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Bridging Europe - A comparative analysis of the construction of the Fehmarnbelt and the Channel Tunnel

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Thesis Pitch

A link to the thesis pitch can be **found here.**

Statutory Declaration

I hereby declare that I have composed the present thesis autonomously and without use of any other than the cited sources or means. I have indicated parts that were taken out of published or unpublished work correctly and in a verifiable manner through a quotation. I further assure that I have not presented this thesis to any other institute or university for evaluation and that it has not been published before.

26 June 2025 ***Barnevik Olsson, Markus***

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Abstract

This thesis examines the planning and financing of cross-border infrastructure megaprojects within the European Union (EU), focusing on the Fehmarn Belt and Channel Tunnel as case studies to inform the European Commission's forthcoming high-speed rail network plan. Adopting a social science perspective, it addresses a research gap by analysing how lessons from these projects can enhance the EU's Trans-European Transport Network (TEN-T) and European Green Deal objectives. Through Qualitative Comparative Analysis (QCA) and a territorial governance framework, the study evaluates three key factors: common objectives and master plans, political transparency and involvement, and connectivity and movement between cities. The Fehmarn Belt, a state-led, EU-supported initiative, demonstrates robust coordination, stakeholder engagement, and TEN-T alignment, but is yet to be finished. The Channel Tunnel, privately financed, achieved transformative connectivity but suffered from cost overruns and limited transparency. Findings suggest that the EU should prioritize formal treaties, transparent governance, and hybrid financing models to ensure the success of its 2025 Rail Infrastructure Plan. Policy recommendations include establishing a Coordinated Treaty Mechanism, an Operational Transparency Pact, and a Cross-Border Infrastructure Blending Facility to streamline planning and financing for similar projects in the future. This thesis contributes actionable insights for EU transport policy, enhancing connectivity, sustainability, and economic integration across Member States.

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1. Introduction

The development of cross-border infrastructure mega projects within the European Union (EU) represents a critical step toward enhancing European connectivity, boosting economic integration, and lowering greenhouse gas emissions. As the EU intensifies its focus on sustainable transport through initiatives like the Trans-European Transport Network (TEN-T) and the European Green Deal, the need to understand how such ambitious projects can be effectively planned and financed becomes absolutely essential. Studies exploring the realization of these projects, particularly from a social science perspective, are surprisingly scarce yet essential for informing future initiatives. While much of the existing literature focuses on architectural or engineering aspects, this thesis adopts a social science approach to address a significant research gap: how can the EU apply lessons from past cross-border infrastructure projects, specifically in terms of planning and financing, to shape its forthcoming high-speed rail network plan? By examining the Fehmarn Belt and the Channel Tunnel as case studies, this thesis aims to extract best practices and lessons learned to guide the European Commission's ambitious rail infrastructure goals.

The timing of this thesis is particularly relevant, given the EU's renewed emphasis on cross-border connectivity and sustainable transport, driven by the leadership of European Commission President, Ursula von der Leyen, and Transport Commissioner Apostolos Tzitzikostas. Their vision for a connected high-speed rail network aligns with the EU's broader objectives of territorial cohesion and environmental sustainability, necessitating an understanding of past projects to avoid repeating historical mistakes (European Commission, 2024). By analysing historical projects and their implications for future rail networks, this study seeks to contribute actionable insights to the EU's transport policy agenda.

This chapter provides an introductory overview of the Fehmarn Belt and Channel Tunnel projects, offering summaries of each to set the stage for Chapter 4, Case Studies and Methodology. It also outlines the European Commission's upcoming Rail Infrastructure Plan, exploring its context within the TEN-T framework and its significance in the current EU policy landscape.

1.1. Case Studies: Fehmarn Belt and the Channel Tunnel

The Fehmarn Belt and the Channel Tunnel are landmark EU cross-border infrastructure projects, offering important lessons for the European Commission's upcoming high-speed rail network

plan. The Fehmarn Belt, an 18-kilometer immersed tunnel under construction between Rødbyhavn, Denmark, and Puttgarden, Germany, will be the world's longest underwater tunnel for road and rail. Costing €7.5 billion, it aims to cut rail travel time between Copenhagen and Hamburg from 4.5 to 2.5 hours. Construction began in 2021, with completion currently expected by 2029. Financed primarily by the Danish state, with additional funds from the EU Connecting Europe Facility (CEF), it relies on tolls and user fees, with Denmark bearing the financial risk. Planning challenges included environmental concerns, such as marine ecosystem impacts, and harmonizing Danish-German technical standards (Schmidt, 2025). These challenges highlight the complexity of aligning national priorities within a supranational framework, a recurring theme in cross-border projects (Guasco, 2015, 205).

The Channel Tunnel, commonly known, and from now on named as "the Chunnel", is a 50.5-kilometer rail tunnel linking Folkestone, UK, to Coquelles, France, and has been operational since 1994. Costing £4.65 billion (around €12 billion in 2025 terms), it was funded privately through a consortium of banks and shareholders under the Eurotunnel Group. Planning, starting in the 1980s, required complex UK-France negotiations, formalized in 1986. The project faced significant cost overruns and technical challenges, doubling initial estimates, and required financial restructuring in the 1990s due to lower-than-expected revenues. Nevertheless, it revolutionized cross-border travel, with Eurostar and Eurotunnel services competing with air travel (Westcott, 2014). The Chunnel's private-led model offers a counterpoint to the Fehmarn Belt, illustrating the trade-offs between market-driven efficiency and public oversight.

These projects highlight contrasting financing models; state-led with EU support for Fehmarn Belt versus private investment for the Channel Tunnel. The Fehmarn Belt exemplifies modern EU-backed initiatives, while the Channel Tunnel illustrates private-sector risks and rewards. Their planning and financing mechanisms offer critical insights for the EU's high-speed rail ambitions. A detailed analysis will be provided in Chapter 4, Case Studies and Methodology. By comparing these cases, this thesis seeks to uncover governance strategies that can bridge institutional divides and enhance project delivery.

1.2. The European Commission's Rail Infrastructure Plan

The European Commission, under President Ursula von der Leyen, has prioritized the development of a high-speed rail network as a cornerstone of the EU's sustainable transport strategy. In her mission letter to Transport Commissioner Apostolos Tzitzikostas, von der Leyen outlined the goal of presenting a plan in 2025 for an "ambitious European high-speed rail network

to help connect EU capitals, including through night trains, and to accelerate rail freight" (European Commission, 2024). While specific details of the plan remain unknown at the time of writing, it is expected to build on the framework of the Trans-European Transport Network (TEN-T), as outlined in Regulation (EU) 2024/1679. The TEN-T is the EU's primary instrument for coordinating transport infrastructure development, aiming to create a seamless, multimodal network across Member States. It is structured in three tiers: the core network, targeting completion by 2030, connects major cities and hubs; the extended core network, due by 2040, links additional urban centres; and the comprehensive network, set for 2050, ensures connectivity to all regions (EU, 2024). The investments are expected to generate economic benefits worth €750 billion by 2070 and save over 100 million tons of CO_2 annually. It is also estimated to create 1.5 million jobs in the EU (We Build Value, 2025). These projections underscore the transformative potential of rail infrastructure, but their realization hinges on overcoming governance and financing challenges evident in past projects (Draghi, 2024, 48, 51).

The upcoming Rail Infrastructure Plan is likely to prioritize "low hanging fruit", such as high-speed rail corridors, addressing gaps in cross-border connectivity and enhancing interoperability. This also corresponds with the completion of core networks within the TEN-T. Ursula von der Leyen has emphasized the need for seamless ticketing systems, proposing a Single Digital Booking and Ticketing Regulation by the end of 2025 to simplify cross-border travel (European Commission, 2024). Commissioner Tzitzikostas, during his European Parliament hearing on November 4, 2024, confirmed that the plan will focus on completing missing TEN-T sections, deploying crucial technologies such as the European Rail Traffic Management System (ERTMS), and promoting sustainable transport modes (European Parliament, 2024). The plan is also expected to address financing as the Mission letter emphasizes mobilizing financing. This could potentially be done through some sort of an investment plan, which would propose strategies to scale up investments in decarbonization, including electrification and alternative fuels (European Commission, 2024). The emphasis on financing reflects lessons from projects like the Fehmarn Belt, where EU support facilitated coordination, and the Chunnel, were private financing exposed vulnerabilities.

The new Commission's focus on rail infrastructure goes well in line with the critical challenges identified in the widely discussed reports by former Italian Prime Ministers Mario Draghi and Enrico Letta, which highlighted the lack of a cohesive high-speed rail strategy as a "glaring paradox" in EU infrastructure policy (Letta, 2024, 5; Draghi, 2024, 51). According to the Heinrich Böll Stiftung (2025), the plan will likely emphasize cross-border projects to boost rail's modal share, currently at 8 percent in most EU countries, compared to 20 percent in Switzerland. Key obstacles include technical barriers, such as differing signalling systems across

the Member States, and financial constraints, with estimates suggesting €500 billion in investments are needed by 2050 to achieve the EU's high-speed rail ambitions (We Build Value, 2025). These barriers necessitate robust governance frameworks to ensure interoperability and stakeholder alignment, as demonstrated in the Fehmarn Belt's planning process (Guasco, 2015, 16). The high-speed rail infrastructure plan will also consider the growing need for military mobility by ensuring that infrastructure supports strategic defence purposes. As noted by Commissioner Tzitzikostas in a response to the European Parliament on 10 April 2025, this includes identifying and addressing key bottlenecks that could hinder mobility in times of armed conflict. This multifaceted approach highlights the need for flexible governance models capable of balancing diverse policy objectives.

2. Research Question

How can the EU apply the lessons, both in terms of planning and financing, from the Fehmarn Belt and the Channel Tunnel infrastructure projects to the new Commission's upcoming high-speed rail network plan?

3. Theoretical and Literature Review

This chapter presents the theoretical lens and literature used to analyse the selected case studies. It is structured around three key dimensions relevant to cross-border infrastructure megaprojects: (i) territorial governance in cross-border contexts; (ii) the planning of cross-border infrastructure; and (iii) financing models. The chapter provides a foundation for the operational indicators later applied to the Fehmarn Belt and the Chunnel. By grounding the analysis in established literature, this thesis ensures a robust framework for comparing governance processes across diverse institutional settings. This thesis draws on qualitative research methods and is grounded in the analysis of secondary material.

3.1. Territorial Governance in Cross-Border Contexts

The theoretical foundation for this thesis is drawn from the concept of territorial governance, with a focus on how it operates across national borders. Territorial governance concerns the coordination of spatial policies and decision-making among different administrative levels and sectors (Stead, 2014, 681; ESPON, 2013). It addresses institutional arrangements that influence how public authorities interact in planning, funding, and executing shared infrastructure. ESPON (2013) provides an essential framework for analysing territorial governance in cross-border regions, highlighting both procedural and institutional arrangements. It is mainly used to show how joint legal and planning instruments support project implementation. Stead (2014, 682) contributes to understanding the horizontal and vertical coordination that is vital for infrastructure development involving multiple tiers of government.

