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Significance of the contractual relationship for the efficient railway maintenance project planning

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Abstract

Efficiently planned railway maintenance helps ensure reliable infrastructure and the proper functioning of its components. The Swedish Transport Administration delegates maintenance work to contractors through a tender process. This paper analyses differences in communication and collaboration in the planning and execution of maintenance under two contract types. A document review and interviews with 22 project managers identifies issues in planning and scheduling related to knowledge transfer at contractor companies, booking time for maintenance and lack of trust between contractors and the client. The results show how the two types of contracts are perceived differently by the parties to the contracts.

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1. Introduction

Communication between participants is a criterion for the success of any type of project [1], and communication in organisations and projects is a well-documented topic in the literature [2-7]. However, communication between the client and the contractors who provide maintenance for the Swedish railway has not been investigated as much [8-10]. To address the existing research gap, this paper explores such communication in Swedish railway maintenance projects.

A large part of railway maintenance requires the track to be out of service for some period, and this can cause interruptions in railway traffic. Hence, efficiently planned track maintenance would benefit the railway transportation system as a whole. The Swedish Transport Administration (Trafikverket) is the national infrastructure manager responsible for constructing, operating and maintaining railways in Sweden [11]. On behalf of Trafikverket, various maintenance companies are responsible for maintaining and building new infrastructure using their equipment, resources and experience. The agreements between the client, Trafikverket, and contractors are bound by two types of contracts in Sweden. The level of responsibilities delegated to the contractor might affect the communication between parties. This study aims to contribute to an understanding of how distributed responsibilities affect communication.

This study aims first to explore communication between project managers from Trafikverket and site managers from contractor companies in Sweden. Second, it analyses the perceived distribution of responsibilities between contractors and managers (declared by contract type) concerning maintenance planning and scheduling.

2. Maintenance of Swedish Railways

2.1. Maintenance projects

A European standard [12] defines maintenance as a combination of actions during the life cycle of an item intended to keep it in or restore it to a state in which it can perform its required function. Basic maintenance is the foundation of a maintenance plan, which constitutes about two-thirds of all railway maintenance [13]. There are two basic types of maintenance: preventive and corrective. The purpose of preventive maintenance is to reduce the probability of failure of an item. It involves inspections, lubrication and repairing and replacing parts. Preventive maintenance is done regularly, and it is either predetermined (clock-based and age-based) or condition based. Corrective maintenance is done after an item has failed, and it includes repairing or replacing the broken item. The purpose of corrective maintenance is to get the system functioning as quickly as possible because of the extra cost because the equipment or infrastructure is not available for production. In railways, acute errors often require a track to be completely closed to traffic until the fault is rectified [14].

Before signing a maintenance contract, Trafikverket conducts a basic evaluation of future capacity for the entire contract period to create maintenance windows (time when track is reserved for maintenance) for each specific contract [15]. After signing the contract, there is a one-year period of collaboration, when contractors discuss the contract with the client and try to resolve potential problems before they occur. Trafikverket and the contractor discuss the amount of time the contractor needs for the specific maintenance activities stated in the trackwork plan. Train operations and trackwork are planned in a coordinated process – the annual capacity allocation process. Contractors are responsible for operational planning and applying for time on track in the track utilisation plan four to 12 weeks before performing the trackwork. The application goes to the planners in Trafikverket, whose job is to balance the number of trains on the tracks with the amount of maintenance and investment work. Maintenance must occur during the maintenance window or when there is less traffic on the tracks [16-18].

2.2. Contracts

Railway maintenance in Sweden is performed by contractors chosen by Trafikverket in a tender process. Depending on the type of maintenance, the following contract classification exists [19]:

- **Renewal projects.** A contract is signed for each project. This type of contract is typically used to restore infrastructure parts to their intended standard.

- National maintenance contracts. A contract is set up for each distinctive type of activity, which typically requires the use of expensive equipment. The contract length is 3–5 years, and it may be extended for 2 or 2+2 years. These contracts are typically used for preventive maintenance.
- Regional maintenance contracts. The contract makes the contractor responsible for maintenance in one region of the infrastructure network. The contract length is usually 5 years, and it may be extended for 2 or 1+1 years. These contracts are used for all maintenance types.

