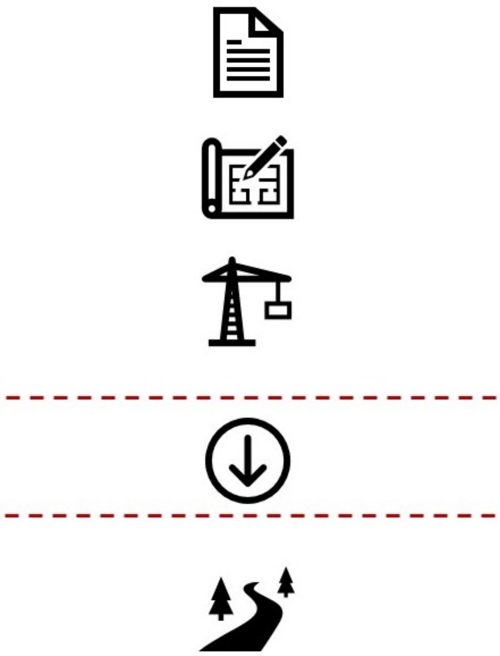

A Risk-Based Evaluation of the Handover Process for Information Transfer at the Swedish Transport Administration

Master's thesis in the Master's Programme Infrastructure and Environmental Engineering

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DIVISION OF GEOLOGY AND GEOTECHNICS

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2026
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MASTER'S THESIS ACEX30

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Cover:
Schematic illustration of the infrastructure lifecycle, highlighting the handover between construction and operation.
Department of Architecture and Civil Engineering
Göteborg, Sweden, 2026

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ABSTRACT

This thesis investigates the handover process between the Investments and Maintenance business areas at the Swedish Transport Administration (STA), with a focus on identifying deficiencies in information transfer and organisational practices. The study aims to analyse how the process is carried out in practice, where the risks and challenges arise, and which improvement measures can most effectively reduce these risks. The research is based primarily on qualitative interviews with personnel involved in the handover process, complemented by a qualitative risk assessment. To evaluate and prioritise potential improvement measures, the Analytic Hierarchy Process (AHP) was applied, using time, cost, and health and safety as decision criteria. The findings indicate that the handover process is generally functional but exhibits significant variation in implementation. While successful outcomes are common, recurring challenges are identified in areas such as stakeholder involvement, unclear responsibilities, fragmented information management, and gaps in competence. These issues give rise to risks related to delays, increased costs, and, in some cases, safety-critical errors. In addition, the AHP analysis shows that early involvement of specialists from Maintenance is the most effective measure for reducing risk, as it addresses root causes and prevents errors in early project stages. Measures such as temporary project groups and full-time handover coordinators contribute to improved coordination and continuity, while mandatory training provides long-term support for competence development but has a more limited immediate impact. Besides, the study concludes that improving the handover process requires a focus on early, preventive interventions combined with strengthened organisational coordination and knowledge sharing. The findings provide practical guidance for the STA and contribute to a broader understanding of how handover processes in infrastructure projects can be improved to enhance efficiency, reliability and safety.

Key words: Handover process, Risk assessment, Infrastructure project management, Analytic Hierarchy Process (AHP), Swedish Transport Administration

En riskbaserad utvärdering av överlämningsprocessen i informationsöverföring på Trafikverket

Examensarbete inom masterprogrammet Infrastruktur och miljöteknik

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SAMMANFATTNING

Det här examensarbetet utforskar överlämningsprocessen mellan verksamhetsområdena Investering och Underhåll på Trafikverket, med fokus på att identifiera brister i informationsöverföring och organisationens metoder. Studien avser att analysera hur processen görs i praktiken, vart riskerna och utmaningarna uppstår samt vilka förbättringsåtgärder som kan reducera dessa risker på effektivast sätt. Studien är huvudsakligen baserad på kvalitativa intervjuer med personal i roller som är involverade i överlämningsprocessen, kompletterat av en kvalitativ riskutvärdering. För att utvärdera och prioritera förbättringsåtgärder, användes Analytic Hierarchy Process (AHP) som använde tid, kostnad och hälsa och säkerhet som beslutskriterier. Resultatet indikerar att överlämningsprocessen är funktionell i de flesta fallen, men visar på stora variationer i implementering. Medan lyckade överlämningar är vanliga, finns återkommande utmaningar i flertalet områden som sent engagemang av intressenter, oklara ansvarområden, fragmenterad informationshantering, och glapp i kompetens. Denna typ av problem ökar risker relaterade till förseningar, ökade kostnader och i vissa fall säkerhetskritiska fel. AHP-analysen visar att tidigt involverande av specialister från Underhåll i processen är den mest effektiva åtgärden för riskreducering, detta eftersom den adresserar rotorsaker och förebygger fel i tidiga projektfaser. Åtgärder som temporära projektgrupper och heltids-överlämnandekoordinatorer bidrar till förbättrad koordination och kontinuitet, medan obligatorisk utbildning bidrar med långsiktig kompetensutveckling men har en mer begränsad omedelbar verkan. Slutsatsen är att överlämningsprocessen kräver fokus på tidiga, förebyggande insatser, kombinerat med förstärkt organisationskoordination och kunskapsdelning. Resultaten förser praktisk vägledning för Trafikverket och bidrar med en bredare förståelse om hur överlämningsprocessen i infrastrukturprojekt kan förbättras för att öka effektivitet, tillförlitlighet och säkerhet.

Nyckelord: Överlämningsprocess, Riskutvärdering, Infrastrukturprojekt, Analytic Hierarchy Process (AHP), Trafikverket

Contents

Preface

This master's thesis was carried out at the Swedish Transport Administration (Trafikverket) as part of the Master's Programme in Infrastructure and Environmental Engineering at Chalmers University of Technology during the spring semester of 2026.

The study focuses on the handover process between the business areas Investments and Maintenance, and aims to identify deficiencies as well as evaluate improvement measures from a risk perspective. The work has been conducted as a qualitative case study, combining interview-based findings with risk analysis and the Analytic Hierarchy Process (AHP).

First and foremost, I would like to express my sincere gratitude to my supervisor Lovisa Svanling at Trafikverket for valuable guidance, continuous support, and engagement throughout the thesis work. The insights and feedback provided have been essential for shaping both the direction and quality of the study.

I would also like to thank my academic supervisor Arsalan Najafi at Chalmers University of Technology for constructive feedback and valuable discussions, which have contributed to improving the analysis and overall structure of the thesis. I also extend my appreciation to my examiner Kun Gao for contributing to the academic quality of the thesis.

Furthermore, I am very grateful to all interview participants at Trafikverket who generously shared their time, experience, and perspectives on the handover process. Without their contributions, this study would not have been possible.

Finally, I would like to thank everyone at IVvrv3 for their support and encouragement throughout the project.

Gothenburg, June 2026
Emma Martander

Notations

The Swedish Transport Administration has an affinity for abbreviations and uses some terms without direct translations. Therefore this section will clarify translations and abbreviations for industry and organisation specific terms.

Translations

Ombudbyte	Change of delegate
Diarieföring	Journalising
Signeringsbeslut	Decision of signing

Abbreviations

STA	Swedish Transport Administration
ÖFT	Open for traffic (Öppen för trafik)
VO	Business area (Verksamhetsområde)
ÖK	Handover coordinator (Överlämnandekoordinator)
MK	Reception coordinator (Mottagandekoordinator)
SÖK	Organising handover coordinator (Samordnande överlämnandekoordinator)
PL	Project manager (Projektledare)

1 Introduction

1.1 Background

Road infrastructure projects involve long lifecycles where decisions made during planning, design, and construction have significant implications for future operation and maintenance (Bajare et al., 2024; World Economic Forum, 2024). The transition from project delivery to long-term management, known as the handover process, is therefore a critical moment in the lifecycle of infrastructure. This process is known to be challenging due to the temporary nature of project organisations, the large volume of technical information that must be transferred, and the involvement of numerous external consultants and contractors (Beckers et al., 2013; Swedish National Audit Office, 2017). When handovers are incomplete or delayed, maintenance organisations may lack the information needed to plan, prioritise, or manage risk effectively.

In Sweden, the Swedish Transport Administration is responsible for planning, constructing and maintaining the national road network (Government Offices of Sweden, n.d.). Given the scale and complexity of its operations, efficient coordination between the business areas responsible for investment projects and those responsible for maintenance is essential. However, as in many large organisations, differences in working culture, objectives, and time horizons can make transitions difficult. Project teams at Investments are focused on delivering infrastructure on time and within budget, whereas Maintenance prioritise long-term performance, reliability, and safety (Bajare et al., 2024; Beckers et al., 2013). These differing priorities can lead to misaligned expectations regarding what information should be delivered, when, and in what form.

In addition, increasing digitalisation and growing volumes of data place further demands on handover practices. Ensuring that information is complete, accurate, and accessible is becoming increasingly critical for effective asset management. This makes the handover process an important area for analysis and improvement. Understanding how the process functions in practice, where gaps arise, and how these gaps affect long-term operations is therefore highly relevant for improving performance and sustainability of Sweden's road infrastructure.

1.2 Aim and Objectives

The aim of this thesis is to analyse the handover process between the business areas of Investments and Maintenance at the Swedish Transport Administration. The thesis aims to find deficiencies related to information transfer and organisational processes while also proposing improvement measures that can be implemented to reduce risks and deficiencies in the current process.

To guide the exploration of the thesis and clarify the scope of the study, the following research questions have been formulated as objectives;

- How is the handover process between Investments and Maintenance carried out in practice, and how does implementation vary?