In cross-border regions, this concept helps describe how countries and subnational entities manage planning processes across legal, administrative, and political boundaries. Faludi (2013, 1310) describes territorial governance as a process that requires adaptation between jurisdictions with distinct systems. This includes harmonising planning instruments and aligning institutional procedures, both of which are central to large-scale CBC projects such as the Fehmarn Belt and the Chunnel.

While some publications examine cross-border regionalism, which focuses more on identity formation and cultural cooperation, this study follows a different route by concentrating on three key factors of Castanho et al. (2018, 95-96) and Castanho (2019, 8-9). Apart from other publications on cross-border regionalism, the focus of this thesis is on implementation capacity, rather than regional identity. Castanho et al. (2018) and Castanho (2019) contribute to this field by presenting survey-based findings from multiple European border regions. Their research

identifies three key factors behind successful cross-border cooperation: (i) shared objectives and master plans; (ii) political transparency and involvement; and (iii) connectivity between cities. These variables were selected because they were the most important factors in the research of Castanho et al. (2018, 95-96) and Castanho (2019, 8-9), but they also encapsulate the procedural, institutional, and functional dimensions of territorial governance critical for CBC projects (ESPON, 2013). This thesis applies these factors as practical dimensions of territorial governance in a cross-border setting. Chapter 4 describes how these are translated into indicators used to compare the Fehmarn Belt and the Channel Tunnel.

Gualini (2006) further emphasizes the political economy of scale in European spatial policy, arguing that cross-border projects require the balancing of power between national and supranational actors. This perspective is relevant to both case studies of this thesis, where UK-France negotiations shaped governance structures in the case of the Chunnel, and where EU involvement through the TEN-T framework influenced coordination in the Fehmarn Belt construction (The Global Infrastructure Hub, n.d.; Guasco, 2015, 164). Gualini's work further highlights the need for institutional mechanisms to manage these complex dynamics, aligning well with ESPON's (2013) focus on procedural arrangements between states.

ESPON (2006) provides essential historical context to the thesis, analysing CBC through INTERREG and ESPON activities. Additionally, it underscores the evolution of territorial governance in Europe, noting that early CBC efforts focused on economic integration, forerunning modern projects such as the Fehmarn Belt. This historical perspective also complements Grix's (2001) general overview of CBC research, reinforcing the thesis focus on functional integration over cultural regionalism.

Nadin et al. (2020, 792) provides valuable perspectives in highlighting trends in integrated spatial planning across Europe. They argue that effective territorial governance in CBC projects requires adaptive planning frameworks that also includes stakeholder input, an important principle especially evident in the consultations around the construction of the Fehmarn Belt (Femern A/S, n.d.). Their work further strengthens this thesis's emphasis on Castanho et al.'s (2018, 95-96) factors of political transparency and involvement, suggesting that participatory governance improves the legitimacy of a CBC project.

Additionally, Rosas-Ferrusca et al. (2012, 124) offer a conceptual framework for territorial governance, emphasizing the role of institutional capacity in coordinating cross-border projects. Their analysis strengthens and aligns with that of Faludi (2013, 1309-1310), specifically his call for harmonized procedures, providing a theoretical basis for comparing the state-led Fehmarn Belt with the privately driven Chunnel. These sources help deepen the understanding of territorial governance as a dynamic process, essential to EU infrastructure policy.

3.2. Planning of Cross-Border Cooperation projects

Large cross-border infrastructure planning is shaped by diverse factors, including environmental and legal requirements to institutional readiness. The EU's regulatory environment, including TEN-T regulations, provides a common planning architecture, but member states remain responsible for the practical implementation. Planning success in today's EU is contingent on coordination mechanisms that navigate these overlaps.

Eggleton (2024, 1-6) is particularly useful as it presents a comprehensive review of planning methodologies for large infrastructure. His research helps position this thesis within a broader academic conversation and confirms the need for definitional clarity when analysing international infrastructure projects. The findings of this thesis align with Eggleton's emphasis on planning institutions and governance structures. In the EU context, such projects are supported by frameworks like the European Territorial Cooperation (ETC) and the Connecting Europe Facility (CEF).

Bisbey et al. (2020, 181-182) importantly distinguish between "hard" and "soft" infrastructure in CBC projects. "Hard" refers to physical infrastructure like tunnels and railways, while "soft" includes legal frameworks, planning institutions, and intergovernmental treaties. In the EU, with its many institutional mechanisms ("soft" infrastructure) already in place, new cross-border high-speed rail projects are increasingly shaped by the demands of new hard infrastructure.

The Fehmarn Belt and Chunnel cases demonstrate two different planning approaches. In the Fehmarn Belt case, Guasco (2015, 78) highlights the centrality of political agreements and long-term spatial planning, formalised through a State Treaty in 2008. Guasco's work is used to highlight how spatial strategies and political commitments are coordinated across borders in practice. In contrast, the Chunnel's planning relied on bilateral commercial concessions under the 1986 Treaty of Canterbury, with minimal direct public-sector planning beyond initial approvals. The Global Infrastructure Hub (n.d.) gives a concise overview of the Chunnel and supports the argument that institutional models differ widely and have implications for governance and implementation.

The importance of shared objectives and master plans, as emphasised by Castanho et al. (2018, pp. 95-96), is particularly evident in the Fehmarn Belt case. The 2008 State Treaty between Denmark and Germany embodies this shared vision for connectivity and coordination (Guasco, 2015, p. 78). In contrast, the Channel Tunnel project lacked such a spatial strategy, reflecting the fact that it was developed before the establishment of the TEN-T framework (The Global Infrastructure Hub, n.d.). This difference underscores how formalised cross-border

agreements can enhance the coherence and long-term strategic value of megaprojects.

Naturally, the European Commission (n.d.) provides a clear outline of the TEN-T framework, which serves as a planning blueprint for projects like the Fehmarn Belt and will continue to do so during the decades to come. It emphasises interoperability and multimodal connectivity, addressing technical, or hard, barriers like differing signalling systems, a challenge in both case studies, and a big challenge overall in the establishment of a high-speed rail system that connects Western Europe with Eastern Europe. The Council of the EU (2024) detail the updated TEN-T Regulation (EU) 2024/1679, which prioritizes core network completion by 2030. These sources are key in understanding the practical details and in highlighting the EU's role in facilitating cross-border planning, offering a model for future rail projects.

Another crucial source in the case of this thesis is the World Bank (2019), which complements by defining connectivity corridors, an important concept and tool in understanding EU rail connectivity and the spatial planning behind it. The World Bank (2019) especially emphasises the need for measurable increases in passenger and freight flows, aligning well with the Fehmarn Belt's projected traffic estimates and the Chunnel's actual passenger growth, bringing a practical lens for evaluating planning outcomes (Femern A/S, n.d.; Anguera, 2018, 2, 6).

3.3. Financing of Cross-Border Cooperation projects

CBC research has progressed from informal, locally-driven efforts in the post-war era to a well-established field of study within the EU's broader cohesion policy framework. Over time, the scope of this research has broadened, encompassing not only economic cooperation but also political, social, and environmental issues. Grix (2001) is included for his overview of the evolution of CBC research, which helps situate this thesis historically. While somewhat dated, his insights on interdisciplinary approaches remain valid in explaining the multiple facets involved in cross-border planning.

The growing emphasis on governance, sustainability, and the effects of political shifts like Brexit and rising nationalism points to the future directions of the research area of territorial governance. Furthermore, within the frame of EU multilateralism, cross-border cooperation is becoming more practical by connecting infrastructure between member states, hence linking cultures and people. Bisbey et al. (2020, 182-183) are used again here to stress the complexity of financing models. They underscore the significance of multi-actor financing frameworks for such infrastructure and highlight the increasing importance of private sector participation. Their analysis offers a useful basis for evaluating both the Chunnel (privately funded) and the Fehmarn

Belt (publicly supported).

In terms of the mere size of the Chunnel and the Fehmarn Belt, these projects symbolize the practical approach of cross-border cooperation, and how the EU aims to further integrate the member states into one European entity and polity. Femern A/S documents provide firsthand data on the planning and financing of the Fehmarn Belt project. These are essential primary sources for assessing public investment and institutional coordination in real-time. Similar to Femern A/S (n.d.), the German Federal Ministry for Digital and Transport (2024) also provide a helpful project timeline, with details regarding both the planning and financial processes of the construction of the Fehmarn Belt. These primary sources originate directly from the actors involved in the construction of the Fehmarn Belt, enhancing the thesis's empirical grounding.

OECD (2021) provides a critical perspective on financing, underscoring that effective infrastructure governance requires transparent financial frameworks to build trust and, perhaps most importantly in regard to infrastructure mega projects: prevent delays. This is particularly relevant for the Fehmarn Belt, where public funding and EU contributions were openly documented, providing impressive transparency (Femern A/S, 2022). In contrast, the Chunnel's private financing model faced criticism for limited transparency, contributing to the financial restructuring (Anguera, 2018, 11).

Anguera (2018, 3, 9) offers an ex-post evaluation of the Chunnel's financing, highlighting its extensive economic underperformance due to cost overruns and all too optimistic traffic forecasts. These analyses are key to understanding the Chunnel's financial model, as it underscores its risks, providing lessons for the EU's upcoming rail plan, which very well may involve hybrid financing (European Commission, 2024). Another important source for the thesis is We Build Value (2025), which provides estimations of economic benefits of TEN-T investments, projecting an impressive €750 billion by 2070, suggesting that public-private partnerships (PPP) could mitigate risks while maximizing returns. These projections emphasize the potential of hybrid financing to balance risk and reward, a strategy that could mitigate the vulnerabilities seen in the Chunnel.

Importantly, the respected Green and German think tank of Heinrich Böll Stiftung (2025) emphasizes the need for increased rail investment to boost modal share, matching the Fehmarn Belt's financing model, which leverages EU funds to support sustainability goals. Lastly, the increasingly familiar Draghi (2024) and Letta (2024) reports are referenced to, highlighting their critique against the EU's current rather fragmented infrastructure strategy, advocating for coordinated financing to address gaps in high-speed rail. These reports reinforce the urgency of developing cohesive financing strategies to support the EU's rail ambitions, drawing on lessons from the cases of the Chunnel and the Fehmarn Belt.

3.4. Synthesis

The literature shows that territorial governance plays a critical role in planning, delivering, and financing large-scale CBC projects. Research programs such as ESPON (2013) and authors such as Faludi (2013, 1303-1304, 1309) highlight the relevance of coordinated spatial planning across administrative levels, which informs how the Fehmarn Belt and Chunnel are analysed. Castanho et al. (2018, 95-96) and Castanho (2019, 8-9) contribute key empirical findings on CBC success factors that are operationalised in this thesis.