2.3. Design-Build (DB) and Design-Bid-Build (DBB)

In the construction industry, as well as in the railway sector, two contracting forms are typically used – Design-Build (DB) and Design-Bid-Build (DBB). In Sweden, these are called ABT06 ‘Totalentreprenad’ and AB04 ‘Utförandentreprenad’ contracts, respectively – in railway sector regional maintenance. These two types of contracts attract attention in the literature, but there is a lack of empirical studies on the preferred contract type [20, 21]. For both contract types, it is common that the lowest rate wins the contract. This maximises the profit of the project, but it might affect the quality of the work [21, 22].

Two contract types have different distributions of responsibility between the client and the contractor (see Table 1). In DB contracts, the contractor is involved in both the design and construction of the project. The advantage of this contract type is the ability of designers and contractors to exchange knowledge [23]. The result of the project can be stated in functional terms. This means that the contractor has more freedom to decide how to perform the work, which creates room for innovation. DB contracts are also more flexible, as the contractor can wait until the last responsible moment to decide about the final design specifications. However, more of the project risks are put on the contractor, and this may make the project more expensive because contractors must add a risk premium to compensate for the risk they take [20].

In DBB contracts, the client is responsible for designing and describing the work that must be done in the project. This type of contract has an advantage for a client who has expertise and experience in the field. However, such detailed specifications at an early stage reduce the contractor’s opportunities for innovation, reduce project flexibility and may require time-consuming re-planning if circumstances change. The separation between planning and production in the DBB contract also reduces the sharing of knowledge between actors at different stages [20]. Risks during the project are more evenly distributed between client and contractor than in DB contracts.

For Swedish railway maintenance, in the AB04 contract, the client inspects the railway system and delivers orders for every action which must be performed on the given stretch of railway in the contract influence area. In the ABT06 contract, the contractor is entirely responsible for maintenance operations on track, and it does its own inspection of the rails to determine which work to prioritise. Preferences of contract type are discussed in the result section.

Table 1. Differences in contract types

Feature	Contract type	
	DB/ABT06	DBB/AB04
Design responsibilities	Contractor	Client
Risk	Contractor	Distributed
Degree of knowledge exchange	High	Limited
Degree of innovative development	High	Limited
Degree of project flexibility	High	Limited

3. Method

In this study, we used qualitative research methods: literature review and interviews. We analysed literature concerning planning and management, including documents, reports from the internal Trafikverket database and literature from open sources.

We interviewed 12 project managers from Trafikverket and 10 site managers from the maintenance contractor companies. The interviewees' participation was voluntary and anonymous. The 'snowballing' sampling method described by Harrell and Bradley [24] was used to identify interviewees: project managers proposed different site managers to interview. Diversification was achieved by interviewing project managers from similar projects with similar budgets, costs, and timeframes but working under different types of contracts. Semi-structured interviews that lasted about 30 minutes were conducted online following the interview guide in Appendix A. Managers from Trafikverket and contractor companies were asked the same questions about the types of contracts and the levels of communication. Thematic analysis was used to analyse the transcribed responses of 22 interviewees.

4. Results

All interviewees agreed that communication is one of the most crucial factors in project success. Communication between the interviewed project managers and contractors was performed in three ways: in person, calls and email. On-site meetings were held once a month, and other technical meetings were held regularly. Most interviewees believe that communication is the same in both contract types but with different frequencies. A minority noted that there is more frequent communication in the AB04 contract because of the contractor's needs. Conversely, interviewees mentioned that in the ABT06 contract, communication is less frequent. In the ABT06 contracts, all activities were defined at the start of each year. Therefore, contractors needed to communicate with Trafikverket only if some changes or other factors affected the project. In general, communication between contractors and project managers was frequent, but it is debatable whether the communication was efficient. The interviewees' preferences for the types and volume of information shared in the communication were different. For the project managers, the most crucial information from the site managers was the progress and changes in the production plan. The site managers were most interested in information about changes that might affect the scope, planning or the project budget. The project managers with more experience communicated less with contractors. At the same time, most agreed that the frequency of communication depends on personal relationships.