- Which stages of the process are most critical, and what information gaps affect operations and maintenance outcomes?
- Where and why do risks and deficiencies arise in the process?
- Which improvement measures are most effective in reducing risk within the Swedish Transport Administration context?

1.3 Limitations

This study has several limitations. First, it focuses solely on handover processes within road infrastructure projects; rail-infrastructure projects are therefore excluded. The analysis is limited to handovers from the business area Investments to the area of Maintenance and does not consider handovers elsewhere in the organisation. Although the thesis addresses the risks to long-term performance, it does not examine broader performance factors such as construction defects or design quality beyond those directly related to the handover process. Similarly, political or regulatory constraints and their influence on the handover outcome are not analysed.

All interview participants were from within the organisation. As a result, the study does not capture potentially valuable external stakeholder viewpoints. The research also relies exclusively on qualitative methods, meaning it does not generate measurable outcomes such as performance indicators.

The study focuses on the handover process itself rather than the digital tools or information systems used to support it. Finally, the proposed improvement measures are not tested in practice but are evaluated based on their perceived risk-reducing effect.

2 Literature Review

The management of infrastructure assets spans multiple stages, from early planning and design to construction, operation, and long-term maintenance. Within this lifecycle, the transition from project delivery to maintenance, referred to as the handover process, has increasingly been recognised as a critical factor influencing asset performance, reliability, and lifecycle cost. While the larger subject of infrastructure lifecycle management involves diverse technical, organisational, and economic considerations, this review focuses specifically on the handover process, where information, responsibilities, and knowledge are transferred from production-oriented project teams to maintenance organisations. This transition is particularly important in civil engineering contexts, where assets are long-lived, documentation is extensive, and maintenance decisions depend heavily on the quality and completeness of information handed over.

The significance of this topic lies within its demonstrated impact on both operational efficiency and long-term infrastructure management. Ineffective handover processes can lead to incomplete documentation, increased maintenance costs, delays in operational readiness, and reduced ability to conduct proactive asset management. In contrast, well-structured handover practices improve information continuity, enhance organisational learning, and contribute to more sustainable lifecycle outcomes. Despite its importance, the handover process remains one of the most inconsistently executed stages within infrastructure project delivery, making it a relevant and necessary focus for research.

While the review examines handover practices from an international and cross-sector perspective, particular attention is given to insights that are applicable to public infrastructure owners, such as national transport authorities, to ensure relevance for the Swedish Transport Administration's Investments–Maintenance handover context.

Based on these considerations, this literature review investigates the following:

- How is the handover process between project delivery and maintenance conceptualised in the existing literature?
- What challenges, deficiencies, and best practices are identified in relation to handover processes in infrastructure projects?
- How do organisational structures, documentation practices, and information management systems influence the effectiveness of handover to maintenance organisations?

To answer these questions, the review applies a broad and systematic search strategy designed to capture multiple perspectives on handover processes within infrastructure management. Keywords were derived from preliminary internal investigations and centred around maintenance, investment, infrastructure, project, and handover. These were combined into the following search string: handover AND infrastructure AND maintenance OR operations NOT (vehicles OR mobile OR algorithm). Searches were conducted in major academic databases relevant to civil engineering and organisational practice, including Scopus, ScienceDirect, and

Google Scholar, as well as Trafikverket's Publikationsdatabas to ensure coverage of Sweden-specific institutional material.

Inclusion criteria were restricted to studies whose primary focus related to civil engineering, infrastructure asset management, or organisational processes connected to handover. Only publications in Swedish or English were considered, and duplicates or studies outside the scope of infrastructure handover were excluded. In addition to peer-reviewed research and technical reports, the review incorporates grey literature such as governmental publications, technical guidelines, and previous academic theses because the research topic concerns operational and procedural practices that are often documented outside traditional academic channels.

This review is organised into three main sections. The first provides conceptual background and definitions related to handover and situates the process within the broader infrastructure lifecycle. The second synthesises the literature into key thematic areas, including information flows, organisational structures, documentation requirements, digital tools, and common deficiencies. The third identifies gaps, methodological limitations, and areas for future research. Together, these sections establish a foundation for analysing how handover processes function in practice and how they can be improved to better support maintenance-focused organisations.

2.1 Handover Processes and Information Management

Within infrastructure and construction projects, handover refers to the transfer of information, responsibility, and knowledge from project teams to maintenance and operations units. It is increasingly understood as an iterative, multi-step process rather than a discrete project event. The process typically begins with the distribution of technical information to relevant actors, supported by organisational strategies and digital systems (Yoon Chan, 2024). Because operational conditions evolve continually, information is frequently updated, meaning that use and revision occur simultaneously rather than in a linear sequence (Ramesh, 2016; Yoon Chan, 2024). The quality of information, which is often assessed based on accuracy, timeliness, completeness, and consistency, directly affects whether the receiving party can assume and maintain operational control effectively.

This perspective aligns with broader knowledge-transfer theory, which positions handover as a form of organisational learning. According to Szulanski (1996), successful transfer relies on both the presence of actionable knowledge and a recognised need for its transfer. Knowledge typically moves through stages of initiation, implementation, ramp-up, and integration, reflecting the progression from initial exchange to full operational embedding. Barriers such as organisational "stickiness" or vague responsibilities can hinder this progression, reinforcing that handover involves far more than a simple exchange of documents (Lester, 2007).

Research shows that handovers encompass both graphical and non-graphical information, ranging from sketches, maps, and Geographic Information System data to manuals, operational guidelines, maintenance logs, and roadside management records (Aziz et al., 2017; Yoon Chan, 2024). Because information produced in one stage is validated in the next, effective data management must begin early in design. Early engagement of the maintenance organisation ensures that data collected remains fit for operational use (Aziz et al., 2017; Ramesh, 2016).

A recurring theme in the literature is the importance of continuous cross-departmental collaboration during data creation. Studies show that early and sustained cooperation between project teams, future operators, and external stakeholders significantly reduces inconsistencies in information flow (de Almeida Rodrigue et al., 2024; Johansson, 2023). However, many projects still rely on fragmented information practices, which weaken the continuity of documentation and increase the risk of incomplete or mismatched data.

2.2 Organisational and Contextual Factors in Handover Processes

The organisational arrangement between the client, the contractor and the future operator is a defining factor in the unfolding of the transfer. Often, these entities are distinct, creating challenges in responsibility allocation and expectation management (Bodemyr & Strind, 2017). Project organisations often view handover as an end-point rather than a transition, which reduces motivation and limits the depth of collaboration with maintenance operators (Bodemyr & Strind, 2017; Johansson, 2023). Despite this, the project team retains authority over final handover decisions, including warranties and failure management (Bodemyr & Strind, 2017).

Contracts typically specify what information must be delivered, but reality often diverges from contractual assumptions. Projects are frequently incomplete at the time of the handover, requiring coordination of both “hard” documentation and “soft” knowledge transfer such as training, meetings, and explanations of deviation decisions (Johansson, 2023). Variation in competence, staffing, and organisational structures further affects how responsibilities are distributed between production and maintenance units (Bodemyr & Strind, 2017).

Infrastructure projects are characterised by complexity, long timelines, and frequent changes. Construction often begins before design is finalised, increasing the likelihood of outdated documentation (Hoehne, 2023). Public infrastructure projects often operate under higher scrutiny, time pressure, and stakeholder diversity compared to private projects, amplifying the importance of structured handover practices (Bao et al., 2023; Hoehne, 2023).

Studies emphasise that planning, design, construction, and operation are often treated as separate domains with little integration. Strategies that bridge these organisational divides are crucial to improving handover outcomes (de Almeida Rodrigue et al., 2024; Nordlöf et al., 2023). Broader project risks, including cost constraints, political expectations, and social impacts, further highlight the importance of early and sustained stakeholder engagement (de Almeida Rodrigue et al., 2024).

2.3 Digital Systems and Information Infrastructure

Digitalisation is widely seen as a key enabler of a structured and efficient handover. In the United States, for example, contractors are often required to enter maintenance information into standardised software chosen by the client organisation (East et al., 2013). When the receiving organisation provides a unified digital system, efficiency increases significantly.

Recommendations across studies emphasise the importance of maintaining a continuously updated digital documentation library throughout the project lifecycle (East et al., 2013; Ramesh, 2016). Some frameworks treat the handover as a distinct lifecycle stage that includes warranty records, performance data, and maintenance documentation, underscoring that digital tools help formalise and standardise this process.

2.4 Systemic Weaknesses in the Handover Process

Problems often originate in early project phases. Overoptimistic assumptions, unclear cost and risk assessments, and vague contract formulations create foundational weaknesses (Mäkelä, 2016; Schneider et al., 2016). Leadership often lacks detailed project understanding, and divergent departmental interests undermine alignment on handover goals. A uniform procedural approach that is applied regardless of project type would further limit effectiveness (Mäkelä, 2016).

Ambiguity in roles, responsibilities, and documentation standards becomes prominent as projects progress. Many managers consider their responsibility limited to delivering documents, not ensuring usability (East et al., 2013). The lack of standardisation results in inconsistent content and quality (Laine, 2012; Ramesh, 2016). Tight schedules reduce time available for verification and quality assurance. Competence gaps across organisations allow technical errors to pass undetected (Nordlöf et al., 2023).