Bisbey et al. (2020, 181-182) offer helpful distinctions between "hard" and "soft" infrastructure. The connections between the two are even more pronounced in cross-border projects. "Hard" infrastructure refers to the physical systems that link countries, including border crossings, railways, tunnels, bridges, power grids, telecommunication cables, and water pipelines. In contrast, "soft" infrastructure encompasses the intergovernmental institutions, policies, regulations, expertise, and capacity that enable the planning, implementation, and effective use of these physical networks. Modern CBC projects in the EU lean more towards hard infrastructure, as the intergovernmental institutions to a large extent already exist with the EU network. However, in achieving better transport connectivity, especially for high-speed rail, new hard infrastructure is needed.

The inclusion of project-specific sources, such as Guasco (2015), Femern A/S, and The Global Infrastructure Hub, strengthens the practical grounding of the research. Femern A/S is a Danish planning company charged with preparing and constructing the project. All of these sources provide insight into how theoretical concepts are manifested in the actual planning documents of both cases, treaties, and its funding models. They also confirm the relevance of the chosen analytical framework and its applicability to current European infrastructure initiatives.

The European Commission (2024) and related policy documents (Council of the European Union and European Parliament, 2024; European Union, 2024) are extremely essential for the thesis as it situate it within the EU's current policy landscape, emphasizing today's increasing role of TEN-T and CEF in financing and planning. They also strengthen the case of the EU's evolving role as a facilitator of CBC, a role that can be further strengthened by adopting lessons from the case studies.

Territorial governance was chosen as the theoretical lens because it effectively captures the interplay of institutional, legal, and spatial factors in CBC projects, matching the conditions of the chosen case studies (Faludi, 2013, 1309; ESPON, 2013). Unlike theoretical frameworks that focus solely on the technical and economic factors, territorial governance emphasises coordination across jurisdictions, stakeholder engagement and general alignment with broader

policy goals. In the case of this thesis, those goals are translated into the EU's TEN-T objectives (European Commission, n.d.). This theoretical lens is hence perfectly suited to analyse the Fehmarn Belt and the Chunnel, both of which involve binational coordination and differing governance models. For example, Faludi's (2013, 1309) emphasis on harmonizing planning instruments aligns with the Fehmarn Belt's 2008 State Treaty, while Gualini's (2006) focus on the political economy of scale informs the Chunnel's private-led dynamics. This framework allows the thesis to look into how governance structures shape project success, hopefully bringing best lessons to the EU's high-speed rail ambitions and CBC projects overall.

3.5. Research Gaps and Thesis Contribution

The literature reveals a gap in social science analyses of CBC infrastructure megaprojects, as most studies have a practical focus, such as engineering and economic perspectives (Eggleton, 2024, 2; Anguera, 2018, 2). These are naturally critical; however, they also often overlook the governance dynamics that shape the outcomes of such projects. For instance, Eggleton (2024, 4) notes a lack of consistent criteria for something simple as defining international large-scale infrastructure projects, potentially leaving governance processes underexplored in research. This thesis does not attempt to establish new criteria but instead applies existing governance and planning concepts to two cases. Regardless of the exact criteria, it can very well be argued that both the Chunnel and the Fehmarn Belt, both complex infrastructure projects linking two nations, both unique in its grandness and global magnitude, both with high construction costs, are highly probable to fulfil such criteria – if it were to exist.

Perhaps self-assumed, nevertheless it is important to clarify that the empirical research on the Fehmarn Belt remains limited due to its ongoing construction. This thesis contributes by offering an early-stage analysis of the project's planning and governance frameworks. The comparative approach also allows for drawing lessons between completed (Chunnel) and in-progress (Fehmarn Belt) projects. Naturally, unforeseen circumstances that risk having effects on the Fehmarn Belt are a possibility. However, the findings of this thesis can nevertheless be of value to both future EU projects and the overall research area of CBC as the building phase of the Fehmarn Belt project has been ongoing since 2019, and its planning since the end of the 1990s (Femern A/S, n.d.). In that regard, it cannot exclusively be considered an entirely new infrastructure project.

This thesis fills the identified gaps by employing Qualitative Comparative Analysis (QCA) to systematically compare the Fehmarn Belt and the Chunnel, focusing on territorial governance dimensions derived from Castanho et al. (2018, 95-96) and (Castanho, 2019, 8-9). These dimensions provide operational indicators to assess governance processes (ibid.). By

analysing the Fehmarn Belt's state-led, EU-supported model and the Chunnel's private-led approach, the thesis brings lessons for the EU's upcoming 2025 Rail Infrastructure Plan. This comparative approach not only addresses the lack of governance-focused studies but also provides insights into the ongoing construction of the Fehmarn Belt, leveraging planning and financing data to anticipate future outcomes (Femern A/S, 2022; Guasco, 2015). The thesis's focus on institutional coordination and stakeholder engagement further bridges the gap between technical and social science perspectives, offering a holistic understanding of CBC infrastructure dynamics. This holistic approach ensures the thesis's findings are both academically rigorous and practically relevant for EU policymakers.

This thesis fits into the research tradition of territorial governance and CBC studies, building on works like ESPON (2013), Faludi (2013), and Castanho et al. (2018, 95-96) and Castanho (2019), which emphasize institutional coordination and spatial planning. Simultaneously, this thesis differs as it challenges the tradition by shifting focus from smaller-scale, urban-focused CBC projects (e.g., Castanho's city-to-city cases) to long-distance infrastructure corridors like the Fehmarn Belt and Chunnel. This shift highlights the unique governance challenges of megaprojects, such as binational financing and legal harmonization, which are relatively underexplored in existing literature. By integrating EU policy frameworks (such as the TEN-T) and project-specific sources (Femern A/S, n.d.; The Global Infrastructure Hub, n.d.), the thesis also challenges the dominance of technical analyses, advocating for a governance-centric approach that aligns with the EU's integration goals. By operationalising the key factors by Castanho et al. (2018, 95-96) and Castanho (2019, 8-9) into specific indicators, grounded in broader territorial governance literature, they are then applied systematically through QCA. This tailored application ensures that the theoretical framework not only is robust and grounded in relevant literature, but also appropriate for application. Zooming out, it enables a nuanced application of state-led, as well as private-led, governance models and their implications for future CBC rail projects in the EU. This nuanced application strengthens the thesis's contribution to both academic and policy debates on cross-border infrastructure.

4. Case Studies and Methodology

This chapter goes into detail of the case studies of the Fehmarn Belt and the Chunnel. It also outlines the methodology of Qualitative Comparative Analysis (QCA) and how it will be applied in chapter 5: Analysis and Discussion. Additionally, three key fey factors by Castanho et al. (2018, 95-96) and Castanho (2019, 8-9) and their operational indicators are presented and discussed with regards to the analytical framework of Territorial Governance. The chapter establishes a rigorous methodological foundation for comparing the case studies, ensuring the analysis is systematic and replicable (INTRAC, 2017).

With regard to the methodology of this thesis, to ensure the accuracy and appropriateness of EU-specific terminology in Chapter 6: "Policy Recommendations", an AI language model (Grok) was used to refine the phrasing of the recommendations, particularly in regard to technical and institutional terms. As the thesis author lack direct experience working within EU institutions, this assistance was critical to align the text with the formal language and conventions used in EU policy documents, such as those related to the Trans-European Transport Network (TEN-T) and the European Green Deal. This use of AI was limited to enhancing clarity of the recommendations and precision regarding institutional language, while the content, analysis, and recommendations in itself remain original. Additionally, the AI model of ChatGPT was used in Bibliography with the aim to provide a coherent referencing model.

4.1. Case Studies

Unlike the CBC case studies of Castanho et al. (2018), which focused on functional urban areas within 60 kilometres from each other, the Chunnel and Fehmarn Belt instead represent strategic long-distance cross-border infrastructure corridors. Just as the CBC case studies of Castanho et al. (2018) focus on connecting urban areas, so do the cross-border megaprojects of the Chunnel and Fehmarn Belt. However, these projects connect cities with longer distances between each other. The Chunnel connects London with primarily Paris, but also cities like Brussels, Lille and Amsterdam, while the Fehmarn Belt connects Copenhagen with Hamburg. Both projects align with the EU's Trans-European Transport Network (TEN-T) policy objectives of improving connectivity between capitals. These corridors also feature prominently in the TEN-T core and Scandinavian-Mediterranean corridors, signalling their strategic importance for EU-wide mobility and integration (EU, 2024).

Crucially, this thesis does not treat these projects as isolated engineering feats but as manifestations of territorial governance processes. Territorial governance provides a lens through

which to evaluate not only spatial planning coordination, but also the institutional, legal, and participatory dimensions of cross-border megaprojects (Faludi, 2013, 1303, 1307, 1309). The two cases were selected for their differing approaches to coordination and institutional design, especially in how they align with the three governance dimensions operationalised in Chapter 4.2: common objectives and planning, political transparency, and connectivity.

The comparison offers insight into how complex projects are governed across borders under different political-economic settings. The Fehmarn Belt, developed through a formal state treaty and largely financed by Danish public funds with EU co-funding, represents a state-led model of infrastructure development. In contrast, the Chunnel was initiated under a concession agreement, involving almost exclusive reliance on private capital and operating under a commercial governance structure, with comparatively limited state involvement in its oversight. These contrasting models provide a rich basis for analysing the trade-offs between public and private governance approaches.

These cases thereby capture a broad spectrum of governance arrangements, from highly institutionalised public partnerships to the more market driven. Each project also interacts differently with the EU framework: while the Chunnel was largely planned outside of the EU's current TEN-T regulatory regime, the Fehmarn Belt is embedded within it, connecting Scandinavia with the rest of the European continent. Analysing these different models within the same theoretical lens contributes to a deeper understanding of how cross-border infrastructure can be designed to support the EU's goals of territorial cohesion and spatial integration.

While shorter city-to-city examples, such as from Castanho et al. (2018), provide helpful insights in coordination on a micro-case level, larger-scale projects such as the Chunnel and the Fehmarn Belt introduce additional layers of complexity, including binational financing and long-term governance mechanisms. Furthermore, the distinct institutional paths of the Chunnel and the Fehmarn Belt and their financing choices offer a platform to critically evaluate the role of national planning cultures, multi-level governance mechanisms, and legal harmonisation in realising such projects. While both cases fulfil basic conditions of cross-border territorial governance, their differences allow us to test the flexibility and robustness of the analytical framework in different contexts.