The scope of the contract and its cost were constantly discussed during the projects. The discussions were more frequent in the first period of a contract. Interviewees stated that the content of discussions depended on the type of contract and the tender price. In the ABT06 contract, the contractor had to deliver a tender with the lowest possible price to win the contract, and this affected the contractors' performance. Contractors strategically searched for ways to increase the price over the life of the contract. Some strategies mentioned in the interviews were using expensive machinery and setting high prices for activities that are not in the contract. Such strategies resulted in conflicts between the two collaborative parties, as they caused uncertainty and distrust between the contractor and Trafikverket. Possible solutions could be earlier contractor involvement in investment projects and selection of the maintenance contractor based on criteria other than price. It must be noted that the authors do not know whether Trafikverket uses early contractor involvement in maintenance projects.

Collaboration between the project manager and the site manager can be challenging. According to the project managers, the biggest challenges to collaborating with the contractors were working towards a combined goal, working from a long-term perspective, interpreting the contract, handling asymmetry of information and maintaining competence when moving from an expiring contract to a new one. On the other hand, according to the site managers, the biggest challenge to collaborating with project managers was a lack of trust and excessive control from Trafikverket.

All the interviewed contractors pointed to the problem of not getting enough time to work on track maintenance. Time on track must be distributed fairly between train operations and maintenance, which is the responsibility of Trafikverket. According to the interviewees, delays in the start of trackwork were often caused by mistakes in the capacity allocation process. This occurred more often in ABT06 contracts, which implies applying for time on track more than one year in advance. The interviews showed that some contractors had shorter periods between when their plans were finalised and work performance that is regulated by Trafikverket. The project managers argued that some of the site managers had poor planning skills.

The length of a contract is a central part of some challenges in the relationship between the two actors. The contract period is typically 5 years, with the possibility of prolonging the contract period for 2 additional years. Most of the site managers thought that those contract periods are too short to invest in the necessary resources (some project

managers agreed with this). The short period led the contractors to minimise investment in personnel education and machinery to save the project money. At the same time, the contract period produced uncertainty for the contractor companies, which caused a high turnaround of personnel. Trafikverket operates with vertical coordination internally and externally because they focus on planning, rules and authority. Companies operating in stable environments do not need to rely on flexibility and adaptability; they are more likely to be bureaucratic organisations [26]. Trafikverket fits in this description where the organisation is not threatened by high uncertainty, which can affect the organisation negatively. However, the contractors live in a more unstable environment, especially closer to the end of the contract period in year four. According to the interviews, only years two, three and four in a contract period resulted in good collaboration.

Knowledge transfer during and after the contract period is crucial, and it can affect future maintenance contracts. Changing contractor companies every five years is mentioned as one of the main reasons for the loss of knowledge. Knowledge must be easily accessible and sharable in the maintenance company, and this aligns with Trafikverket's intention to improve communication and learning. The interviewees gave examples of employees at contractor companies who left the company if the contract was not prolonged. The employees either switched to businesses where the contract conditions are more secure or to other contractor companies that gained a new tender. The valuable knowledge of those individuals was lost when they left their respective companies. A solution for this issue could be prolonging the contract period or implementing an organised transfer of knowledge.

5. Discussion

Some clear differences between the two contract types emerged in the analysis of the interviews (see Table 2). Larger projects were under ABT06 contracts, while smaller ones were under AB04 contracts. However, the criteria used to select the contract type for a project are unclear. According to Lædre [27], the choice of contract strategy depends on the project managers leading the project. The choice might be influenced by the balance of shared responsibilities and resources at Trafikverket. Most contractors preferred to work under AB04 contracts, while most of the interviewed project managers preferred ABT06 contracts. Some contractors said that they prefer AB04 contracts because the responsibilities in the project were more fairly divided between the participants. Some project managers said that they prefer ABT06 contracts because the contractor could freely perform the maintenance work and because this contract type was also more cost-efficient. On the other hand, project managers said that if they had more personnel, they would prefer AB04 contracts because of the greater control they would have and the greater knowledge they would gain during this contract.

