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Procurement of Railway Infrastructure Projects – A European Benchmarking Study

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Abstract

This benchmarking study compares how railway investments are procured in five European countries: Sweden, Norway, Germany, the Netherlands, and the UK. In total, 19 procurement managers and project managers were interviewed. This study compares the national rail clients' procurement strategies regarding: delivery system, reward system, contractor selection, and collaboration model. Historically, these clients have used in-house production. The first step towards a gradually increased usage of the market was to outsource the construction activities while keeping the design and development competence in-house. All five countries have mainly used Design-Bid-Build contracts in their initial outsourcing. However, the last few years there is a discernible trend in Sweden, Norway, the Netherlands and the UK towards allocating more design and development responsibilities to contractors (i.e. Design-Build contracts) and increasing the strategic focus on cooperation. The UK and the Netherlands are forerunners in this trend that can be viewed as a third step in the transition towards a market oriented railway sector. Norway and Sweden is in the middle of this transition, whereas Germany has not initiated this change. The transition towards a gradually increased usage of the market has two main dimensions; degree of cooperation and degree of contractor freedom, which differs among the countries. The UK and Sweden focus on increasing both these dimensions, while The Netherlands and Norway mostly focus on increasing the degree of contractor freedom. Germany still limits both dimensions by performing design and development in-house and letting contractors compete for construction work in Design-Bid-Build contracts. Due to historical and cultural reasons, Deutsche Bahn in Germany is very hesitant to engage in collaboration with external suppliers; focusing on competition is considered more appropriate and less controversial.

Keywords: Competition; Cooperation; Infrastructure Projects; Railway Investments; Public Procurement.

1. Introduction

The European railway systems are critical for both long-distance and commuter traffic, as well as freight transportation [1]. Until the early 1990s, most European railway systems were organized in the form of state-owned and vertically integrated monopolies [2]. The EU directives from 1991 (Dir.91/440/EEG) stipulates the separation of the national railways into different organizations for owning and developing the infrastructure and for operation and transport activities. Following this trend, all or parts of the design, construction and maintenance of railway infrastructure have been deregulated and opened for competition in many countries.

In deregulated railway sectors, clients' procurement strategies heavily influence both efficiency and innovation in construction projects [3]. Despite this, innovation needs and opportunities are seldom considered when choosing procurement strategy [4]. Instead it is often more short-term efficiency related objectives, such as cost, time and quality, which are considered [5]. This focus on short-term efficiency may hinder innovation and thereby sustainable

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development. In fact, an investigation shows that high-speed rail projects in Europe generally result in cost overruns, which can be reduced by better appraisals [6]. The challenge for public clients in the infrastructure sector, such as rail administrations in the European countries, is thereby to develop and implement procurement strategies that provide suppliers with possibilities and incentives to enhance long term socioeconomic efficiency, i.e. take on a life cycle cost (LCC) perspective.

Although procurement strategies are a widely studied topic in the construction and engineering industry, specific research on railway procurement is scarcer. This is not surprising since it is a relatively new phenomenon, as deregulations of the European railway sectors have been implemented gradually and to various degrees in different countries the last two decades. As different countries have undertaken deregulations in different ways it gives an opportunity to compare and benchmark procurement strategies in different countries. Accordingly, the purpose of this study is to compare how railway investments are procured in five European countries: Sweden, Norway, Germany, the Netherlands, and the UK. The transport authorities in these countries face challenges related to increased infrastructure investments and pressure to improve value for money to tax payers. Procurement strategies are therefore central for achieving efficiency and innovation in railway projects. The empirical findings may then serve as a basis for knowledge sharing and organizational learning within and across the public client organizations.

2. Theoretical Framework

2.1. Competition, Coopetition and Cooperation

In any buyer-supplier relationship it is vital to obtain suitable levels of competition and cooperation. Broadly speaking, cooperation is the performance of an activity in a way that the actions undertaken by one actor facilitate the actions undertaken by the other, whereas competition emerges when the actions undertaken by one actor hinder the actions by the other [7]. Competition and cooperation thereby emerge in vertical buyer-supplier relationships where the two modes counteract each other [8]. Competition, which is based on the idea that each actor tries to maximize their own benefits, is related to individualism and self-centeredness, resulting in conflicts when actors have opposing interests [9, 10]. However, competition also provides individual suppliers with incentives to innovate and improve efficiency to become more productive. Cooperation, which is based on trust and reciprocity, is in contrast related to collectivism and concern for the needs of others. Cooperation can thus be defined as collective work to achieve mutual goals [9]. When different actors have mutual goals a win-win situation arises, where actors are interdependent and benefit from cooperation, which promotes coordination, adaptation and knowledge sharing [11].