4.1.1. Fehmarn Belt

The Fehmarn Belt Fixed Link is an 18 km immersed tunnel connecting Rødbyhavn in Denmark to Puttgarden on the German island of Fehmarn. When completed, it will be the world's longest combined road and rail tunnel, significantly reducing travel time between Copenhagen and Hamburg from approximately 4.5 to 2.5 hours (Femern A/S, n.d.). The Fehmarn Belt will reduce

the Rødby-Puttgarden crossing to a total of 10 minutes by car and 7 minutes by train, cutting the Copenhagen-Hamburg rail journey from 4.5–5 hours to 2.5 hours. This is expected to shift traffic from ferries and the longer land route to the tunnel, with estimates of over 100 trains and 12,000 cars daily by 2029. The shorter route (160 km less) will enhance freight efficiency, encouraging a shift from trucks to electric trains, reducing greenhouse gas emissions. Projections show economic and environmental benefits, including reduced congestion on Danish rail networks by rerouting freight trains (The Danish Ministry of Transport, 2022; Femern A/S, n.d.). These projections highlight the project's potential to transform regional connectivity, aligning with the EU's sustainability goals (We Build Value, 2025).

Since the end of the 1990s, the Fehmarn Belt connection has been on the political agenda. Initial studies began following a State Treaty between Denmark and Sweden regarding a fixed link across the Öresund, which resulted in the finalization of the Öresund Bridge, connecting Sweden and Denmark. At Sweden's request, Denmark agreed to explore the possibility of a similar connection across the Fehmarn Belt. Studies were made and Germany also showed interest in the project (Femern A/S, n.d.).

The project is founded on the 2008 State Treaty signed between Denmark and Germany. This formal agreement set out the financial, technical, and legal responsibilities of each party. The Danish state is responsible for financing, construction, and operation, while Germany committed to upgrading access routes on its side. EU financing accounts for approximately 10 percent of the cost (Danish Ministry of Transport, 2022). The Danish Parliament passed the Construction Act in 2015, providing legal authority and budget approval for the project. Germany's more complex planning procedure, *Planfeststellungsverfahren*, delayed final approval until 2020 after multiple appeals were dismissed by the Federal Administrative Court (Guasco, 2015, 79-82). Construction began in June 2020.

The project is managed by Femern A/S, a state-owned Danish company under Sund & Bælt Holding. Financing is primarily public, supported by EU co-funding under the Connecting Europe Facility. When complete in 2029, Denmark is set to introduce a usage toll which is expected to reimburse the Danish investment within 28 years of operation (Femern A/S, 2022).

The Fehmarn Belt exemplifies institutionalised cooperation and long-term political commitment. Its strategic inclusion in the TEN-T Scandinavian–Mediterranean Corridor reflects EU prioritisation of seamless transnational mobility. Unlike many CBC projects studied by Castanho et al. (2018) the Fehmarn Belt involves extended planning horizons, multinational environmental assessments, and synchronised legal frameworks across jurisdictions (Castanho, 2019, 8-9).

4.1.2. The Chunnel

The Channel Tunnel, commonly referred to and from now on called *The Chunnel* in this thesis, is the biggest tunnel project both in the history of Europe and in the world. It was completed in 1994, extending 50 km between Folkestone (UK) and Coquelles (FR) under the English Channel. Before its construction, ferries were the only mode for cross-Channel vehicle transport, carrying millions of passengers annually. The English Channel was in high demand for vehicle ferries before the Chunnel was constructed, with Dover-Calais being a key route. Heavy goods vehicles were naturally also completely dependent on ferries, with significant volumes due to trade between the UK and mainland Europe (The Global Infrastructure Hub, n.d.). The Chunnel's construction addressed a critical connectivity gap, forever transforming cross-border mobility in Europe (Westcott, 2014).

In 1986, the Treaty of Canterbury authorised the construction and operation of the tunnel through a concession model. The so-called Eurotunnel Group was assigned the planning and construction of the project (The Global Infrastructure Hub, n.d.). The project's total cost exceeded 9 billion pounds sterling, entirely financed through private capital, bank loans, and equity. There was no direct government funding or guarantees. Construction took six years and involved significant engineering innovation, with drilling from both sides of the Channel, eventually meeting in the middle. The tunnel includes twin rail tunnels and a service tunnel, however no car tunnel.

The Chunnel significantly increased connectivity between the UK and mainland Europe, across the English Channel. By 2019, Getlink (2019), the company that manages and operates the Channel Tunnel, reported that the Chunnel transported 21 million passengers annually by train (via Eurostar and vehicles boarding "Le Shuttle") and 1.6 million trucks, indicating a substantial shift from ferries. Le Shuttle (car and bus transport) and Eurostar (passenger trains) captured significant market share, with ferries retaining some passenger traffic due to lower costs (The Global Infrastructure Hub, n.d.).

12 years after its completion, cost-benefit analyses of the Chunnel indicate that the project, in retrospect, has not delivered net positive value to the British economy. Simply put, the overall resource costs exceeded the benefits generated. While users have benefited – primarily through lower prices – these gains have come at the expense of service providers. Both ferry companies and the Tunnel's operator have faced substantial financial losses. Contrary to initial expectations, the main benefit to users was not time savings, but rather a redistribution of value from producers. Long-term assessments reinforce the conclusion that the project has performed poorly in both financial and economic terms (Anguera, 2006).

In 2018, Ricard Anguera Camós published the paper *The Channel Tunnel Cost Benefit*

Analysis after 20 years of operations. It shows that passenger transport reached 21 million in 2014, showing steady growth, especially considering that there had been a financial crisis a few years before. This number though, was significantly below the most optimistic projections, which anticipated triple that number. The Chunnel eventually reached over 50 percent of the cross-Channel passenger market in 2014, with freight numbers reaching the 1985 forecasts. Producer losses were still bigger than the gains in 2014, however the gains had almost caught up.

Functionally, the Chunnel remains a cornerstone of transnational European connectivity. Before Brexit, it formed part of the TEN-T core network, serving the UK-France high-speed corridor. Its legacy represents both the opportunities and limitations of private-led CBC megaprojects, particularly regarding fiscal risk-sharing, long-term adaptability, and governance visibility (Bisbey et al., 2020, 182-183). Displaying both similarities and major differences to the Fehmarn Belt, the Chunnel indeed constitutes a suitable project for comparison.

4.2. Methodology and Analytical Framework

This chapter presents the methodology, and the analytical framework used to assess the two case studies, drawing on the theoretical foundation established in Chapter 3. The methodology ensures a systematic approach to comparing complex governance processes, aligning with the thesis's research objectives.

To structure the comparative component of this study, Qualitative Comparative Analysis (QCA) is used as the methodological approach. Created by Charles Ragin in the 1970s, QCA was initially developed as a research methodology. It has gained increasing use in monitoring and evaluation (M&E) and allows for the analysis of multiple cases in complex contexts, and, in some instances, it involves gathering new data, while in others, it can be applied to pre-existing data (INTRAC, 2017). QCA is particularly well-suited to comparing a limited number of cases and making sense of the many and complex factors, which is the case of the Chunnel and the Fehmarn Belt. QCA enables the identification of necessary conditions for observed outcomes by analysing and comparing causal factors across both cases (ibid.). In this study, QCA is applied by systematically analysing secondary data from project documents and literature. The three key factors derived from the territorial governance framework serve as the core analytical categories. Each case is assessed based on whether it exhibits the conditions specified by the operational indicators in terms of planning and financing. The comparison involves tabulating these findings to identify patterns and differences. By comparing the two, these differences are analysed and can, hopefully, be considered in future projecting, especially in regard to the EU's 2025 Rail Infrastructure Plan.

Three principal governance factors based on the findings of Castanho et al. (2018, 95-96) have been identified for operationalisation. The three factors were the result of an exploratory methodology similar to the one developed by Loures (2011) based on the case study research method by Yin (1994). The Castanho et al. (2018, 95-96) findings were formed through studying 20 various European CBC case studies, and published in Habitat International, a scientific journal for human settlements (Habitat International, n.d). Among those case studies, however, neither Fehmarn Belt nor the Chunnel were included. This strengthens the case of a research gap of these two cases. It also provides an insurance in its applicability in the comparative case of this thesis.

However, the authors do not provide detailed indicators for how these factors can be operationalised. Therefore, to enable a structured comparison between the Chunnel and Fehmarn Belt, the operationalisation is based on a publication by Castanho (2019, 8-9), which in turn builds directly on the 2018 study. It expands the theoretical framework through additional survey data, analysis, and case-based insights. Furthermore, this study has a political-strategic focus and provides clear indicators, making it more ideal for operationalisation and relevant to the thesis research question. Although the operationalisation builds on the findings of Castanho et al. (2018, 95-96) and Castanho (2019, 8-9), these three dimensions are also well anchored in broader territorial governance research. The indicators for each key factor are as follows:

(i) Definition of Common Objectives and Master Plans

In territorial governance literature, alignment across scales and jurisdictions is considered a prerequisite for integrated policy delivery (Faludi, 2013, 1303, 1307). This factor also corresponds directly with the principle of *strategic coherence* across borders, which is central in ESPON's (2013) understanding of what constitutes effective territorial governance. For the success of CBC projects, Guasco (2015, 62, 68-69, 92) underlines the importance of a bilateral or multilateral formal treaties outlining shared objectives and legal responsibilities. Nadin et al. (2020, 798) emphasise the importance of integrated spatial strategies in transboundary contexts, noting that such frameworks strengthen coordination between policies and the joint aims of territorial development. Stead and Waterhout (2008, 30) highlight that participatory alignment with regional actors fosters place-sensitive planning and supports the application of subsidiarity principles in infrastructure planning. These operationalizing features are confirmed in the operationalizing indicators from Castanho (2019, 8-9), which reflect institutional and procedural mechanisms that help to achieve such alignment:

- Develop and choose joint strategies for territorial development with a wide scope.

- Public participation is promoted in the development of common objectives and master plans.

In previous case studies, this has been of particular importance in the cases of Vienna (AT)–Bratislava (SK) and Saint Louis (FR)–Basel (CH) (Castanho, 2019, 9).

(ii) Political Transparency and Involvement

In line with principles of democratic legitimacy and procedural justice, territorial governance literature emphasises openness, accountability, and participation. This is strengthened by Bisbey et al. (2020, 179) who emphasize that transparency in decision-making, such as publishing documentation on timelines, costs, benefits, and environmental impacts, is important for project transparency in territorial governance. ESPON (2013) points out that active involvement of regional and local authorities in shaping and implementing shared goals also is crucial. OECD (2021) explicitly links effective infrastructure governance with procedural clarity and transparency, emphasising that large infrastructure investments require robust public oversight to build trust and prevent delays. Gualini (2006) stresses the political and institutional importance of openness, noting that transparent procedures help secure long-term political support across multiple governance levels. This aligns with the EU's own policy emphasis on democratic legitimacy in spatial planning and resonates with OECD (2017) recommendations on infrastructure governance. The operational indicator from Castanho (2019, 8-9) is well in line with other literature on the theme:

- Create and implement policies for increasing political and fiscal transparency.