Stakeholder engagement suffers as operational experts are often involved too late, resulting in documentation that does not align with real needs or workflows (de Almeida Rodrigue et al., 2024; Johansson, 2023). IT systems may require specialised training, limiting their effectiveness in use. Weak feedback loops prevent long-term learning and refinement.

As the handover approaches, disputes, uncertainty, and strained relationships become more common (Mirzaee & Martek, 2025). Technical systems require coordination across multiple disciplines, increasing complexity (de Almeida Rodrigue et al., 2024). Information is often delivered in formats poorly suited for maintenance use or lacking sufficient detail (Ramesh, 2016). Significant time is spent reconstructing missing information, and mismatches between requirements and delivered data remain frequent (Yoon Chan, 2024).

Long-term deficiencies include information loss, outdated documents, and unclear responsibilities (Yoon Chan, 2024). Over time, these issues degrade the usefulness of the delivered information and undermine the maintenance organisation's ability to fully assume operational responsibility (de Almeida Rodrigue et al., 2024; Yoon Chan, 2024).

2.5 Conclusion of Review

The literature on the handover of infrastructure projects highlights a number of consistent contributions that deepen understanding of how information, responsibility, and knowledge are transferred from project delivery to maintenance organisations. Across the reviewed studies, researchers emphasise that handover is a multidimensional, iterative, and knowledge-intensive process rather than a one-time administrative event. Significant contributions include detailed accounts of the types of information involved, ranging from technical documentation to GIS data and operational guidelines, and the recognition that information quality is central to ensuring effective operational uptake (Ramesh, 2016; Yoon Chan, 2024). Multiple authors demonstrate that early and continuous collaboration, especially involving future maintenance actors during design and construction, strengthens information flows and reduces inconsistencies in data creation and use (Aziz et al., 2017; de Almeida Rodrigue et al., 2024; Johansson, 2023).

Organisational studies add further insight by showing how structural arrangements shape responsibility allocation, communication, and motivation throughout the handover process (Bodemyr & Strind, 2017). Research on digital tools provides practical evidence that unified information systems and continuous documentation practices can significantly improve handover outcomes (East et al., 2013). Meanwhile, broader project-management literature contributes theoretical frameworks that conceptualise handover as a form of organisational learning, highlighting the challenges of "sticky" knowledge and the importance of embedding transferred information into routine operational practices (Szulanski, 1996).

However, despite these contributions, the literature reveals several persistent gaps and shortcomings. This includes:

- Fragmented focus: Many studies emphasise documentation and digitalisation but do not explore organisational culture, communication, or behavioural dynamics.
- Limited evidence: Few studies conduct analyses of how handover quality affects operations.
- Lack of context-specific research: Scandinavian and Swedish public-sector contexts are under-represented.
- Methodological variability: Studies use diverse definitions of handover, making cross-comparison difficult.
- Insufficient attention to maintenance needs: Many frameworks are production-oriented and do not fully reflect operational requirements.

Contextually, large infrastructure owners such as national transport agencies remain under-represented in academic discourse. Scandinavian and particularly Swedish public-sector conditions where projects involve specific administrative structures, procurement models, and long-term management obligations are scarcely examined. The literature also rarely addresses how strategic decisions made during planning and procurement shape downstream handover effectiveness, nor does it explore in depth how competence gaps, time pressures, and project-specific risk profiles influence handover outcomes.

These gaps point to several promising avenues for future research. Future studies could examine handover processes through different methods, tracking how documentation quality, stakeholder engagement, and digital information systems influence maintenance performance over time. There is also a need for research that integrates organisational psychology with infrastructure management to better understand how motivation, communication cultures, and interdepartmental relationships shape handover outcomes. Additionally, context-sensitive analysis focusing on public infrastructure agencies particularly within Scandinavian governance models would provide valuable insight into how institutional structures and national regulations affect handover practices in real-world settings.

Overall, the literature underscores both the importance and the complexity of handover processes in infrastructure projects. While substantial progress has been made in documenting challenges and proposing best practices, significant knowledge gaps remain. Addressing these through targeted research will be essential for improving the alignment between project delivery and long-term asset management, ultimately enhancing the performance, reliability, and sustainability of infrastructure systems.

3 The Swedish Transport Administration and the Handover

This chapter explains explain the Swedish Transport Administration and the particular handover process (Investments to Maintenance of road infrastructure projects) on which this thesis has its focus.

In the context of the Swedish Transport Administration (STA), the handover process refers to the transfer of information, responsibility, and operational knowledge from the project organisation (Investments) to the maintenance organisation (Maintenance) at the completion of a project (Darhammar, 2025).

The handover process includes the transfer of:

- Technical documentation, such as drawings, specifications, and system descriptions
- Operational and maintenance information required for asset management
- Responsibility for the infrastructure asset
- Knowledge regarding design decisions, deviations, and project-specific conditions

The quality of this transfer directly affects the ability of the maintenance organisation to operate, maintain, and manage the asset safely and efficiently.

3.1 The Swedish Transport Administration as an Organisation

The Swedish Transport Administration is a government agency responsible for the long-term planning of the Swedish transportation system as well as the operations and maintenance of state-owned roads (Landsbygds- och infrastrukturdepartementet, 2010). It is meant to create opportunities for a socio-economically effective and long-term sustainable transportation system, and to aid in the fulfilment of the Swedish transport-policy goals. The agency is also meant to present work for streamlining working processes (Landsbygds- och infrastrukturdepartementet, 2026).

There are six central functions of the organisation; Finance and Control, Safety and Security, HR, Communications, Purchasing and Logistics and, Legal Matters and Plan Review (Ewers, 2026). These are support for work done by the administration and to give the opportunities for the business areas to work systematically and efficiently.

The business areas are where the main operations of Trafikverket take place with the purpose of creating societal benefits (Ewers, 2026). There are six business areas: Market and Planning, Traffic Management, Maintenance, Investments, Major Projects and Information & Communications Technology.

The Organisational relations can also be described by Figure 3.1, shown below.

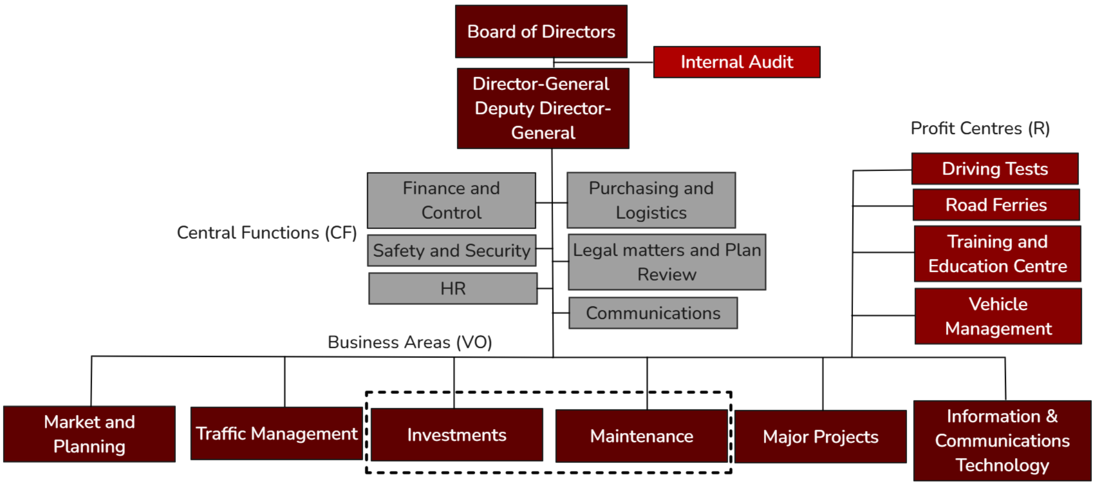

Figure 3.1: Organisational structure of the Swedish Transport Administration (Sjöström, 2025)

This thesis investigates the specific handover process in which projects are started as Investments' projects and then transcend into Maintenance projects and thus is handed over to Maintenance, this process occurs within the rectangle shown in Figure 3.1.

3.1.1 Investments

This business areas is responsible for delivering performed investment measures where costs are lower than one billion and performed reinvestment measures (Ewers, 2026). These are with regard to road and railroads as well as the research portfolio attached to the business area.

3.1.2 Maintenance

Maintenance's role in the handover process is as the receiving party (Renberg, 2025). Responsibility for performing maintenance for STA projects to keep up-to-date maintenance plans for these projects as well as updating the information on technical platforms. The Maintenance business area works through the entire lifecycle until decommissioning.

3.2 The Handover Process and its Crucial Roles at the STA

In the context of the STA, the handover process represents the formal transition where responsibility and control of the infrastructure asset are transferred from the Investments business area to Maintenance, together with all information and documentation required for its continued operation (Darhammar, 2025).

The handover process at the STA is split up into three parts, planning, performing and completion (Darhammar, 2025). The planning phase begins after project initiation, with Investments appointing the handover coordinator (ÖK) and nominating the reception coordinator (MK) at Maintenance. After the ÖK and MK are appointed, an initial meeting is conducted and they are then tasked with establishing a handover-plan. This plan should identify where responsibilities lie, plan dialogue during the project as well as showcasing the timeline and clarify what exactly is supposed to be handed over. The purpose of this phase is to ensure that facilitators receive early information regarding the timing and content of the handover.

The performing phase initiates after the project is approved for starting, with the conducting of the information-meeting which makes sure all actors have all the necessary information (Darhammar, 2025). The purpose of the meeting, which occurs before the procurement from the entrepreneurs, is to give the receiving party the opportunity to give input on the handover and also to prepare for the process any potential changes. A "debrief of facility " is conducted before each opening for traffic (ÖFT). This phase will give the facilitators and other relevant stakeholders the needed information regarding responsibilities and their distribution surrounding the handover process.