Since both competition and cooperation are central for facilitating efficiency and innovation, it is critical to achieve a balance between them, that is, coopetition [10]. When deciding how to balance cooperation and competition the characteristics and circumstances of the particular project are important to consider. Cooperation is especially relevant in projects that are characterized by complexity, customization, uncertainty, long duration, and time pressure. Such projects often require coordination of actors and their activities, flexibility and adaptation of activities and their contents, as well as knowledge sharing and joint problem solving [8, 12 and 13]. In contrast, simple and standardized projects with low uncertainty and little time pressure can be procured with a focus on competition. However, since most projects have neither very high nor very low values of these variables, some kind of coopetition is often suitable, see Figure 1.

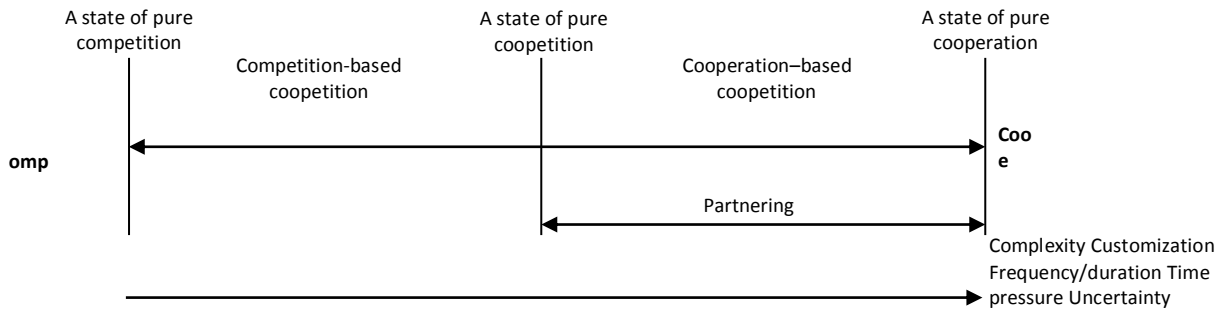

Figure 1. Coopetition continuum –balancing competition and cooperation [10]

The balance between cooperation and competition is highly influenced by the client's procurement strategies. Prior research on procurement in the construction industry has distinguished how four different procurement strategy components affect competition and cooperation in buyer-supplier relationships [8]. The four components are: the delivery system and the nature (e.g., timing) of the contractor involvement, the reward system, the contractor selection procedures, and the collaboration model. The four components are presented in Table 1. and subsequently discussed in Section 2.2.

Table 1. Procurement strategies and their effects on competition and cooperation

	Competition	Coopetition	Cooperation
Delivery system	Design by contractor (DB)	Early involvement in joint design, contractor responsible (DB)	Joint design with shared responsibilities. ECI based on consultant contract
	Design by client (DBB)	Early involvement in joint design, client responsible (DBB)	
Reward system	Fixed price (lump sum)	Cost reimbursement with incentives and target cost	Cost reimbursement with bonuses
	Fixed unit price		
Contractor selection (invitation + evaluation)	Open invitation	Pre-qualification	Direct negotiation
	High focus on lowest price	Lowest price and soft criteria	High focus on soft criteria
Collaborative tools and activities	No collaborative tools/activities	A few collaborative tools/activities	Many collaborative tools/activities

2.2. Procurement Strategies and Their Components

2.2.1. Delivery System, Type of Contract and Nature of Contractor Involvement

There are two main delivery systems; Design-bid-build (DBB) and Design-Build (DB). In DBB contracts a client is responsible for design and the contractor for the construction, entailing a detailed description of what work is to be undertaken [14]. DBB contracts may be preferable if the client has sufficient expertise and experience to specify how to achieve this. A disadvantage is that the absence of contractors' production knowledge during the design may impair innovation and efficiency during the production stage, especially in more complex projects.