This operational indicator was of particular importance in the cases of Nice (FR)–Monaco and La Línea de la Concepción (ES)–Gibraltar (UK) (Castanho, 2019, 9).

(iii) Connectivity and Movement Between Cities

This factor reflects the material and functional goals of territorial governance. It also reflects a key concern of territorial governance, especially in the EU context, namely spatial cohesion. This is often operationalised through infrastructure investment. This factor also resonates with the strategic alignment with the EU's TEN-T Core Network corridors, which define priority axes for European integration (European Commission, n.d.). The World Bank (2019) provides definitions of what that means in practice, namely the development or enhancement of rail, road, or multimodal corridors that link key metropolitan areas across national borders. This is also supported by Guasco (2015, 47, 64). These investments need to be supported by measurable or projected increases in cross-border flows of passengers and freight, to be truly justifiable (Rosas-Ferrusca et al., 2012, 123; Bisbey et al., 2020, 181). It is clear that joint planning and political involvement only can take you so far – without joint investment in the planning of the

infrastructure. Hence, the operational indicator from Castanho (2019, 8-9) aligns well with the aforementioned territorial governance literature:

- Invest in the common planning of accessibility and connectivity infrastructures. Joint planning and political involvement can only take you so far without joint investment in the planning of the infrastructure.

5. Analysis and Discussion

This chapter delves into the analytical part of the thesis, with a section regarding the planning and financing of both the Fehmarn Belt and the Chunnel, respectively. Indicators are tested for both projects within a territorial governance framework, based on the identified key factors by Castanho et al. (2018, 95-96) and Castanho (2019, 8-9). The analysis aims to uncover governance strategies that can inform the EU's 2025 Rail Infrastructure Plan, addressing the research question.

5.1. Planning and Financing

This section provides an in-depth analysis of the planning and financing strategies for the Fehmarn Belt and the Channel Tunnel (Chunnel), two landmark cross-border infrastructure projects in the European Union (EU). By applying the operational indicators from Castanho et al. (2018, 95-96) and Castanho (2019, 8-9) – common objectives and master plans, political transparency and involvement, and connectivity and movement between cities – this analysis evaluates how territorial governance, institutional coordination, and financial models shaped each project's development. The Fehmarn Belt represents a state-led, EU-supported approach, while the Chunnel exemplifies a privately financed model, offering contrasting lessons for the EU's forthcoming high-speed rail network plan, as outlined by the European Commission (2024). These case studies illuminate best practices and challenges in cross-border cooperation (CBC), aligning with the EU's Trans-European Transport Network (TEN-T) goals of enhancing connectivity and sustainability (European Commission, n.d.; EU, 2024).

	The Fehmarn Belt	The Chunnel
Total Cost	€7.5 billion	~£12,3 billion in 2015 (~€18 billion in 2025)
Financial Model	90% DK; 10% EU co-funding*	Private bank loans and shareholder equity
Funding Breakdown	Denmark ~€6.75 bn; EU ~€0.75 bn	Private capital: 100%
Revenue Model	User-pays system	Revenue from Eurostar and shuttle services
Financial Risks	Risk borne by Danish state	Risk borne by private investors

Table 1. Financial comparison of the two case studies (Danish Ministry of Transport, 2022; The Global Infrastructure Hub, n.d.; Femern A/S, 2022; Westcott, 2014 Bisbey et al., 2020, 85-86).

*Germany does not directly fund the tunnel but invests ~€3.5 billion in connecting road and rail infrastructure from Puttgarden to Hamburg, plus €49 million from CEF for German rail connections on Fehmarn Island (German Federal Ministry for Digital and Transport, 2024; Femern A/S, 2020).

5.1.1. The Fehmarn Belt

The Fehmarn Belt is soon to become the world's longest combined road and underwater tunnel. Scheduled for completion in 2029, the project will reduce rail travel time between Copenhagen and Hamburg from 4.5 to 2.5 hours, enhancing connectivity within the TEN-T Scandinavian-Mediterranean Corridor (Femern A/S, n.d.; EU, 2024). Costing €7.5 billion, it is primarily financed by the Danish state, with 10 percent of funds from the EU's Connecting Europe Facility (CEF) (Danish Ministry of Transport, 2022). This section delves into the planning and financing of the Fehmarn Belt, applying the territorial governance framework (Faludi, 2013; ESPON, 2013; Stead, 2014) and Castanho et al. (2018, 95-96) and Castanho (2019, 8-9) indicators to assess its governance, stakeholder engagement, and connectivity outcomes.

The planning of the Fehmarn Belt began in the late 1990s, inspired by the success of the Öresund Bridge, which connected Copenhagen in Denmark and Malmö in Sweden (Femern A/S, n.d.). Following a 1991 agreement between Denmark and Sweden to explore a fixed link across the Öresund, Sweden requested Denmark to investigate a similar connection across the Fehmarn Belt. This led to feasibility studies in the mid-1990s, with Germany expressing interest by 1999 (ibid.). The project's planning was formalized through the 2008 State Treaty between Denmark and Germany, a critical milestone that outlined shared objectives, technical responsibilities, and legal frameworks (Guasco, 2015, 60). This binational treaty aligns with Castanho's (2019) indicator of developing joint strategies for territorial development, emphasizing the importance of formal agreements in CBC projects (ESPON, 2013; Nadin et al., 2020, 798). The treaty's clarity in delineating responsibilities mitigated potential conflicts, ensuring sustained political commitment across borders (Guasco, 2015, 61).

The State Treaty assigned Denmark the primary responsibility for financing, constructing, and operating the tunnel, while Germany committed to upgrading access routes, including rail and road infrastructure on the German side of the strait (Danish Ministry of Transport, 2022). This clear division of roles addressed Faludi's (2013, 1303) concept of territorial governance, which requires coordination across jurisdictions with distinct administrative systems. Denmark's leadership was formalized through the 2015 Construction Act, passed by the Danish Parliament, which provided legal authority and budget approval (Danish Ministry of Transport, 2022). However, Germany's complex *Planfeststellungsverfahren* process, involving rigorous environmental and technical assessments, delayed final approval until 2020 due to legal appeals (Guasco, 2015, 101; Schmidt, 2025). This highlights the challenges of harmonizing planning systems across borders, as noted by Stead (2014, 681, 686), who emphasizes the need for horizontal and vertical coordination in CBC projects. These delays underscore the importance of anticipatory governance mechanisms to streamline cross-border

approvals, a lesson for future EU rail projects.

Environmental concerns were a significant planning challenge, particularly regarding the impact on marine ecosystems in the Baltic Sea strait. Extensive cross-border environmental assessments were conducted, involving stakeholders from both countries to address issues like sediment displacement and marine biodiversity (Schmidt, 2025). The assessment results were also made available for public scrutiny. The DHI Group was assigned the task by Femern A/S to develop a digital transparency tool for environmental data, hence the creation of the ÆGIR data portal (DHI Group, n.d.). However, the project has also received some criticism regarding the relative lack of independent studies with regard to quality assurance (Schjær-Jacobsen, 2017). However, serious effort were nevertheless demonstrated by Femern A/S, which does align with Castanho's (2019) indicator of promoting public participation in developing common objectives, as stakeholder consultations ensured that regional actors, including environmental groups and local communities, were involved in shaping the project (Stead and Waterhout, 2008, 22, 28). Femern A/S, a state-owned Danish company under Sund & Bælt Holding, managed the planning process, coordinating with German authorities and EU bodies to ensure compliance with TEN-T standards (Femern A/S, n.d.). The project's integration into the TEN-T framework reflects the EU's emphasis on seamless multimodal connectivity, as outlined in the TEN-T guidelines in Regulation (EU) 2024/1679.

The planning process was also met by technical challenges, such as aligning Danish and German railway signalling systems and electrification standards. These efforts required joint technical committees and EU support to ensure interoperability, a key TEN-T objective (European Commission, n.d.). Guasco (2015, 96) highlights the centrality of political agreements in overcoming these barriers, noting that the 2008 State Treaty provided a stable framework for long-term spatial planning. The planning of Fehmarn Belt exemplifies ESPON's (2013) framework of territorial governance, which emphasises procedural and institutional arrangements to support cross-border implementation. By fostering shared objectives and integrating public input, the project also aligns with the Nadin et al. (2020, 792) call for integrated spatial strategies that strengthen coordination across policies and jurisdictions.

The Fehmarn Belt's €7.5 billion cost is primarily financed by the Danish state, with approximately 10 percent from the EU's CEF, underscoring its strategic importance within the TEN-T network (Danish Ministry of Transport, 2022). The financing model relies on a user-pays system, with tolls and rail fees expected to recover Denmark's investment within 28 years of operation, starting in 2029 (Femern A/S, 2022). This approach places the financial risk on Denmark, reflecting a strong state commitment to the project's success but exposing it to potential revenue shortfalls if traffic projections are not met (Bisbey et al., 2020, 86). The EU's

contribution reduces financial pressure and enhances the project's legitimacy as a European priority, aligning with the Commission's goal of mobilizing investments for sustainable transport (European Commission, 2024).

The state-led financing model contrasts with the private-led approach of the Chunnel, offering greater stability but less flexibility in risk allocation (Bisbey et al., 2020 85-86). Denmark's assumption of financial risk was a deliberate choice to ensure project control and alignment with national and EU priorities, such as reducing greenhouse gas emissions and enhancing cross-border connectivity (We Build Value, 2025). The CEF funding, while financially limited compared to the total cost of the project, nevertheless played a critical role in signalling EU support, facilitating cross-border coordination, and offsetting costs (Danish Ministry of Transport, 2022). This model aligns with Castanho's (2019) indicator of joint investment in accessibility infrastructure, as EU and Danish funds were strategically allocated to support a multimodal corridor linking Scandinavia and Central Europe.

Despite some criticism, the financing process was relatively transparent, with Femern A/S publishing detailed financial analyses, including cost estimates and revenue projections (Femern A/S, 2022). This transparency aligns with OECD's (2021) recommendations for infrastructure governance, emphasizing public oversight to build trust and prevent delays. The Danish government's commitment to public funding reflects a long-term vision for regional integration, as highlighted by Castanho et al. (2018, 95-96), who note that shared objectives and political transparency are critical for successful CBC projects. However, the reliance on toll revenues introduces relative uncertainty, as economic downturns or lower-than-expected traffic could jeopardize repayment timelines (Femern A/S, 2022). Nevertheless, the tunnel will be in place for many decades, and even though the expected timeline would be slightly of course, it is highly unlikely that the repayment never will be reached.

