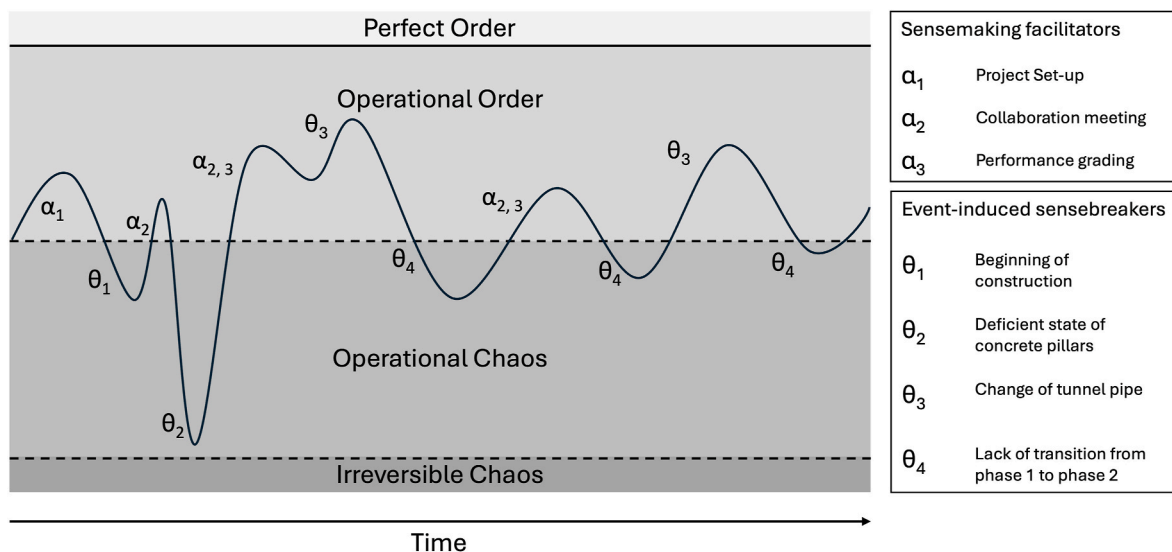


Fig. 3. Illustration of the sensemaking process of the management team, alternating between various stages of chaos and order.

resolved, the project stays within the level of operational chaos, which is an amount of disorder that can be handled by the project participants without terminating the project. When order is sufficiently restored and challenges have been resolved, instilling a sense of control over the project amongst project participants, the project is in a state of operational order. In other words, aligning with the findings of [Denicol et al. \(2020\)](#) a certain resilience against chaos is imperative in complex projects, to allow the fluctuations between chaos and order to stay within the operational levels.

5.2. Sensegiving

Sensegiving ([Gioia and Chittipeddi, 1991](#)) was performed through the development of a project structure and set up of the project team. The client and client's senior project management sets up and defines the project structure, collaborative vision, selects the project team and defines collaborative requirements through sensegiving activities. Sensegiving was done through leading meetings, communication media (like slides, charts, visible pictures), development of joint terminology etc.

The two project managers (senior and deputy PM) were both from the public client and spent a lot of energy to set up a collaborative environment in which general and fairly open directives on collaboration were set up in contractual guidelines. In the beginning of the project the project management team spent a lot of time to make sense of the type of collaboration suitable for the project. In line with the conclusions of [Nachbagaer and Schirl-Boeck \(2019\)](#), collaboration was used as a tool to successfully deliver on the contracts entered into by creating a collective understanding, ensuring intense, fast and clear communication and creating a flexible environment allowing managers to act quickly when uncertainties arose.

The early collective sensemaking of the project management team, with all managers on board and positive about the collaborative approach, enabled sensegiving to spread throughout the organisation. The project developed vocabulary to support this sensegiving, as noted in the interviews. From CPDM literature, the project set-up, procurement, and contracts are important to set the scene for a collaborative working environment ([Chen et al., 2018](#); [Nwajei, 2021](#)). While literature on CPDMs often focuses on the formal and informal governance of complex projects ([af Hällström et al., 2025](#); [Bygballe et al., 2015](#); [Chen et al., 2018](#); [Nilsson Vestola and Eriksson, 2023](#)), in our study the formal governance set up by the client's representatives (the senior and deputy PM) can be categorised as sensegiving activities that triggered sensemaking discussions in both the project management team and the rest of the project.