In a DB contract, contractors are involved early and responsible for detailed design work [15]. This can promote greater exchange of production knowledge between consultants and contractors, which can lead to product design with improved constructability. DB contracts also improve the contractor's opportunities for innovation. A potential problem regarding innovation is however rebranding of DBB contracts into DB [16]. DB contracts without degrees of freedom for the contractors are not to be expected to deliver innovation.

Both DB and DBB contracts promote a focus on competition as they separate, allocate, and clarify the actors' different responsibilities, which make the contracts more transparent [10]. However, if DBB contracts are procured early or if the client is involved in the design stage of a DB contract, both types of contracts can involve some degree of joint specification. Then the clients, consultants and contractors work together to promote a synchronized focus on innovation and efficient production. In such cases, when the contractor is procured early and the actors engage in joint planning and design based on either DB or DBB contracts, where one party has the main responsibility and the other is more consultative, coopetition is promoted [17].

A more collaborative strategy is to fully embrace early contractor involvement (ECI) by adopting a two-stage approach, in which partners first carry out joint planning and design based on consultant contracts before going into detailed design and production based on DB or DBB contract. Such an ECI approach where buyer and supplier share the design work and responsibilities gives a high focus on cooperation [17]. This is suitable when the uncertainty is very high and the client requires contractor involvement in very early design stages to integrate design and production knowledge. ECI has different meanings in different parts of the world, but a common denominator is that it involves a two stage process. First the contractors and other partners are procured to jointly design and define the project, then it is possible to set a target cost and sign contracts for the production stage.

2.2.2. Reward System

In construction projects, the two main reward systems are fixed price (or lump sum) and cost reimbursement (or cost-plus). There are also intermediate alternatives, based on cost reimbursement coupled with incentives, fixed contractor fee, and/or bonuses. By procuring a contractor through competitive tendering based on a fixed price the client wants to facilitate competition and receive the market's lowest price [10]. This assumes that the tender specifications are flawless and exhaustive, which in practice is very difficult and costly to achieve, especially when the conditions are not fully understood due to high complexity and uncertainty. Bajari and Tadelis (2001) therefore claim that fixed price is appropriate in simple projects with low uncertainty where the product is easy and inexpensive to describe and design. This type of payment scheme does not involve any economic incentives for joint problem solving and collaborative development, as the contractor will take all profits from cost efficient solutions [18]. Another disadvantage is that the contractor has no incentive to deliver added value in the form of higher quality than promised [19].

Fixed unit prices connected to a bill of quantities are common in the infrastructure sector. This reward system enhances competition even when there are uncertainties about the scope of the work in terms of quantities of different

types of work. It also provides flexibility compared to a pure fixed price since it is easy to make changes in the quantities; the contractor gets paid for the actual quantities of work, not the planned or forecasted amount of work. A drawback is that the contractor might not have any motivation to innovate or increase the efficiency to lower the amount of work, since that will lead to reduced payment.

Pure cost reimbursement means that the contractor receives payment for all costs incurred, which decrease the risk for the contractor [18, 20]. The contractor then has no obvious reason to make more effort than necessary to carry out the work, which is negative for cost efficiency. Nor is there any incentive for cost-saving innovation as it may only lead to reduced compensation. Quality-enhancing innovations may be somewhat more interesting for the contractor but they cannot lead to higher profits, only cost recovery. Due to these drawbacks, this reward system is often coupled with economic incentives connected to a target cost, where the actors share gains and pains when the real costs differ from the target cost. When incentive-based payment is based on a 50/50 gain/pain share this reward system can be regarded as a mix of fixed price and cost-reimbursement, facilitating coopetition. Incentive-based payment is particularly suitable for early procurement of contractors and joint specification as it provides collaborative project stakeholders a common fate reward for gains due to innovative technologies and efficient improvements. A disadvantage of incentive-based payment is that rules on adjusting the target cost tends to be rather complex contractual terms that often give rise to discussions or even disputes [21-23].

To diminish these disruptive disputes of target cost changes, many clients instead use a reward system that includes a fixed contractor fee, covering profit, risk and central administration. When using a fixed fee, the contractor will get cost reimbursement for the direct operating costs, but the absolute value of the profit is fixed from the outset. For the contractor, the fixed fee provides incentives for cost-saving efficiency and innovation as reduced costs will lead to a greater relative gain, in terms of a larger profit margin. Another, even more collaborative, alternative is to link bonuses to non-economic aspects, such as quality, timeliness, work environment, and environmental impact [5, 24]. The contractor can then receive monetary bonuses if certain levels of different functional requirements are exceeded.