5.1.2. The Chunnel

The Channel Tunnel, or Chunnel, is a 50.5-kilometre rail tunnel connecting Folkestone, UK, to Coquelles, France, completed in 1994. It remains a cornerstone of European connectivity, linking London with Paris, Brussels, and other cities via Eurostar and freight services (Westcott, 2014). Its original cost was £4.65 billion (around €12 billion in 2025 terms), but cost eventually doubled, and it was entirely privately financed by the Eurotunnel Group through bank loans and shareholder equity, with no direct government funding (The Global Infrastructure Hub, n.d.). This section analyses the Chunnel's planning and financing, using the territorial governance framework (Faludi, 2013; ESPON, 2013; Stead, 2014) and Castanho et al. (2018, 95-96) and Castanho's (2019, 8-9) indicators to evaluate its governance, transparency, and connectivity

outcomes.

The Chunnel's planning began in the 1980s, driven by bilateral negotiations between the UK and France, culminating in the 1986 Treaty of Canterbury (The Global Infrastructure Hub, n.d.). This treaty authorized the Eurotunnel Group, a private consortium, to design, build, and operate the tunnel under a concession model, marking a significant departure from state-led projects like the Fehmarn Belt (Bisbey et al., 2020, 85). The Eurotunnel Group included *Eurotunnel plc* (based in the UK) and *Eurotunnel SA* (based in France). These two parent companies were publicly listed and had identical boards of directors, ensuring a binational governance structure. At the same time, another British-French consortium of construction companies was formed, TransManche Link (TML) specifically created to design and construct the tunnel (ibid.; Getlink, 2019).

The planning process focused on two main things: 1) the technical feasibility and 2) the commercial viability, with the primary objective of creating a high-speed rail link to compete with air and ferry services (Westcott, 2014). Unlike the Fehmarn Belt, the Chunnel was planned before the EU's TEN-T framework was fully developed, limiting direct EU involvement (European Commission, n.d.).

The Treaty of Canterbury established common objectives, such as enhancing connectivity across the British Channel, but these objectives were primarily commercial rather than regionally integrative (The Global Infrastructure Hub, n.d.). The planning process required harmonizing UK and French legal and technical systems, a complex task given differing railway standards and regulatory environments (Westcott, 2014). Here, intergovernmental agreements facilitated coordination, but the private-led approach limited public participation, diverging from Castanho's (2019) indicator of promoting public involvement in master plans. Local communities and regional authorities had minimal influence, with planning decisions driven by the Eurotunnel Group's commercial priorities (Bisbey et al., 2020, 86). This limited participation risked reducing the project's legitimacy among stakeholders, a contrast to the Fehmarn Belt's more inclusive approach.

Technical challenges were significant, including drilling twin rail tunnels and a service tunnel under the English Channel, with construction teams meeting in the middle after six years (The Global Infrastructure Hub, n.d.). The precision had to be extremely precise. Environmental assessments were conducted, but their scope was narrower than that of the Fehmarn Belt, focusing on immediate construction impacts rather than long-term ecosystem effects (Westcott, 2014). The lack of EU frameworks meant planning relied heavily on bilateral negotiations, which, while effective in achieving the project's core objectives, lacked the broader territorial governance perspective advocated by Faludi (2013, 1303). The Chunnel's planning process thus prioritized

efficiency over inclusive governance, contrasting with the Fehmarn Belt's more EU-aligned approach (ESPON, 2013). This efficiency-driven approach highlights the trade-offs between speed and stakeholder engagement, an important consideration for future EU projects.

The Chunnel's initial £4.65 billion cost was entirely financed through private capital, including bank loans and equity from the Eurotunnel Group's shareholders, impressively with no direct government funding or guarantees (The Global Infrastructure Hub, n.d.). This private-led model shifted financial risk to investors, a new and bold approach in European infrastructure history, but one that aligned with the neoliberal policies of the 1980s but exposed the project to significant vulnerabilities (Bisbey et al., 2020, 83-84). Cost overruns doubled initial estimates, reaching £9 billion by completion, and lower-than-expected revenues led to financial restructuring in the 1990s (Westcott, 2014). The absence of public funding reduced fiscal burden on governments but highlighted the risks of private-led megaprojects in unpredictable markets (Bisbey et al., 2020, 84-85).

The financing model relied on projected passenger and freight revenues, primarily from Eurostar and shuttle services, to repay loans and generate profits (The Global Infrastructure Hub, n.d.). However, optimistic rail traffic forecasts, partly due to the exponential increase of low-budget airline fares, and high interest rates strained the Eurotunnel Group's finances, requiring debt renegotiations (Westcott, 2014). Other reasons include the COVID-19 pandemic as well as Brexit (Worth, 2024). This contrasts with the Fehmarn Belt's state-led model, where public funding and EU support provided greater stability (Danish Ministry of Transport, 2022). Naturally, with the UK exiting the EU in 2018, naturally The Chunnel's financing aligns with Castanho's (2019) indicator of joint investment in accessibility infrastructure, as private funds supported a transformative rail link, but the lack of public oversight limited transparency and risk mitigation (OECD, 2021).

Transparency in the Chunnel's financing was limited, with financial projections and cost estimates primarily accessible to investors rather than the public (Bisbey et al., 2020, 84). This factor contrasts with the Fehmarn Belt's open financial analyses and aligns with criticisms from OECD (2017) about the need for robust public oversight in large infrastructure projects. The Chunnel's private model demonstrated the potential for market-driven innovation but shows the risks of excluding public-sector support, particularly for projects with high capital costs and long payback periods (Bisbey et al., 2020, 85-86).

5.2. Comparative Analysis

This section presents a comparative analysis of the Fehmarn Belt and Chunnel projects through

a qualitative document review of second-source material, focusing on their planning and financing through the lens of territorial governance. By applying the key factors from Castanho et al. (2018, 95-96) and Castanho (2019, 8-9) – common objectives and master plans, political transparency and involvement, and connectivity and movement between cities – by their operational indicators, this analysis evaluates how these cross-border infrastructure megaprojects align with the EU's goals for its forthcoming high-speed rail network plan, as outlined by the European Commission (2024). The Fehmarn Belt represents a state-led, EU-supported model, while the Chunnel exemplifies a privately financed approach, offering contrasting insights for the EU TEN-T ambitions. The analysis is structured around the three governance indicators, assessing each project's strengths, weaknesses, and implications for future EU rail initiatives. The findings aim to address the research question: How can the EU apply lessons from the Fehmarn Belt and Chunnel, in terms of planning and financing, to its upcoming high-speed rail network plan?

5.2.1. Common Objectives and Master Plans

The establishment of common objectives and master plans is a cornerstone of effective territorial governance, ensuring alignment across jurisdictions and fostering strategic coherence (Faludi, 2013, 1303; ESPON, 2013). This indicator, as operationalized by Castanho (2019, 8-9), emphasizes the development of joint strategies for territorial development and the promotion of public participation in planning processes. Both the Fehmarn Belt and Chunnel projects demonstrate efforts to align objectives, but their approaches differ significantly due to their governance and financing models.

The Fehmarn Belt excels in this indicator, with the 2008 State Treaty establishing clear, shared objectives for connectivity and economic integration with its formalized shared goals of enhancing connectivity and economic integration within the TEN-T Scandinavian–Mediterranean Corridor (Guasco, 2015, 96). The treaty outlined clear technical, financial, and legal responsibilities, with Denmark leading construction and financing, while Germany committed to upgrading access routes (Danish Ministry for Transport, 2022). Extensive stakeholder consultations, including environmental groups and local communities, ensured public participation, aligning with Castanho's (2019) indicator and Stead and Waterhout's (2008, 28) emphasis on participatory planning. The project's integration into the TEN-T framework, supported by EU oversight, ensured strategic coherence with broader EU objectives, such as seamless multimodal connectivity (EU, 2024; Nadin et al. 2020, 798). These efforts reflect a strong governance structure that harmonized Danish and German planning systems, addressing Faludi's (2013, 1303) call for coordination across jurisdictions.

In contrast, the Chunnel's planning, formalized through the 1986 Treaty of Canterbury, focused primarily on commercial objectives, aiming to create a high-speed rail link to compete with air and ferry services (The Global Infrastructure Hub, n.d.). The treaty established a framework for the Eurotunnel Group to design, build, and operate the tunnel, but its scope was narrower, prioritizing market-driven goals over broader territorial development (Bisbey et al., 2020, 85). Public participation was limited, with planning decisions driven by the private consortium's commercial priorities, diverging from Castanho's (2019) indicator of inclusive master plans, further supported by Stead and Waterhout (2008, 30). The absence of EU frameworks, as the project launched previous to the TEN-T's full development, further constrained alignment with regional strategies (ESPON, 2013). While the treaty facilitated binational coordination between the UK and France, the Chunnel's planning lacked the participatory and integrative elements seen in the Fehmarn Belt, limiting its alignment with modern EU governance standards.

The state-led approach of the Fehmarn Belt, supported by EU frameworks, offers a model for aligning cross-border projects with strategic EU goals, such as those outlined by the Transport Commissioner and the Commission President in the prerequisite to the 2025 Rail Infrastructure Plan (European Commission, 2024). It can be argued that the Fehmarn Belt project's emphasis on public participation and formal treaties provides a blueprint for ensuring stakeholder engagement and legal clarity across the board. The Chunnel, while successful in achieving its core objective of connectivity, demonstrates the limitations of a commercial focus, particularly in engaging regional actors and aligning with broader territorial goals. For the EU's high-speed rail plan, the Fehmarn Belt's approach suggests that formal agreements and EU integration are critical for coordinating complex projects, while the Chunnel underscores the need for inclusive planning to enhance legitimacy and regional impact.

5.2.2. Political Transparency and Involvement

Political transparency and involvement are critical for building trust and ensuring democratic legitimacy in cross-border infrastructure projects (OECD, 2021; ESPON, 2013). Castanho's (2019) indicator emphasizes the creation of policies for increasing political and fiscal transparency, aligning with OECD's (2021) recommendations for robust public oversight. The Fehmarn Belt and Chunnel present stark contrasts in their approaches to transparency and stakeholder engagement, reflecting their differing governance models.

The Fehmarn Belt demonstrates strong political transparency through extensive public consultations, detailed environmental reports, and open financial analyses (Femern A/S, 2022; Schmidt, 2025). Femern A/S, the state-owned company managing the Fehmarn Belt project,

published comprehensive documentation on costs, timelines, and environmental impacts, aligning with Castanho's (2019) indicator and OECD's (2021) principles of procedural clarity. Stakeholder engagement involved regional authorities, environmental groups, and local communities, with a focus on fostering trust and addressing concerns about marine ecosystems (Schmidt, 2025). The project's integration into the EU's TEN-T framework required compliance with EU transparency standards, further enhancing accountability (EU, 2024). Germany's time-consuming *Planfeststellungsverfahren* process, despite causing delays, ensured thorough public scrutiny, reinforcing democratic legitimacy (Guasco, 2015, 167). This transparency strengthened political support across jurisdictions, aligning with Gualini's (2006) emphasis on openness for long-term project success.