The last phase is the completion of the handover (Darhammar, 2025). Firstly, the handover meeting is conducted with relevant people decided by the coordinators depending on the scope of the project. During the meeting, decisions on responsibility of different parts of the facility after the handover are made. This phase is also when the delivery of all information and documents is complete and signed over. Journalising is done and handling of warranty is signed over to Maintenance and change of delegate is ensued.

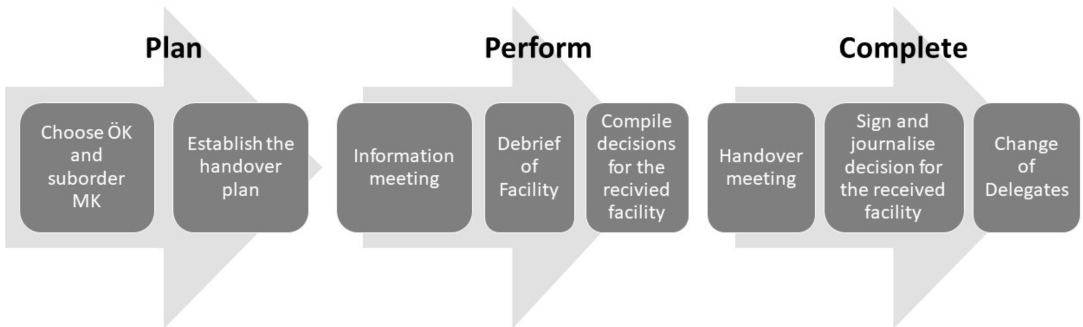

Figure 3.2: The steps of the handover process at the STA

In the case where a handover cannot be completed for whatever reason, the order of events is different (Darhammar, 2025). The project and the receiving party separately describe why the handover can not be completed, then ÖK and MK will compile a decision using the two descriptions and present for the project manager. The project manager will then have a meeting with concerned parties to put together how the project will be handled.

During the handover process, certain roles have a larger part to play. Sections below explains the most crucial roles and their responsibilities in the handover process.

3.2.1 Handover Coordinator - ÖK

The ÖK coordinates the handover process from the Investments side (Darhammar, 2024b) and the role is usually handed to the project engineer of the project team. This role is responsible for the process being followed in accordance to Trafikverket protocols. ÖK has continuous dialogue with MK and has the majority of the responsibilities in the handover process. They relay changes in project organisation, time plans and larger changes. It also required for the ÖK to ensure external stakeholders have the knowledge required to engage in the project.

3.2.2 Receiving Coordinator - MK

The MK, in contrast to the ÖK, is a full-time role, working on receiving projects and ensures a smooth reception of information in coordination with the ÖK (Darhammar, 2024a). This is done through a continuous dialogue with Maintenance and the ÖK. It is also the responsibility of the MK to journalise the received information and documents.

3.2.3 Coordinating Handover Coordinator - SÖK

SÖK's support the handover process in a region and works to ensures a smoother handover of responsibilities and data (Holmqvist, 2020). This is done through working with the ÖK and continuous dialogue with MKs. Together with SÖK's from other regions, experiences are shared to identify weaknesses and areas of improvement. The SÖK is also responsible to educate new handover coordinators and to be the utmost competence surrounding the handover process.

3.2.4 Project Manager - PL

The project manager, while not being a handover specific role, has a crucial role in the handover process as they have the decision power of the project team (Darhammar, 2025). This makes it important that the PL has a good understanding of the handover process as they have a facilitating role.

4 Methods

This thesis adapts a qualitative research design meaning it aims to find patterns in non-numerical data, focusing on the handover process between the Investments and Maintenance business areas within the Swedish Transport Administration. The methodology consists of three main components: (1) semi-structured interviews to gather data on current practices and perceived issues; (2) risk analysis to identify areas for improvement; and (3) measure procurement to identify improvement measures for implementation. This chapter describes how data was collected, how participants were selected, how material was analysed, and how final results were derived.

4.1 Interviews

Semi-structured interviews were utilised as the primary method of data collection. This interview format combines a predefined set of questions with sufficient flexibility to allow interviewees to elaborate on their experiences, clarify details, and raise issues not anticipated at the outset. This flexibility makes semi-structured interviews particularly suitable for investigating complex organisational processes, where formal routines exist but are interpreted and enacted differently across roles and context (Adams, 2015).

A conscious strategy was used to identify interview participants with direct and relevant experience of the handover process. Key roles were prioritised, including Handover Coordinators, Receiving Coordinators and Coordinating Handover Coordinators, due to their involvement in the coordination, execution, and approval of the handover. In addition, project engineers working with installation-intensive assets within Maintenance were interviewed in order to capture practical challenges associated with technical deliveries and their implications on the handover process. The initial script used for the interviewed can be found in Appendix A.

In total, fourteen interviews were conducted, seven with Investments and seven with Maintenance, with an average duration of approximately 50 minutes. All interviews were carried out with the informed consent of participants and were audio-recorded to ensure accurate documentation. Recordings were transcribed verbatim, and the transcripts were analysed using thematic coding. This analytical approach allows patterns and recurring issues to be identified across participants and is commonly used in qualitative research to structure data (Adams, 2015; Braun & Clarke, 2006). The resulting themes formed the basis for the risk analysis and subsequent procurement of improvement measures.

4.2 Risk Analysis and Measure Procurement

A qualitative risk analysis was conducted to identify and evaluate potential vulnerabilities within the handover process. Risks were identified through triangulation of interview data and observations from relevant internal documentation. Given the absence of quantitative incident data and the exploratory nature of the study, a qualitative risk assessment approach was considered appropriate.

Identified risks were assessed using a risk matrix, where perceived likelihood and consequence severity were evaluated using qualitative scales. The scales being low-medium-high for both likelihood and impact. Risk matrices are commonly applied in this context, where risks are assessed through expert judgement and experiential knowledge rather than statistical probability estimates, and where the primary objective is prioritisation rather than precise quantification (Cox Jr, 2008; Duijm, 2015). The matrix enabled differentiation between frequently occurring operational issues and less frequent but high-impact risks.

The purpose of the risk matrix was not to derive numerical risk values, but to structure and visualise risk patterns in a transparent manner. This aligns with recommended uses, risk matrices being used as decision support tools with awareness of their limitations (Cox Jr, 2008).

Potential improvement measures were identified based on deficiencies highlighted during the risk analysis and the interviews. To ensure practical relevance, an initial screening was conducted in which feasibility within the current organisational structure and resource constraints was considered. This step reduces the number of candidate measures to a manageable and feasible set for further evaluation.

The identified risks and improvements measures form the basis for the subsequent AHP analysis, where the measures are systematically evaluated and prioritised.

4.3 Analytic Hierarchy Process

To systematically evaluate the identified measures, Multi-Criteria Decision Analysis (MCDA) was applied using the the Analytic Hierarchy Process (AHP). The method was chosen due to its suitability for decisive problems involving multiple, potentially conflicting criteria and primarily qualitative input data, which aligns with the interview-based findings of the study (Saaty, 1987; Triantaphyllou & Mann, 1995). AHP is particularly appropriate in public-sector contexts where decision-making is guided by societal and organisational values rather than profit maximisation (Triantaphyllou & Mann, 1995).

The AHP analysis was conducted in five main steps:

1. Structuring the decision problem
2. Defining criteria and alternatives
3. Pairwise comparisons
4. Calculation of weights and priorities
5. Consistency check.

4.3.1 Structuring the Decision Problem

The problem was structured as a hierarchy consisting of:

- Goal (G): Identify the most effective risk reductive measure
- Criteria (C):
  - C1: Time-related risk reduction

    - C2: Cost-related risk reduction
    - C3: Safety and health-related risk reduction
- Alternatives (A):
    - A1: Early Maintenance specialist involvement
    - A2: Temporary project groups
    - A3: Mandatory education
    - A4: Full-time handover coordinator

These criteria and alternatives were derived from the interviews and the qualitative risk analysis (chapter 4.2), to ensure results are aligned between interview findings and the decision model. This hierarchy is also illustrated in Figure 4.1.