5.3. Facilitating sensemaking processes

A collaboration process was developed throughout the project and supported a continuous facilitation of sensegiving and sensemaking between the different main actors in which the client, the designer and the contractors could discuss issues, reflect on these and seek for possible re-interpretations and solutions. While project management literature has focused much on events and emergencies that trigger sensemaking (see [Gacasan and Wiggins, 2017](#); [Kutsch et al., 2021](#); [Tukiainen et al., 2010](#)), few studies discuss how a clearly defined process can support sensemaking in CPDMs. From the case, collaboration was supported and facilitated through continuous collaboration meetings in which the main actors (client, contractor and design engineers), reflected upon the collaboration and project process and discussed their insights. These reflective meetings supported a continuous sensemaking process between the main actors. Sharing their grades in the collaboration meetings allowed for discussions pertaining to important topics to emerge and for a dynamic sensegiving process to take place as all three actors could influence the sensemaking process, by sharing their reflections on the past. Combining these individual inputs from the managers'

personal sensemaking processes created a collective sense of the current status of the project, upon which future actions were based.

5.4. Triggers stimulating sensemaking: planned versus unplanned

From the case we found a number of events that could be viewed as triggers of sensemaking ([Sandberg and Tsoukas, 2015](#)), of which some were partially planned while others were unplanned. These events triggered enactment processes when difficult problems occurred and had to be dealt with. While the initial setup and the framing of the project were planned events developed by the public client's project manager and supported sensegiving as a process to influence meaning construction of the other project actors ([Gioia and Chittipeddi, 1991](#)), there were other triggers or events that influenced sensemaking of collaboration throughout the project duration. While sensemaking literature often focuses on surprising or unplanned events ([Gacasan and Wiggins, 2017](#); [Kutsch et al., 2021](#); [Sandberg and Tsoukas, 2020](#); [Tukiainen et al., 2010](#)), also planned events can support or trigger sensemaking as we see from our findings which is in line with [Sandberg and Tsoukas \(2020\)](#) overview of possible triggers for sensemaking.

All of the events mentioned in this case that triggered sensemaking did so by breaking down the prevailing interpretations and understandings of specific aspects of the project, namely sensebreaking ([Pratt, 2000](#)). The event-induced sensebreakers illustrated in [Fig. 3](#) all depict elements of the project that were differently understood or thought of prior to the meaning being destroyed. Before the production phase there was a sense of having more time and resources, less stress and pressure, which changed when the production phase started; the initial collective understanding of the concrete pillars was that they were less damaged than they actually were; the change of tunnel pipe was thought to take more time than it did due to an imagined inaccessibility; the transition from the design phase to the production phase was originally meant to be completed within a few months from starting the construction on site but did not happen at all. Thus, the meanings of these events were broken down and replaced with new meanings as a result of the triggered sensemaking processes.

Our findings mainly focused on major planned events and unplanned events that were mentioned as critical incidents by the interviewees to have an impact on collaboration in large projects. The events like the transition from the design phase to production phase in the project was initially a carefully planned event, but due to unforeseen circumstances and time pressure the event became a combination of a planned and unplanned event and triggered stress, uncertainty, and frustration when designs were not yet finalised while construction already started. This event started a sensemaking loop of enactment, selection and retention ([Weick et al., 2005](#)). In the different events, sensemaking activities ([Weick et al., 2005](#); [Cristofaro, 2022](#)) took place of (1) enactment when the project recognised a lack of collective sense; (2) selection in which project members tried to identify and evaluate alternative stories and solutions to the situation, and (3) retention was mainly seen in the final event of the project in which the project team integrated the new sense in actions and planning of the final tunnel pipe. The unplanned and surprising event of the concrete pillars that were in bad shape triggered a new loop of sensemaking. The unplanned event was mentioned by many of the interviewees as an important event that had a major impact on the collaboration and project team. Due to the surprise of the condition of the pillars the project team had to reconsider, replan, and redesign the work under a heavy time pressure. The project management team was able to make sense of this critical incident and work collaboratively to select and apply an approach on which they reflected upon during the interviews as something they could not have done without the good collaborative culture. The lessons learnt from the unplanned event were later on retained in the event of the changing of the tunnel pipe and were viewed as a successful collaborative activity.