Table 2. Differences in interviewee experiences of the two contract types

Feature	Contract type	
	ABT06	AB04
Communication frequency	Limited	High
Concern about not getting enough time on track	High	Limited
Size of the project	Large	Small
Preferences for contract type	Client	Contractor

This study has several limitations, such as its focus on Swedish projects. One advantage of the sample is that the context and framework conditions of the studied projects are quite similar. Ideally, the sample would have been larger. However, it was not the aim of this study to get a statistically representative sample, which is difficult in this type of research [25]. However, some implications can be derived from the collected data.

6. Conclusions

This study investigates the collaboration and communication between contractors and Trafikverket based on interviews with project managers at Trafikverket and site managers at maintenance companies. We present the

communication and collaboration issues in two types of contracts in Sweden. The project managers and site managers have regular meetings, which ensures a successful project implementation. The study revealed fundamental challenges to collaboration like lack of trust, uncertainty and loss of knowledge.

We found a difference in preferences for contract types by contractors and clients. Contractors prefer AB04, a DBB contract type; it fosters better collaboration and reduces the number of conflicts between the contractor and Trafikverket. That contract type leads to less discussion regarding the scope and the terms of the contract. In addition, Trafikverket gains more knowledge of railway conditions because they are more involved in inspections and daily operations, which reduces the loss of knowledge.

The results show that the contractors must struggle to receive time on the tracks. This is not in line with the intentions of Trafikverket, whose maintenance windows support clear and long-term availability, as described in the literature study. This could mean that communication takes time and that the use of maintenance windows is not yet fully implemented. A shortage of time to perform track maintenance may affect the contractor's performance and lead to disagreement about their remuneration.

In further research, we aim to investigate the capacity planning process from the perspectives of the contractor.

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Appendix A. Interview Guide

Interview guide project managers	Interview guide site managers
<p>1. Background questions:</p> <p>How long have you been working in the rail industry? Experience as a project manager? What is your role as a project manager? What project are you working on now? What type of contract is the project under?</p>	<p>For how long have you been working in the rail industry? Experience as a site manager? What is your role as a site manager? What project are you working on now? What type of contract is the project under?</p>
<p>2. Communication:</p> <p>How often do you contact the site manager? What information from the site manager has the biggest impact on the project? What information is it that is shared most? How do you contact each other about a case?</p>	<p>How often do you contact the project manager? What information from the project manager has the biggest impact on the project? What information is it that is shared most? Who do you and the project manager usually contact about a case?</p>
<p>3. Contract:</p> <p>Do you have experience with both ABT06 and AB04 contracts? Do you have any preference over which one is best? Why? Is there any difference between how you communicate with the site manager depending on contract type? Is there any difference between how often you communicate with the site manager depending on contract type? What do you think about the length of the maintenance contracts? What if you do not follow the contract? Do you have any changes to the contract during the course of the project?</p>	<p>Do you have experience with both ABT06 and AB04 contracts? Do you have any preference over which one is best? Why? Is there any difference between how you communicate with the project manager depending on contract type? Is there any difference between how often you communicate with the project manager depending on contract type? What do you think about the length of the maintenance contracts? Can you make changes to the contract during the course of the project?</p>
<p>4. Planning:</p> <p>How do you plan work on the tracks? Do you have any requirements on how the contractor does his work? Do you have any requirements for the contractor to use tools that can streamline the work?</p>	<p>How do you plan the work on the tracks? How do you plan maintenance work against the plan? How long before work do you lock in your plans? How long before the planned work in the tracks begins, do you know what times you get? Do you use any kind of tool that can make the work in the tracks more efficient?</p>

5. Cooperation:

What is the biggest challenge during the collaboration with the contractor? What is the biggest challenge during the collaboration with the Trafikverket?
 How is the cooperation with the Trafikverket?

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