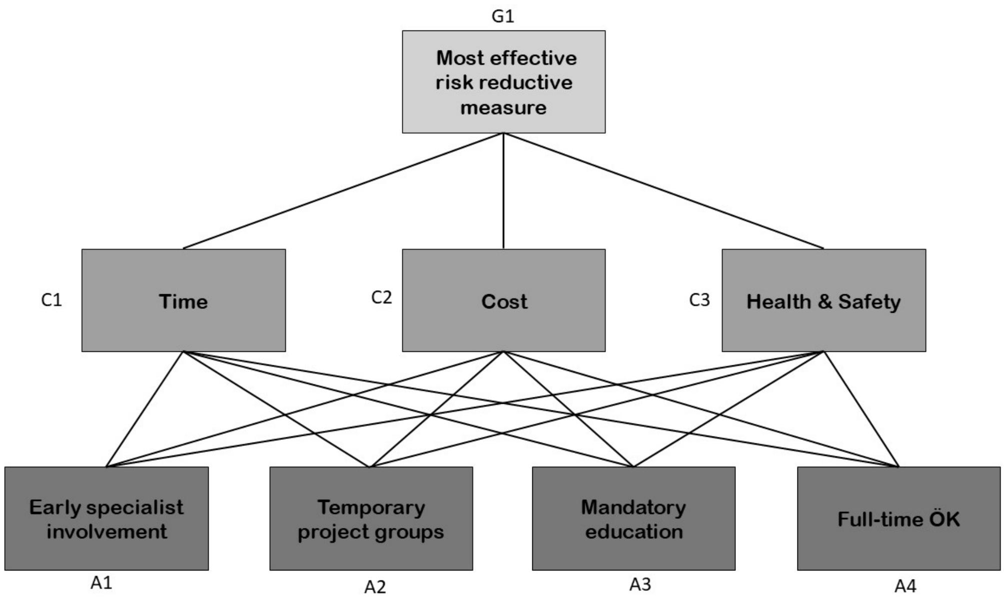

Figure 4.1: Hierarchical structure of the AHP model, including goal, criteria (C1-C3), and alternatives (A1-A4)

4.3.2 Pairwise Comparison

The evaluation criteria were compared to each other pairwise using Saaty's fundamental scale (see Table 4.1). Saaty's fundamental scale is used to measure the "intensity of importance" in comparisons, where a one is equal importance and a nine is extreme importance (Saaty, 1987). The comparisons were performed based on a synthesis of interview findings as well as in discussion with the STA supervisor. Pairwise comparisons enable decision-makers to express relative judgement between elements, which has been shown to align well with human cognitive process when evaluating trade-offs (Triantaphyllou & Mann, 1995).

In practice, this means that each criterion is compared with every criterion to determine which is more important and to what extent. Similarly, each improvement measure is compared to the others under each criterion to evaluate its relative effectiveness in reducing risk.

Table 4.1: Saaty fundamental scale.

Value	**Interpretation**
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very strong Importance
9	Extreme Importance

The improvement measures were compared pairwise under each criterion using the same procedure, resulting in a priority score for each measure with respect to each criterion. These judgements do not represent precise measurements, but rather informed assessments based on qualitative interview findings, organisational context, and strategic values of STA.

The full pairwise comparison matrices for the alternatives are provided in Appendix B (Table 7.1). These are included to ensure transparency, while the main methodology focuses on explaining the comparison process.

4.3.3 Calculation of Weights and Priorities

All pairwise comparison matrices were normalised to derive:

- Weights for each criterion (C1-C3)
- Priority scores for each alternative (A1-A4) under each criterion

These weights reflect the relative importance of each criterion, while the priority scores represent how effective each measure is in respect to the specific criteria.

4.3.4 Aggregation of Results

The overall priority of each alternative was calculated as a weighted sum of its priorities across all criteria, as seen in equation 4.1:

$$\sum_{i=1}^{n} P_i \cdot W_i \tag{4.1}$$

where P_i represents the priority of an alternative under a given criteria i, and W_i the corresponding weight of a criterion i. This means that the overall priority is calculated as the sum of its performance under each criterion, weighted by the importance of that criterion.

This aggregation ensures that alternatives that perform well under highly weighted criteria receive a higher overall ranking.

4.3.5 Consistency Check

To ensure that the pairwise comparisons were logically consistent, consistency checks were performed. Meaning, the purpose of the consistency check is to ensure that the pairwise comparisons are logically coherent and not contradictory. Consistency was evaluated using the Consistency index (CI) and consistency ratio (CR), calculated through equations 4.2 and 4.3 respectively:

$$CI = \frac{\lambda_m - n}{n - 1} \tag{4.2}$$

$$CR = \frac{CI}{RI} \tag{4.3}$$

where λ_m is the maximum eigenvalue, n is the matrix dimension, and RI is the corresponding Random Index (see Appendix C, Table 7.2).

A CR below 0.1 was required for all matrices, which indicates an acceptable consistency in judgement in line with established guidance for acceptable judgement consistency in AHP applications (Triantaphyllou & Mann, 1995). The full calculations of consistency can be found in Appendix C.

5 Results & Discussion

This chapter presents the findings of the study, based primarily on the interviews with personnel involved in the handover process at the STA. The results are complemented by a risk analysis and proposed improvement measures, which together provide a comprehensive picture of the current state of the handover process and areas for improvement.

Overall, the interviews indicate that the handover process generally works well and often results in successful transitions between Investments and Maintenance business areas. Respondents describe the process as largely effective when all parties engage early and collaborate actively. At the same time, the findings demonstrate recurring challenges related to involvement, clarity of responsibilities, documentation quality, competence distribution, and the efficiency of workflows.

Table 5.1 summarises the strengths and shortcomings identified in the interviews.

Table 5.1: Summary of factors

Shortcomings	*Success Factors*
Collaboration between areas	Early communication
Specialist competence	Shared understanding
Bureaucracy	Information exchanges
Working culture	Clear expectations

5.1 The Current State of the Handover Process at STA

Respondents consistently emphasise that, despite challenges discussed later in this chapter, the majority of handovers proceed as intended. Several participants highlight constructive collaboration in smaller offices, strong specialist engagement when available and dialogue between business areas working well. These strengths often enable projects to reach a successful handover even when obstacles arise along the way.

However, the findings also reveal significant variations in how the process is interpreted and carried out in practice. Many of the challenges described do not stem from the design of the process itself, but how it is implemented under differing project conditions, competence levels, and organisational structures.

The following sections present the key themes identified in the interviews. The challenges identified in the following sections relate directly to the key components of the handover process, particularly the transfer of information, responsibility, and knowledge between Investments and Maintenance.

5.1.1 Timing and Responsibility

A central issue identified in the interviews relates to how timing and responsibilities are managed throughout the handover process. Respondents frequently point out that the initiation of the handover process, particularly the sub-ordering of the

MK, often occurs too late, limiting the opportunity for early involvement from the receiving side.

Although guidelines exist, several interviewees describe the process as something learned primarily through experience rather than structured training. This results in differing interpretations and inconsistent implementation across projects. In practice, the distribution of responsibility also becomes imbalanced towards the end of the project. While responsibility is formally shared between roles, the workload tends to fall heavily on the ÖK as other project members transition to new assignments.

For example, when responsibilities becomes unclear towards the end of a project, remaining project engineers may be required to resolve documentation issues without clear mandate r support, leading to inefficiencies and delays.

5.1.2 Collaboration Between Parties

Closely related to issues of timing and responsibility, several interviewees highlight challenges in collaboration between the different actors involved in the handover process. Differences in organisational structures, priorities, and working practices are described as key barriers to effective cooperation.

A recurring issue is the lack of structured communication channels and mechanisms for sharing experience across projects. This leads to repeated mistakes and reduces organisational learning. Collaboration is often described as dependent on individual experience and familiarity with the process, rather than being systematically supported.

A concrete example of this is when contractors and Investments lack a shared understanding of documentation ownership, resulting in uncertainty regarding who is responsible for producing or validating record drawings. In contrast, respondents from smaller offices report more effective collaboration, which they attribute to closer working relationships and more frequent informal interaction.

5.1.3 Competence and Capacity

In addition to organisational challenges, competence and capacity emerge as important factors influencing the quality of the handover process. Many interviewees identify gaps in both internal expertise and contractor competence as key contributors to recurring issues.

Participants frequently express concern that contractors lack sufficient understanding of STA's documentation requirements, resulting in inconsistent or low-quality deliveries. At the same time, project members within Investments are described as having limited ability to fully assess specialised systems, particularly in technically complex areas.

For instance, incorrect or incomplete documentation for installation-intensive systems, such as lighting or pumping stations, may occur when sufficient specialist knowledge is not available to review the delivered material. Respondents note that when in-house specialists are involved, the quality of deliveries improves significantly, highlighting the importance of competence in ensuring reliable handover outcomes.

5.1.4 Information Management and Documentation

Many participants describe significant difficulty in locating and verifying the information required for a complete handover. Information is often distributed across numerous files, systems, and formats, and the level of detail varies considerably between projects. This scattered structure is frequently described as fragmented.

In this context, fragmented information refers to information being distributed across multiple systems, formats, and actors without a unified structure, which limits accessibility and usability. Rather than forming a consistent and coherent dataset, information is scattered and requires significant effort to collect and interpret.

For example, technical drawings, maintenance manuals, and project updates may be stored in separate digital systems or communicated through informal channels such as email, making it difficult to establish a complete and reliable overview of the asset.

This fragmentation increases the risk of inconsistencies, duplication, and information loss, particularly in projects with long time horizons. Interviewees frequently highlight staff turnover among project engineers as a contributing factor, where knowledge is not fully documented and is lost when individuals leave the project. As a result, subsequent actors must reconstruct missing information, which introduces inefficiencies and increases the likelihood of errors.

5.1.5 Review Process and Workflow Efficiency

The challenges related to documentation and information quality also extend to the review process and overall workflow efficiency. Several participants highlight that the intended review process, which is based on sample-based verification, is often not feasible in practice.

Due to the low quality of submitted documentation, Maintenance is frequently required to perform detailed reviews of all deliveries rather than selected samples. This increases workload and leads to delays in providing feedback to Investments, which in turn slows the overall handover process.

For example, when documentation contains inconsistencies or lacks sufficient detail, reviewers must spend additional time verifying and correcting information, creating bottlenecks in the workflow. In addition, the relatively long intervals between handovers limit opportunities for learning and routine development, making it more difficult for staff to build efficiency in the process.

5.1.6 Engagement and Motivation

Interviewees highlight varying levels of commitment to the handover process across different roles. Several respondents note that the handover i sometimes treated primarily as a final administrative task rather than a critical part of the project lifecycle.