Conversely, the Chunnel's private-led approach resulted in limited transparency and minimal public involvement (Bisbey et al., 2020, 85). Financial projections and cost estimates were primarily accessible to investors, with little public disclosure, diverging from Castanho's (2019) indicator and OECD's (2017) call for public oversight (Westcott, 2014). The Eurotunnel Group's commercial priorities drove decision-making, with regional authorities and communities having minimal influence (Bisbey et al., 2020, 85). While the 1986 Treaty of Canterbury ensured binational coordination between the UK and France, the lack of public engagement reduced accountability and limited stakeholder trust, particularly when costs exceeded the limits and its consequential financial restructuring in the 1990s (The Global Infrastructure Hub, n.d.). In a critical review of the operation of the Channel Tunnel Safety Authority (CTSA), Eisner (2000) notes that the whole project was clouded in secrecy, with an early head of CTSA in a parliamentary hearing "doubted whether the public were consulted during the construction and design of any other major engineering project".

The absence of EU oversight was only natural as the project predates the TEN-T network, however, an overall absence of public oversight constrained transparency compared to the more modern standards (ESPON, 2013).

The Fehmarn Belt's transparent approach, from both Danish and German actors, offers important lessons for the EU's high-speed rail plan, emphasizing the need for open documentation and stakeholder engagement to build trust and decrease the risk for delays (European Commission, 2024). The Chunnel's experience highlights the risks of limited transparency, including financial vulnerabilities. For future EU projects, adopting the Fehmarn Belt's model of public oversight and EU integration can enhance governance, while the Chunnel's challenges underscore the importance of balancing commercial interests with public accountability.

5.2.3. Connectivity and Movement Between Cities

Connectivity and movement between cities are central to the EU's territorial cohesion goals, particularly within the TEN-T framework (EU, 2024; World Bank, 2019). Castanho's (2019) indicator emphasizes joint investment in accessibility infrastructure, such as rail and multimodal corridors, to enhance cross-border flows of passengers and freight. Both the Fehmarn Belt and Chunnel significantly improve connectivity, but their alignment with EU priorities and focus on multimodal infrastructure differ.

The Fehmarn Belt is designed to reduce rail travel time between Copenhagen and Hamburg from 4.5 to 2.5 hours, integrating road and rail infrastructure within the TEN-T Scandinavian–Mediterranean Corridor (Femern A/S, n.d.; EU, 2024). Today, the primary connection between Copenhagen and Hamburg is the ferry service across the Fehmarn Belt between Rødby (DK) and Puttgarden (DE). This 18-km strait crossing takes approximately 45 minutes by ferry, excluding waiting and boarding times. However, it remains a very popular route. The alternative is the longer land route via bridges connecting Zealand, Funen, and Jutland, adding about 160 km to the journey. By opening in 2029, estimation shows that over 100 trains and 12,000 cars daily will pass through the tunnel (Femern A/S, n.d.). Denmark is financing 90 percent of the construction with EU CEF funds covering the other 10 percent. Germany's financial contribution to the Fehmarn Belt does not include direct funding of the tunnel itself but investment in the connecting infrastructure on the German side. Specifically, Germany is responsible for upgrading the road and rail connections between the tunnel portal at Puttgarden and the wider German transport network. These hard infrastructure connections are financed by the German government, totalling around €3.5 billion, as upgrades are also needed between Puttgarden and Hamburg (Femern A/S, 2020). In addition, in 2024 it was announced that approximately €49 million in funding from the CEF will support the construction of the German rail connection to the Fehmarn Belt tunnel on the island of Fehmarn (German Federal Ministry for Digital and Transport, 2024).

This multimodal approach supports Castanho's (2019) indicator of joint investment in accessibility, with measurable improvements in passenger and freight flows projected to enhance regional economic integration (World Bank, 2019; Rosas & Ferrusca, 2012). However, it is worth noting that while the investment is partly a joint one, the absolute majority of the cost is covered by the Danish state, with Germany only managing the connecting infrastructure on the German side, rather than the tunnel itself (German Federal Ministry for Digital and Transport, 2024). The project's alignment with TEN-T standards, including interoperability through harmonized signalling and electrification systems, ensures seamless connectivity across borders (Guasco, 2015, 168; European Commission, n.d.). EU funding from the Connecting Europe Facility (CEF)

and Danish state investment reflect a strategic commitment to accessibility, aligning with the EU's 2025 Rail Infrastructure Plan goals of connecting capitals and boosting rail freight (European Commission, 2024; Danish Ministry for Transport, 2022). However, the Fehmarn Belt connection extends its increased connectivity between Copenhagen and Hamburg further than these cities alone, as both act as transport hubs for a larger region. Copenhagen is a key transport hub connecting Scandinavia to the rest of Europe, hence improving connectivity and movement between the European "mainland" to major cities such as Malmö, Gothenburg, Oslo and Stockholm. Hamburg on the other hand, is well connected to the Ruhr Area, Munich and Berlin and have direct train connections to i.e. Poland, Switzerland, Austria and Czechia. Seldom has one sole infrastructure project had such a large impact on European infrastructure connectivity.

The Chunnel truly revolutionized connectivity between London, Paris, Brussels, Amsterdam and other cities, with Eurostar and shuttle services achieving high passenger flows (Westcott, 2014). It meets Castanho's (2019) indicator of investing in accessibility infrastructure, as private funds supported a transformative rail link (The Global Infrastructure Hub, n.d.). However, its focus was primarily on passenger rail, with limited emphasis on freight, and its pre-TEN-T context meant less alignment with current EU multimodal priorities (World Bank, 2019; EU, 2024). The absence of EU funding and oversight limited its integration into broader regional strategies, unlike the Fehmarn Belt's EU-supported approach (Bisbey et al., 2020, 84-85). Nevertheless, the Chunnel's relative success in competing with air travel demonstrates the potential of high-speed rail to transform cross-border mobility (Westcott, 2014).

The Fehmarn Belt's multimodal focus and EU integration make it a stronger model for the EU's high-speed rail plan, which prioritizes seamless connectivity and sustainability, as it not only connects two major cities, but several EU Member States closer to each other (European Commission, 2024). The Chunnel's success in passenger connectivity highlights the value of high-speed rail but underscores the need for broader freight and multimodal considerations. Future EU projects can draw on the Fehmarn Belt's alignment with TEN-T corridors and the Chunnel's market-driven innovation to, as efficiently and cost-effective as possible, maximize connectivity outcomes.

Key Factor	The Fehmarn Belt	The Chunnel
Common Objectives and Master Plans	*Strong Fulfilment:* Formalized through the 2008 State Treaty	*Partial Fulfilment:* 1986 Treaty of Canterbury, but focus on commercial objectives, limited public participation
Political Transparency and Involvement	*Strong Fulfilment:* High transparency through open data	*Weak Fulfilment:* Limited transparency
Connectivity and Movement Between Cities	*Strong Fulfilment:* Almost halving travel time CPH-HBG, integrating TEN-T Scandinavian-Mediterranean Corridor	*Strong Fulfilment:* Revolutionized connectivity between Britain and mainland Europe

Table 2. A comparative summary of the analytical conclusions (Guasco, 2015, 87, 137, 159-160, 168; Femern A/S, n.d.; EU, 2024; Global Infrastructure Hub, n.d.; Femern A/S, 2022; Schmidt, 2025; Westcott, 2014, Getlink, 2019; German Federal Ministry for Digital and Transport, 2024).

6. Policy Recommendations

The European Commission's upcoming Rail Infrastructure Plan, as outlined by President Ursula von der Leyen and Transport Commissioner Apostolos Tzitzikostas, aims to create an ambitious high-speed rail network to connect EU capitals, enhance rail freight, and support the European Green Deal's sustainability goals (European Commission, 2024). Drawing on the comparative analysis of the Fehmarn Belt and the Chunnel, this chapter addresses the research question:

How can the EU apply the lessons, both in terms of planning and financing, from the Fehmarn Belt and the Channel Tunnel infrastructure projects to the new Commission's upcoming high-speed rail network plan?

The Fehmarn Belt's state-led, EU-supported model and the Chunnel's private-led approach offer distinct lessons for planning and financing cross-border infrastructure megaprojects. These lessons are distilled into six policy recommendations for the European Commission to ensure the success of its high-speed rail network plan, aligning with the Trans-European Transport Network (TEN-T) objectives and territorial governance principles (EU, 2024; Faludi, 2013; Castanho et al., 2018, 95-96; Castanho, 2019, 8-9).

6.1. Planning Recommendations

1. **EU Coordinated Treaty Mechanism**

   The Fehmarn Belt project shows the benefits of formal bilateral agreements, while the Chunnel suffered from a lack of structured, ongoing governance commitments. Regardless of financing model, the EU should assist in making future cooperation more efficient. This can be done with the establishment of a "Coordinated Treaty Mechanism" that offers a legal and practical toolkit for international CBC infrastructure agreements. Such a mechanism could include examples of judicial clauses, institutional roadmaps, and mediation mechanisms overseen by a fitting EU body to streamline transnational coordination, such as DG MOVE. The 2008 Treaty signed by Denmark and Germany was a success, however, such success due to national commitments cannot always be guaranteed. If several new CBC infrastructure projects are to be initiated with the upcoming Rail Infrastructure Plan, Member States should have the opportunity to receive practical assistance in the often complicated and burdensome administrative process. This also helps fulfil the key factors of Castanho et al. (2018, 95-96), especially *Common Objectives and Master Plans*, as well as *Political Transparency and Involvement*.

2. Binding Operational Transparency Pact

Research shows that a crucial indicator for a successful cross-border project is *Political Transparency and Involvement* (Castanho et al., 2018, 95-96). In response to the somewhat unbalanced decision-making process (Germany causing initial delays in the Fehmarn Belt project) and relatively unreliable cost projections (The Chunnel doubled in cost), the EU should introduce a binding "Operational Transparency Pact" for all cross-border rail projects receiving EU funding. The Transparency Pact should mandate open-access data on matters such as budgets, environmental assessments, stakeholder consultations, and the companies involved in the planning and construction process. It is only fair that if EU funding is directed, certain transparency requirements need to be met. Responsibility for such a pact could be directed to the European Court of Auditors, as this could be considered an auditing matter. An alternative overseeing institution is the European Climate, Infrastructure and Environment Executive Agency (CINEA).

3. Mandatory Multilevel Planning Councils

Lessons from the Fehmarn Belt suggest that strong local and regional involvement increases the legitimacy and practical relevance of infrastructure megaprojects. The EU should require the formation of cross-border "Multilevel Planning Councils" for major projects, including subnational actors, civil society representatives, and private stakeholders. These councils could be convened as part of the TEN-T planning process and could very well feed directly into CEF funding assessments. This would also assure that the key factor of *Common Objectives and Master Plans*, as well as *Political Transparency and Involvement*, are taken into account.