From the cases several aspects were found that had an impact on the sensemaking process. These aspects were especially related to

construction projects and therefore relevant to discuss. The high technical and contractual complexity of the case project, the high uncertainty of the project and short amount of time for the construction were all factors that influenced the sensemaking process in the case study. Especially the high uncertainty and complexity triggered sensemaking processes, but the time pressure made it challenging to perform sensemaking before and during the activity, but project management and members made sense of the episode afterwards when they reflected on the work.

By applying a sensemaking perspective, the study contributes with an insight in how project actors reconcile differences in understanding, align diverse interests, and adapt to unexpected challenges, which is highly relevant in major infrastructure construction projects that are complex and uncertain. Furthermore, this approach contributes to a deeper and more nuanced understanding of the challenges and opportunities associated with collaborative project delivery in the context of infrastructure construction.

5.5 Managerial Contributions.

By implementing collaborative practices and understanding the sensemaking processes in complex construction projects, project participants support the aim of achieving a high level of order, thus keeping the project within the operational zone and avoiding irreversible chaos. In projects where a CPDM or another collaborative approach is applied to the project delivery, the meaning of collaboration needs to be clearly communicated in the early stages of the project. When selecting and procuring organisations and people in the project, an emphasis should be on how collaboration is to be understood and how project participants are expected to work and behave accordingly. Establishing this idea in the management team early and creating a structure for how to maintain a collaborative way of working throughout the project requires time but has proved to be beneficial when dealing with unforeseen challenges and uncertainties. Additionally, as managers organise and set up the project, they should ensure there are forums in which situations are continuously created for the discussion and assessment of collaborative performance in relation to what was decided in the contracts and procurement. These forums ought to occur on a regular basis throughout the project.

6. Conclusion

This study on collaboration in major infrastructure construction projects sheds light on the critical role of collaboration in achieving project success. The adoption of CPDMs, combining relational governance with contractual governance, has become increasingly prevalent in the realm of infrastructure construction. While existing literature has predominantly emphasised the importance of relational governance, this research contributes to literature by delving into the process of how collaboration is developed and sustained within such models. The early stages of a project play a pivotal role in setting the tone for collaboration as the findings suggest. Sensegiving, initiated by the public client and project managers, is instrumental in framing collaboration through procurement processes, contractual guidelines, and organisational structures. However, our research also highlights the need for flexibility, especially in complex, uncertain projects, where sensebreaking events tend to occur and where collaboration may serve as an effective tool to navigate challenges.

The study identifies triggers and events of sensebreaking and sensemaking, both planned and unplanned, emphasising the cyclical and iterative nature of collaboration. Planned events, such as the transition between project phases, also influence sensemaking, often creating a dynamic interplay between order and chaos. Event-induced sensebreakers such as unplanned incidents like unforeseen issues with loadbearing elements only visible until the demolition has begun, underscore the importance of adaptability and a collaborative culture in overcoming challenges. While some sensebreaking events impose greater pressure and stress on project participants, others have the

opposite effect, like the change of tunnel pipe which unexpectedly created additional time in the project schedule.

Regarding limitations, the project from which data was collected and analysed was set in a Scandinavian setting, an environment which may be more prone towards collaborative ways of working compared to what may be found in other regions. Another limitation is connected to the Covid-19 pandemic, which inhibited the possibility to perform observations during the early stages of the project. Future research streams could explore in greater detail the nuances of sensemaking during various project phases, and the influence of different collaborative approaches on project outcomes. Furthermore, exploring the role of technology and its potential to facilitate communication, decision-making and information sharing and thus enhancing collaboration is another possible research avenue. For both policymakers and practitioners, a comparative study on different collaborative models across various infrastructural contexts could prove to be of value.

CRedit authorship contribution statement

Christoffer Rönn Dahl: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Petra Bosch-Sijtsema:** Writing – review & editing, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Rasmus Rempling:** Writing – review & editing, Supervision, Funding acquisition. **Mats Karlsson:** Supervision, Funding acquisition.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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