This reduced prioritisation affects engagement and can lead to uneven quality in documentation and insufficient attention to detail. It becomes particularly apparent in later stages of the project, where time pressures and transitions to new assignments reduce focus on the handover activities.

A typical example is when project members aim to complete handover tasks quickly in order to move on to subsequent projects, resulting in incomplete or insufficiently reviewed documentation. Furthermore, long handover duration are described as negatively affecting motivation, as prolonged processes reduce a sense of ownership and accountability.

Overall, the findings indicate that the identified challenges are interconnected rather than isolated. Issues related to timing, collaboration, competence, and information management reinforce each other, collectively contributing to increased risk and reduced efficiency in the handover process. While the formal structure of the process is perceived as adequate, its effectiveness is highly dependent on consistent implementation, early involvement of key actors, and the availability of appropriate competence and organisational support.

5.2 Risks and the Handover Process

The interviews highlight three primary categories of risk associated with the current handover process: time, cost, and safety. These categories reflect the most critical challenges identified in the previous section and serve as the basis for the subsequent risk analysis and prioritisation of improvement measures.

To provide a structured overview of these risks, a qualitative risk matrix was developed to assess their likelihood and impact.

5.2.1 Risk Matrix

Figure 5.1 presents the qualitative risk matrix summarising some of the risks identified in the handover process based on the interview findings. The matrix visualises the distribution of risks according to their perceived likelihood and impact severity, providing an overview of where risks are concentrated within the process.

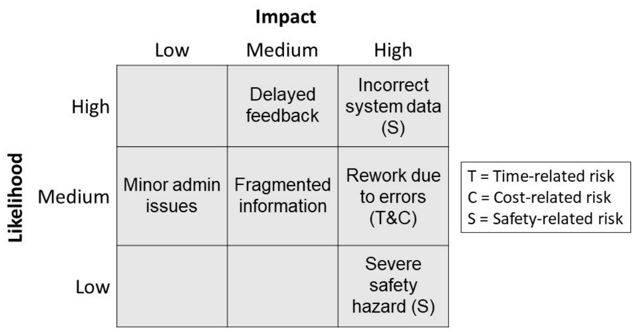

Figure 5.1: Qualitative risk matrix for the handover process at the Swedish Transport Administration

The matrix shows a clear cluster of risks in the high and medium impact areas, several risks related to process execution and coordination are positioned in areas combining high likelihood with critical impact. This indicates that these issues do appear and also have substantial consequences.

In addition, the matrix highlights a number of risks with low likelihood but high impact, particularly those related to competence and accountability. As an example, errors in the National Road Database (NVDB) are positioned in the high impact category, reflecting the potential for downstream consequences even if such events occur less frequently. This distinction illustrates that the handover process is exposed to both persistent operation inefficiencies and less frequent but safety-critical failures.

Primarily, the risk matrix demonstrates that the most significant risks to the handover process are those that either occur frequently with substantial impact or have the potential for high impact consequences if not addressed. This distribution provides a structured overview of the risk landscape and serves as an empirical basis for the subsequent prioritisation of improvement measures.

Overall, the matrix illustrates that the handover process is affected by both recurring operational inefficiencies and less frequent but high-impact risks. These findings provide a foundation for further analysing risks within each category and for identifying targeted improvement measures.

5.2.2 Time - C1

Time-related risks were among the most frequently identified issues in the interviews. Several respondents from Investments explain that Investments often has to wait long periods before receiving feedback on the quality of their deliveries, in some cases receiving comments after the deadline has already passed. This delay not only slows project progress but also affects how Investments is evaluated, as they are assessed based on their ability to deliver complete and correct information by the given deadline.

Interviewees also share examples of Investments projects remaining open for years longer than planned because the handover cannot be completed, leaving projects stalled and unresolved. Such prolonged timelines impact the overall efficiency of Investments as a business area.

5.2.3 Cost - C2

Closely linked to time-related risks, several interviewees highlight cost implications arising from delays and inefficiencies in the handover process. Respondents note that when projects drag out, personnel must still log their hours in their projects, leading to additional cost accumulation over time. These extended timelines result in unnecessary financial strain on both the project and organisation. When re-doing parts of the project to fit Maintenance's requests costs will increase. Some interviewees discuss this in the broader context of the asset life cycle, stressing that efforts to reduce production costs can ultimately lead to significantly higher operational cost.

Another risk regarding the costs is the budget. The project budget is set by Planning, meaning Investments do not control it. So, when costs rise due to unforeseen issues and the funds are depleted, Investments are placed in a situation beyond their control.

5.2.4 Safety and Health - C3

In addition to time and cost impacts, safety and health risks represent a critical dimension of the handover process. Interviewees point out that certain delivery errors, particularly in electrical systems, can have serious safety implications. Mislabelled or incorrectly connected electrical circuits were frequently mentioned as examples of issues that can pose direct danger on a personal level. These safety risks highlight the importance of thorough reviews, adequate specialist involvement, and accurate documentation to ensure that the finalised facility is safe for operation and maintenance. There are also risks when errors occur in certain deliveries. The NVDB is used by emergency services as well as companies and private citizens for GPS, making it crucial that roads and potential blockages are accurately represented to ensure overall road safety.

Respondents note that when project managers transition to new assignments before the handover is completed, the remaining project engineers are left to handle unresolved issues with limited support. This creates intense workload peaks and places disproportionate responsibility on a single individual. Interviewees warn that this situation, if repeated over time, increases the risk of stress-related health issues, including potential long-term sick leave due to burnout.

In summary, the identified risks demonstrate that deficiencies in the handover process affect multiple dimensions simultaneously. While time-related risks are the most frequent, safety-related risks carry the most severe consequences, and cost impacts are often a result of inefficiencies in the other two categories.

These insights provide a clear basis for identifying and evaluating improvement measures aimed at reducing risk across the process.

5.3 Possible Improvements

Based on the identified risks and deficiencies, the interviews also provide insights into potential improvements to the handover process. These suggested measures reflect both immediate adjustments and more structural organisational changes.

The interviews reveal a number of suggestions regarding how the handover process at the STA could be improved, which will be presented in the sections below. These measures range from short-term, easily implemented adjustments to more long-term structural changes.

5.3.1 Short-term Measures

Short-term measures focus on improvements that can be implemented within existing structures and processes. Several interviewees suggest simplifying the existing handover plan to make it easier to follow and more intuitive for project teams. Respondents note that a clearer, streamlined plan would help reduce ambiguity and unnecessary complexities.

Some participants from Maintenance propose further integrating Facility-specific requirements for roads (AKV) to ensure that the perspectives and needs of Maintenance are more visible throughout the project. Interviewees feel that using AKV more consistently would help highlight operational requirements earlier.

Numerous interviewees recommend providing training for both contractors and engineers at the start of the project regarding documentation and technical aspects. This gives the project team as a whole a better understanding before reviewing and producing documentation.

One participant suggested making pre-validation of certain material mandatory or strongly encouraged. This, since early validation could help catch mistakes sooner and improve quality of material handed over to Maintenance.

5.3.2 Long-term Measures

In contrast, long-term measures involve more structural changes to the organisation and the handover process. Several respondents propose assigning representatives from Maintenance to the project organisation as they feel having Maintenance directly involved in the entire process would ensure future operational needs are consistently addressed. Expanding on this, a participant suggested that a temporary organisation is formed where all necessary personnel from Investments and Maintenance work as one team. This organisation could after handover dissolve and maintenance could facilitate more efficiently as they have the necessary information.

Many interviewees emphasise wanting a unified platform with a simplified handover process that is accessible to all relevant actors, including consultants and contractors, and one that can contain documentation for the entire process. Respondents believe that centralising information would make requirements clearer and reduce uncertainty about where documentation is stored Another measure proposed by some interviewees in Investments, is to redefine the ÖK role so that it functions more similarly to the MK role, with a dedicated focus on handover work. Respondents argue that having an ÖK who works with handovers full-time rather than juggling multiple responsibility could increase continuity and quality as well as build a better routine.

5.4 Evaluation of Improvement Measures

From the range of suggested improvements, four measures were selected for further evaluation. These measures were chosen based on their feasibility within the current organisational context, as well as their recurring emphasis in the interview material.

These measures are hereafter referred to as A1-A4 and are evaluated in relation to their ability to reduce the identified risks.

5.4.1 Early Maintenance Specialist Involvement - A1

The results show that late involvement of Maintenance leads to documentation errors and misalignments that are difficult and costly to correct once design and construction decisions have been finalised. Late involvement often leads to situations where design and documentation choices have been finalised. Early involvement of Maintenance specialists enables proactive identification of operational requirements and inconsistencies at stages where corrective actions are less complex.

This measure primarily reduces time-related risks by limiting rework and delays, while also contributing to cost efficiency by preventing late-stage changes. From a safety and health perspective, early specialist involvement reduces the likelihood of safety critical documentation errors. Although the measure requires careful planning and allocation of specialist resources, it addresses root causes of several high-impact risks and therefore has a strong preventive effect across all risk categories.

5.4.2 Temporary Project Groups - A2

Temporary project groups consisting of personnel from both Investments and Maintenance were identified as a means of addressing organisational fragmentation. Interview results indicate that current coordination problems are largely driven by separate organisational structures and objectives between business areas.

Integrated project groups promote shared responsibility, improve communication, and facilitate earlier detection of errors through continuous interaction. This measure primarily mitigates time-related risks by reducing delays caused by misunderstandings and incomplete information transfer. While coordination efforts may introduce short-term costs, the measure contributes to improved continuity and reduced rework. Its effectiveness depends on clearly defined roles and decision mandates to avoid ambiguity in accountability.