4. Cross-Border Infrastructure Observatory

Similar to the Mandatory Multilevel Planning Councils, a "Cross-Border Infrastructure Observatory" should be introduced to avoid repeating planning inefficiencies across the EU Member States, securing the key factor of *Common Objectives and Master Plans*. The Observatory would collect data on project financing, stakeholder conflicts, and delivery performance. This body would serve as a knowledge base for project replication and institutional learning across similar projects across the TEN-T network and reflects the determination of the European Commission in physically integrating the Union's capital cities by high-speed rail. In turn, this would have a direct effect on the key factor of *Connectivity and Movement Between Cities.*

6.2. Financing Recommendations

1. Cross-Border Infrastructure Blending Facility

One of the biggest barriers to implementation of CBC infrastructure projects is uncertainty in financing. Seeing as the first key factor of Castanho et al. (2018, 95-96) is *Common Objectives and Master Plans*, it is only natural that these plans also would include the financial side of a project. The EU should hence establish a "Cross-Border Infrastructure Blending Facility", that incorporates Public-Private-Partnerships (PPP) through a pre-approved financial architecture. This Facility would provide a ready-to-use co-financing model, reducing transaction costs for Member States, preventing nations to reinvent the wheel, and offering private actors pre-negotiated risk guarantees. As one of the Commission's current priorities with the EU Global Gateway is to secure private financing in EU development projects globally, there are lessons to be learned in how similar PPPs can be built in CBC infrastructure projects within the Union as well. Similar to the EU Global Gateway structure, such a Facility could be managed by the European Investment Bank (EIB) with oversight from a fitting EU expert body, such as DG MOVE.

2. Strategic Planning Grant in CEF Applications

The first key factor for successful CBC, according to Castanho et al. (2018, 95-96) is *Common Objectives and Master Plans.* To encourage strategic integration, the EU should provide a special grant, or a "CBC gold star" one could say, in CEF evaluations for projects that demonstrate a clear link between national and regional spatial strategies, cross-border masterplans, and EU connectivity goals. This would reward projects that operationalise all Castanho's key factors beyond the formal EU requirements, further strengthening infrastructure integration within the Union. The extent of EU involvement in any project can naturally vary, however, if EU demonstrates particular encouragement, this can in turn have a positive effect on the extent of private capital attraction, as well as private investor confidence.

7. Conclusion

The comparative analysis of the Fehmarn Belt and the Chunnel projects provides critical insights for the European Commission's 2025 Rail Infrastructure Plan, addressing the research question: *How can the EU apply lessons, both in terms of planning and financing, from the Fehmarn Belt and the Chunnel infrastructure projects to the new Commission's upcoming high-speed rail network plan?* These landmark cross-border infrastructure megaprojects offer contrasting models of territorial governance, planning, and financing, aligning with the EU's TEN-T objectives and the European Green Deal's sustainability goals (European Commission, 2024; EU, 2024).

The Fehmarn Belt, a state-led, EU-supported project, exemplifies robust coordination, public engagement, and integration with EU frameworks, while the Chunnel, a privately financed endeavour, demonstrates market-driven innovation but highlights vulnerabilities in transparency and financial stability (Femern A/S, n.d.; The Global Infrastructure Hub, n.d.). By synthesizing lessons from both projects, this thesis contributes actionable recommendations for the EU's ambitious high-speed rail network, aiming to connect capitals, enhance rail freight, and reduce greenhouse gas emissions (European Commission, 2024).

The Fehmarn Belt's success lies in its institutionalized approach to territorial governance, as outlined by Faludi (2013, 1305-1306) and ESPON (2013). The 2008 State Treaty between Denmark and Germany established clear objectives, delineating responsibilities and fostering cross-border coordination (Guasco, 2015, 87, 137). Extensive public consultations and environmental assessments ensured stakeholder engagement and transparency, aligning with Castanho's (2019) indicators of public participation and political transparency (Femern A/S, 2022; Schmidt, 2025). The project's integration into the TEN-T Scandinavian-Mediterranean Corridor, supported by 10 percent EU funding from the CEF, reflects strategic alignment with EU priorities, such as interoperability and sustainability (Danish Ministry of Transport, 2022; EU, 2024). However, its reliance on toll revenues could introduce financial risks, underscoring the need for accurate traffic projections and contingency planning, as noted by Bisbey et al. (2020, 87).

In contrast, the Chunnel's private-led model, authorized by the 1986 Treaty of Canterbury, prioritized commercial objectives, achieving transformative connectivity between London, Paris, and other cities (Westcott, 2014). Its financing through bank loans and shareholder equity enabled rapid development but led to cost overruns doubling initial estimates and necessitated financial restructuring in the 1990s (The Global Infrastructure Hub, n.d.). Limited public engagement and transparency, as criticized by OECD (2017), reduced accountability and stakeholder trust, diverging from Castanho's (2019) governance indicators. While the Chunnel's

relatively success in competing with air travel highlights the potential of high-speed rail, its lack of freight focus and pre-TEN-T context limited its alignment with current EU multimodal priorities (World Bank, 2019; EU, 2024).

The EU's 2025 Rail Infrastructure Plan can draw on the Fehmarn Belt's strengths in formal agreements, EU integration, and transparent governance to ensure coordinated planning across Member States (European Commission, 2024). The Chunnel's experience underscores the value of private investment for innovation but highlights the need for public oversight to mitigate financial risks. Hybrid financing models, combining public funds, EU grants, and private capital, can have the capacity to balance stability and market-driven efficiency, as suggested by Bisbey et al. (2020, 93). Additionally, prioritizing multimodal corridors, as seen in the Fehmarn Belt, will support the EU's goals of enhancing rail freight and reducing greenhouse gas emissions, projected to save over 100 million tons of CO_2 annually by 2070 (We Build Value, 2025).

The analysis also reveals broader implications for EU infrastructure policy. The Fehmarn Belt's alignment with TEN-T standards, such as the ERTMS, addresses technical barriers like differing signalling systems, a persistent challenge in cross-border rail projects (Guasco, 2015, 92; European Commission, n.d.). The Chunnel's market-driven approach demonstrates the feasibility of high-speed rail competing with air travel, a key consideration for the Commission's goal of seamless ticketing and night trains (European Commission, 2024). By adopting the Fehmarn Belt's stakeholder engagement and the Chunnel's focus on passenger connectivity, the EU can enhance the social and economic impact of its rail network, creating an estimated 1.5 million jobs and €750 billion in economic benefits by 2070 (We Build Value, 2025).

Building on the comparative findings of this thesis, a series of policy recommendations were developed to strengthen the EU's ability to plan and finance future cross-border rail megaprojects. These recommendations are designed to be practically feasible within the current institutional setup and directly contribute to the implementation of the EU's forthcoming Rail Infrastructure Plan.

In regard to planning, four key recommendations are suggested. First, an EU Coordinated Treaty Mechanism (ECTM) would provide a structured legal toolkit to streamline transnational agreements, building on the institutional successes of the Fehmarn Belt project. Second, a Binding Operational Transparency Pact (OTP) would introduce enforceable rules for budget disclosure, stakeholder consultation, and environmental accountability in EU-funded CBC infrastructure, addressing the governance deficits observed in both cases. Third, the establishment of Mandatory Multilevel Planning Councils (MPC) would ensure that a broad range of actors are systematically involved in the planning phase of megaprojects. Fourth, a Cross-Border Infrastructure Observatory (CBIO) is proposed to gather data on project performance, support institutional

learning, and prevent repeated inefficiencies across Member States.

On the financing side, this thesis recommends the creation of a Cross-Border Infrastructure Blending Facility (CBIBF) to lower entry barriers for Member States and private actors by pre-structuring public-private partnerships. Additionally, a Strategic Planning Grant should be introduced in CEF applications to reward alignment with EU-wide connectivity goals.

These recommendations aim to close the gap between policy aspirations and delivery mechanisms, translating lessons from past megaprojects into future success stories. In doing so, the thesis contributes not only to academic debates on territorial governance and cross-border infrastructure, but also to the practical policy tools needed to realise the EU's ambitious connectivity objectives, with special emphasis on international high-speed rail.

This study also faces several limitations that should be acknowledged. The Fehmarn Belt project is still under construction, with completion expected in 2029, limiting the availability of empirical data on its operational outcomes (Femern A/S, n.d.). While planning and financing data are robust, the lack of performance data introduces uncertainty regarding revenue projections and long-term impacts (Femern A/S, 2022). This thesis relies on current projections and planning documents, which may not fully reflect future realities.

The study focuses on only two case studies, the Fehmarn Belt and the Chunnel, which may not capture the full diversity of cross-border infrastructure projects. Other projects, such as the Öresund Bridge, could provide additional perspectives but were excluded to maintain focus and depth (Femern A/S, n.d.). The selection of these cases, while justified by their scale and relevance to TEN-T goals, limits the generalizability of findings. It should be noted that Castanho et al. (2018, 95-96) have already conducted an impressive case study of over 20 similar CBC infrastructure projects in Europe, interestingly not including the Fehmarn Belt nor the Chunnel. This is a significant strength to the relevance of this thesis and the research gap it aims to fill.

The use of AI to specify and refine the language in the Policy Recommendations section of this thesis also presents limitations. AI can enhance clarity and align terminology effectively, but it also lacks contextual nuance of actual professionals working within the EU institutions. This could lead to the recommendations becoming overly generalized or too theoretical. To address this gap, a peer review by professionals at EU institutions, such as DG MOVE or the European Court of Auditors, would be invaluable in ensuring the applicability and relevance of the policy recommendations.

Furthermore, to improve this study area in future research, a similar thesis would benefit from incorporating primary sources, such as interviews with EU policymakers or project managers involved in the Fehmarn Belt or Chunnel, to provide firsthand insights into governance and financing challenges, as well as best practises.

It is also worth mentioning that the Qualitative Comparative Analysis (QCA) methodology, while suitable for comparing complex cases, heavily relies on the operational indicators from Castanho et al. (2018, 95-96) and Castanho (2019, 8-9), which may not fully capture all relevant governance dimensions (INTRAC, 2017). The focus on three key factors – Common Objectives and Master Plans, Political Transparency and Involvement, and Connectivity and Movement Between Cities – may overlook other variables, such as cultural or geopolitical influences, which could affect project outcomes.

Finally, the thesis assumes the EU's 2025 Rail Infrastructure Plan will prioritize TEN-T alignment and sustainability, based on current policy statements (European Commission, 2024). However, at the time of writing, the plan's final details remain unknown, and shifts in political priorities or economic conditions could alter its scope, potentially affecting the relevance of these recommendations.

Despite these limitations, this thesis provides a robust framework for understanding cross-border infrastructure governance, offering actionable insights for the EU's high-speed rail ambitions. Future research could expand on these findings by analysing additional case studies or incorporating post-completion data from the Fehmarn Belt to validate long-term outcomes. One thing, however, is for certain: this field of study will only become more relevant in the years and decades to come.

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