5.4.3 Mandatory Education - A3

Mandatory education on handover processes was proposed to address the lack of formal knowledge transfer identified in interviews. Many participants currently rely on experiential learning, leading to inconsistent practices and varying interpretations of responsibilities.

Structured training would establish a shared baseline understanding of the objectives, requirements, and documentation standards, reducing dependency on individual experience. The effects of this measure are primarily long-term and indirect. While it supports consistency and awareness across projects, it has a limited immediate impact on preventing project specific risks and therefore serves as a supporting rather than primary risk-reduction measure

5.4.4 Full-time Handover Coordinator at Investments - A4

Introducing full-time handover coordinators is motivated by workload concentration and continuity issues identified in the interview. Handover responsibilities often peak at the end of projects, increasing the risk of errors and stress-related health issues.

Full-time coordinators would improve continuity across projects, support consistent interpretation of requirements, and reduce delays caused by last-minute clarifications. This measure is particularly effective in mitigation workload- and health-related risks, with moderate effects on time and cost performance. However, its implementation requires clear role definition and entails additional personnel costs that must be weighed against the expected benefits.

5.5 Results of AHP Analysis

The results of the AHP analysis are presented in three parts:

1. the relative importance of the criteria,
2. the final ranking of improvement measures, and
3. an interpretation of how these results relate to the challenges in the handover process, identified in the interviews.

The AHP model combines the identified risk categories (C1-C3) and the improvement measures (A1-A4) into a structured framework as presented in Figure 4.1 in the Methods chapter. The criteria represent the main types of risk identified in the qualitative analysis, while the alternatives represent the most relevant improvement measure identified in the study.

5.5.1 Weights and Reasoning

The relative importance of the criteria was determined through pairwise comparison using Saaty's fundamental scale. Table 5.2 presents the matrix used to evaluate the relative importance of time, cost and safety.

Table 5.2: Pairwise Comparison of Criteria

Criterion	C1	C2	C3
C1	1	3	1/2
C2	1/3	1	1/5
C3	2	5	1

The matrix is read row by row. Each value represents the importance of the row criterion in relation to the column criterion. For example, the value of 3 in the first row (C1 compared to C2) indicates that time-related risk reduction (C1) is considered moderately more important than cost-related risk reduction (C2). Conversely, the value of 1/3 in the second row (C2 compared to C1) reflects the reciprocal relationship, meaning that C2 is less important than C1.

Similarly, the value of 1/2 in the comparison between C1 and C3 indicates that time is considered slightly less important than safety and health, while the corresponding value of 2 shows that safety and health (C3) is more important than time (C1). This pattern is consistent across the matrix, where each comparison has a reciprocal value on the opposite side of the diagonal.

The diagonal values are all equal to 1, as each criterion is equally important when compared to itself. These pairwise comparisons collectively form the basis for calculating the relative weights of the criteria, which are used in the subsequent prioritisation of improvement measures.

The criteria each have a corresponding weight as seen in Table 5.3. These weights reflect the relative importance of each criterion's ability to reduce risk in the handover process which were assessed through the interview findings and with the institutional context of the STA as a government agency. The outcome of the weighting prioritises health and safety, followed by time, with cost having the lowest assigned importance.

Table 5.3: Weights of criteria based on risk

Criteria	Weight
C1	0.31
C2	0.11
C3	0.58

Health and Safety (C3) was assigned the highest weight, reflecting severity of the potential consequences and priorities expressed by interviewees. Although safety-critical errors were described as less frequent than many other risks, respondents emphasised their potentially severe consequences. From an organisational perspective, the prioritisation of safety aligns with the agency's role as a public authority. The STA operates under a "safety first" principle, where preventing harm outweighs considerations to efficiency or cost minimisation. This societal responsibility justifies assigning greater importance to risks with high impact on personal safety, even when the likelihood is lower. Consequently, this criterion dominates the weighting scheme.

Time (C1) was given the second-highest weight due to its central role in many operational challenges. Delays in the handover process were repeatedly described as common and disruptive, leading to prolonged project closures and uncertainty regarding responsibilities. Respondents also indicate errors identified late in the process become significantly more difficult to correct, further amplifying the effects of time delays. Importantly, time was also recognised as a key driver of other risks, particularly cost. Extended project duration were frequently associated with increased resource consumption. As such, time was not only treated as an independent risk dimension but also as an contributor to downstream consequences. Despite this, time was weighted lower than C3 because delays were generally perceived as manageable, whereas safety-related risks were associated with more irreversible outcomes.

Cost (C2) received the lowest weight among the criteria. This is reflected in both qualitative findings and organisational context. While interviewees acknowledge that prolonged handovers and rework leads to increased costs, these impacts were predominately consequences of failures in time management and quality assurance rather than as primary risks in their own right. Furthermore, as the STA is a government organisation, maximum profit is not the objective. Cost consideration are therefore framed primary in terms of responsible use of public resources rather than performance. This perspective supports a lower weight for cost, as financial efficiency is of lower priority compared to safety, relatability, and long-term operational quality. This reflects costs role as a secondary impact rather than primary decision criteria.

These weight form the basis for the final priority values, meaning measures performing well in reducing safety-related risks have a greater influence on the overall ranking.

5.5.2 Overall Ranking of Improvement Measure

The final priority value were calculated using the weighted aggregation method described in Section 4.3. As seen in Table 5.4, Alternative A1 has the highest priority, followed by A4 and A2 in close proximity and, A3 is ranked as having the lowest priority.

Table 5.4: Final priority of measures based on risk

Measure	Priority [-]
A1	0.50
A2	0.20
A3	0.09
A4	0.21

Notably, A1 has a significantly higher priority compared to the other alternatives, indicating a clear preference rather than a marginal difference between measures.

5.5.3 Interpretation of Measure Priorities

The AHP results indicate clear differences in the risk-reducing potential of the evaluated measures. Alternative A1, early Maintenance specialist involvement, ranks highest, reflecting its strong preventive effect across all risk categories. By addressing documentation quality, coordination, and safety issues early in the project lifecycle, A1 reduces high-impact risks before they materialise.

Full-time handover coordinators (A4) rank second, primarily due to their ability to improve continuity and reduce workload concentration, thereby mitigating health- and stress-related risks. This measure is more reactive in nature, addressing problems as they arise rather than preventing them early.

Temporary project groups (A2) rank closely behind A4 and primarily contribute to reducing coordination and communication risks caused by organisational fragmentation. While effective across all criteria, their impact is less concentrated on high-impact preventive risk reduction compared to A1.

Mandatory education (A3) ranks lowest, reflecting its indirect and long-term contribution. Although it supports competence development and standardisation, its limited immediate effect on critical risks results in a lower overall priority.

Overall, this suggests that addressing root causes early in the project lifecycle is more effective than attempting to manage risks through downstream corrective measures.

5.5.4 Alignment with Interview Findings

The result of the AHP analysis shows strong alignment with the findings of the interviews, indicating consistency between the qualitative insights and the structured prioritisation of improvement measures. Overall, the ranking of measures reflects the issues most frequently and emphatically raised by interviewees and supports the validity of the analytical approach.

Early specialists involvement (A1), which received the highest overall priority, corresponds closely with interviewees' repeated emphasis on the negative consequences of late Maintenance involvement. Respondents consistently highlighted issues become increasingly difficult and costly to correct once the project has progressed beyond early phases. Several interviewees described notable improvements in quality and clarity of communication when specialists and representatives from the receiving side were engaged early in the process. The dominant priority assigned to A1 therefore reflects its ability to address root causes of multiple high-impact risks identified in the interviews.

The similar priorities of temporary project groups (A2) and full-time handover coordinators (A4) also align well with the qualitative findings. Interviewees describe both coordination failures between business areas and workload concentration at the later project phases as significant and recurring challenges. The comparable priorities of A2 and A4 suggest that these measures address different but equally important dimensions of the handover problem, a nuance also evident in the interview material.

In contrast, mandatory handover courses (A3) received the lowest priority, which is quite consistent with how it was discussed during the interviews. While respondents recognised the value of structured education for establishing a common baseline knowledge and reducing reliance on informal learning, such courses were generally perceived as supportive rather than decisive. The low priority assigned to A3 therefore reflects its more indirect and long-term contribution to risk reduction, as compared to more structural measures.

Taken together, the AHP results reinforce the interview findings by highlighting the importance of early preventive interventions as opposed to measures focused on downstream mitigation or general competence development. The convergence between the risk analysis and interview results strengthens the credibility of the results and suggest that the identified improvement measures address concerns that are both empirically grounded and organisationally relevant.

5.5.5 Implications for Practice

The prioritisation of improvement measures provide actionable guidance for how the handover process may be strengthened in practice, particularly under conditions of limited resources or implementation capacity. Rather than suggesting a uniform solution, the results support a structured approach sequencing and combining measures in a way that maximises risk reduction while remaining feasible within the organisational context of the STA.

If implementation capacity is strained, A1 should be prioritised. As a preventive measure acting early in the project lifecycle, A1 reduces the likelihood that critical deficiencies in documentation, requirements, or relevant installations persists into later phases. From a practical standpoint, prioritising such early interventions can reduce downstream burden placed on coordination, review, and corrective work, thereby improving the overall process efficiency without necessarily increasing total resource consumption. This approach aligns with the organisations safety-first mandate and supports the efficient use of public resources.

Measures A2 or A4 should be understood as complementary responses to different organisational challenges rather than competing alternatives. Temporary project groups primarily address fragmentation and the transfer of information between business areas by strengthening cross-collaboration, while full-time handover coordinator contribute to continuity and workload stability across projects. The near equal prioritisation of these measures suggest that the choice between them should be informed by local or organisational conditions.

A3 should be implemented as a supporting action rather than as a stand-alone solution. While training contributes to increased awareness and possibly standardisation over time, its impact on the most critical risks identified in this study is indirect. In practice, this implies that these initiatives are likely to be most effective when embedded within a broader improvement strategy.

From a resource allocation perspective, the findings indicate that effective improvement does not necessarily require increased budgets but may instead depend on reallocating existing competence and responsibility. Prioritisation measures that reduce high-impact risks early can decrease the need for resource intensive corrective action later in the process. This is particular relevant in a public-sector context, where efficiency is evaluated not in terms of profit but in terms of safety, reliability, and responsible use of public funds.

Overall, the implications of this study point towards a layered improvement strategy, in which preventive measures form the foundation, coordination and continuity measures mitigate residual risks, and training support the long-term learning and consistency. By applying the prioritisation in this manner, STA can strengthen the robustness of the handover process while maintaining flexibility to adapt implementation to varying organisational constraints and project conditions.

6 Conclusion

This thesis analysed the handover process between the business areas Investments and Maintenance at the Swedish Transport Administration, with the aim of identifying deficiencies and prioritising risk-reducing improvement measures. The findings show that while the handover process is perceived as functional and often results in successful transitions, its effectiveness varies significantly depending on how it is implemented in practice.

The study demonstrates that the most critical challenges do not stem from the formal design of the process, but from inconsistencies in execution. Variations in competence, engagement, and interpretation of responsibilities lead to uneven outcomes across projects. In particular, late involvement of Maintenance, unclear responsibility distribution, and fragmented information management were identified as recurring sources of risk. These deficiencies primarily affect the time performance and cost efficiency, but also expose the organisation to safety-critical risks with potentially severe consequences.

Through qualitative risk analysis and AHP prioritisation, the study identified early involvement of Maintenance specialists as the most effective risk-reducing measure. This measure addresses root causes rather than symptoms by preventing documentation errors, reducing late rework, and strengthening safety assurance at early project stages. Measures aimed at improving coordination and continuity were found to provide complementary benefits by mitigating organisational fragmentation and workload concentration. Mandatory education was assessed as a supportive measure with long-term value, but limited immediate impact on high-risk deficiencies.

A key contribution of this thesis is the identification of a gap between formal process structures and practical implementation. The findings highlight that actors involved in the handover process do not share a common understanding of its importance or objectives, which significantly influences outcomes. By combining qualitative insights with structured risk-based prioritisation, the study provides a practical framework for strengthening the handover process in the context of the STA.

From a practical perspective, the results suggest that improvements should prioritise preventive interventions early in the project lifecycle, supported by measures that enhance perceived issues such as coordination, continuity, and long-term learning. Importantly, many of the identified improvements do not necessarily require increased financial resources, but rather clearer role definitions, earlier allocation of competence, and more consistent organisational practices. Implementing such measures can improve efficiency, reliability, and safety across the infrastructure lifecycle.

6.1 Limitations

This study is subject to several limitations. First, the findings are based on a limited number of interview respondents, which may not fully capture all perspectives within the organisation. Additionally, the number of respondents is low compared to the typical qualitative studies. The study also primarily relies on qualitative data, meaning that the results reflect perceived challenges rather than measured performance.

Furthermore, the risk assessment and AHP analysis involve a degree of subjectivity, as they are based on judgements derived from interview data and contextual understanding. Although consistency checks were performed, the prioritisation of measures remains dependent on the chosen criterion and their assigned weights.

Additionally, the evaluation of improvement measures focuses primarily on their risk-reducing potential and does not fully account for factors such as organisational complexity, implementation difficulty or political and institutional constraints. Finally, the results should be interpreted within the context of the Swedish Transport Administration, limiting their direct generalisability to other organisations.

6.2 Suggestions for Future Research

Future research could build on this study in several ways. One area of interest is the role of project leaders in the handover process, particularly regarding their involvement and understanding of its long-term importance.

Further studies could also investigate how handover processes are managed in other government agencies or infrastructure organisations, enabling benchmarking and identification of best practices that could be applied within the STA.

Another relevant direction could be to explore the proposed measures in greater detail, for example through pilot projects or case studies within the organisation. Such studies could assess the practical feasibility and implementation challenges, of these measures.

The use of Artificial Intelligence and how it could aid the process, could be another topic for further research.

Future research could incorporate quantitative data or longitudinal analysis to evaluate how improvements in the process influence overall project performance, efficiency of operations, and safety outcomes.

7 Disclaimer of AI Use

Artificial Intelligence (AI) tools were used in this thesis for language-related support, including spelling correction, grammar improvement, and enhancing the flow and readability of the text.

All analytical content, interpretations, and conclusions are the author's own and were developed independently. The use of AI did not influence the scientific content or the research outcomes of this study.

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Appendix A - Interview Questions

The following questions were used as a guide during the semi-structured interviews.

- Could you expand upon your role and what your part in the handover process is?
- How would you describe the handover process in its current state, from your perspective?
- How do you perceive the transfer of information during the handover?
- Which risks do you perceive that limitations in the handover process create?
- Is there anything additional that should be highlighted, that has not been brought up?

Role-specific questions

ÖK

- How is the dialogue with Maintenance?
- How do you work to ensure good quality deliveries?
- Which improvements do you think can be made? Where are improvements needed the most?

MK

- How is the dialogue with Investments?
- Does the given information correspond to the information needed during maintenance?
- What would make the process better for Maintenance?

SÖK

- How is the dialogue between Investments and Maintenance?
- How do you support ÖK in their work?
- Where do issues arise?

PL

- How is the dialogue between Investments and Maintenance?
- Where do issues often arise?
- How does the quality of deliveries affect further work?

Appendix B - AHP Analysis

Appendix B presents the full pairwise comparison matrices used in the AHP analysis for alternatives. These matrices form the basis for calculating the weights and priorities presented in Chapter 5.2.

Table 7.1: Pairwise Comparison of Alternatives

Time	A1	A2	A3	A4
A1	1	3	5	4
A2	1/3	1	4	1/2
A3	1/5	1/4	1	1/2
A4	1/4	1/2	2	1

(a) With respect to time-reducing, Which alternative is more effective?

Cost	A1	A2	A3	A4
A1	1	3	4	5
A2	1/3	1	2	3
A3	1/4	1/2	1	2
A4	1/5	1/3	1/2	1

(b) With respect to cost-reducing, Which alternative is more effective?

Health & safety	A1	A2	A3	A4
A1	1	3	5	2
A2	1/3	1	3	1/2
A3	1/5	1/3	1	1/3
A4	1/2	2	3	1

(c) With respect to prioritising health and safety, Which alternative is more effective?

Appendix C - Consistency Checks

Appendix C presents the calculations used to evaluate the consistency of the pair-wise comparisons in the AHP analysis.

Table 7.2: Random Index (RI) for different matrix sizes (n), used for consistency checks

n	**RI**
1 & 2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Consistency is evaluated using the Consistency Index (CI) and Consistency Ratio (CR). A consistency ratio below 0.1 indicates acceptable judgement consistency.

Criteria

	A*w	λ_m
C1	0.93	3.004
C2	0.33	3.001
C3	1.75	3.006
MAX		3.006

Table 7.3: Calculation of maximum eigenvalue for pairwise comparison of criteria

$$CI = \frac{\lambda_m - n}{n-1} = \frac{3.006 - 3}{3-1} = 0.0032$$
$$CR = \frac{CI}{RI} = \frac{0.0032}{0.58} = 0.0055 < 0.1$$

Alternatives - Time

	A*w	λ_m
A1	2.22	4.15
A2	1.02	4.07
A3	0.32	4.02
A4	0.55	4.05
MAX		4.15

Table 7.4: Calculation of maximum eigenvalue for pairwise comparison of alternatives in the aspect of time

$$CI = \frac{\lambda_m - n}{n - 1} = \frac{4.15 - 4}{4 - 1} = 0.050$$

$$CR = \frac{CI}{RI} = \frac{0.050}{0.9} = 0.055 < 0.1$$

Alternatives - Cost

	A*w	λ_m
A1	2.22	4.102
A2	0.95	4.06
A3	0.56	4.02
A4	0.34	4.02
MAX		4.102

Table 7.5: Calculation of maximum eigenvalue for pairwise comparison of alternatives in the aspect of cost

$$CI = \frac{\lambda_m - n}{n - 1} = \frac{4.102 - 4}{4 - 1} = 0.034$$

$$CR = \frac{CI}{RI} = \frac{0.034}{0.9} = 0.038 < 0.1$$

Alternatives - Health and Safety

	A*w	λ_m
A1	1.94	4.08
A2	0.71	4.04
A3	0.32	4.03
A4	1.10	4.096
MAX		4.096

Table 7.6: Calculation of maximum eigenvalue for pairwise comparison of alternatives in the aspect of health and safety

$$CI = \frac{\lambda_m - n}{n - 1} = \frac{4.096 - 4}{4 - 1} = 0.032$$

$$CR = \frac{CI}{RI} = \frac{0.032}{0.9} = 0.035 < 0.1$$

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