2.2.3. Contractor Selection and Bid Evaluation

In construction projects, selecting capable contractors is a critical task for clients [25, 26]. Partner selection is carried out through bid invitations of potential bidders and bid evaluations that can be focused on lowest price or multiple criteria. Sometimes, the bid evaluation may be preceded by a pre-qualification stage where suitable contractors are pre-qualified and invited to submit tenders. Whereas an open tender procedure enhances competition, pre-qualification and invitation of fewer bidders facilitate more cooperation [17].

In bid evaluation, a focus on lowest price enhances competition and it is often the most important evaluation criterion, especially among public clients that fear appeals from losing bidders [10, 27]. A focus on lowest price generates an emphasis on short-term benefits by encouraging reduction of investment costs rather than focus on long-term life cycle costs and innovation. Due to the drawbacks of lowest price selections, there has been growing interest in a shift to multi-criteria selections, also considering soft criteria [25, 28] since it enhances cooperation [8]. It is especially vital that tender evaluation focuses on soft criteria in complex projects or when the contractor is expected to contribute to innovation in the design stage [29]. Prior construction management research suggests that multiple criteria that consider appropriate competences, experiences and attitudes can improve many different performance aspects, such as reducing cost and time overruns [30, 31], and improving quality [32], and innovation [26, 29].

2.2.4. Collaboration Model and Partnering Arrangements

In the construction industry, there are many different labels describing collaborative relationships (e.g., alliance and integrated project delivery), but the most commonly used term is partnering [33]. Although partnering arrangements are based on collaborative procurement strategies affecting all four strategy components, the collaboration model is often considered as the core component. Because project actors often interact to co-develop the product, extensive use of collaborative activities and tools may be suitable to strengthen cooperation in the partnering team [34, 35].

Prior research suggests that some examples of vital activities and tools for strengthening cooperation are: formulation and follow-up of joint objectives, joint IT-systems, and a joint project office [10, 34]. These collaborative activities and tools cost both time and money to implement, but especially in large and complex projects they may have positive effects on many performance aspects, making these investments worthwhile [36]. Joint IT-systems facilitate integration and communication among project actors and can thus improve time, cost, and quality performance [37]. Joint objectives enhance the development of a win–win situation in which all project participants together strive to improve project performance as formulated in objectives [36]. Co-location in a joint project office on site enhances face-to-face communication and interaction, which is important for innovation [35].

3. Method

3.1. Selection of Countries

Five European countries that have national transport authorities that procure infrastructure projects were selected and accepted to participate in the study. The five countries and their transport authorities are in a period of large infrastructure investments that require significant increase in resources and competences. Most of these client organizations have therefore decided to handle these challenges by introducing structural changes in the procurement and management of projects. The clients also face other challenges such as low competition for tenders, need of efficiency improvements and new ways for involving contractors in the process. The following countries are included in the study: Sweden, Norway, Germany, the Netherlands, and the UK. Because only European countries were selected, the clients adhere to the same public procurement act, which enhance comparison and benchmarking among them.

3.2. Data Collection

In each country interviews were held with procurement managers, project managers and/or project department executives, resulting in 2-5 interviews per country. This was important in order to capture both a procurement perspective and a project management perspective on how procurement strategies work in practice in railway projects. In total, 19 people were interviewed, each interview lasting 20-120 minutes, with an average of 90 minutes. See Table 2. for more information regarding respondents in each country.

Table 2. Interviews in five European countries

Country and organization		Number of respondents and their roles/professions		
		Project manager/ executive	Procurement officer/ manager	Country total
Sweden	Trafikverket	2	3	5
Norway	Jernbaneverket	1	1	2
Germany	Deutsche Bahn	1	3	4
The Netherlands	ProRail Amsterdam Metro	2 1	1	4
The UK	Network Rail Dept. for Transport	2 1	1	4
Total		10	9	19

The interviews were semi-structured and the questions were open-ended and informed by a literature review of prior procurement related research within the construction industry. The theoretical framework (see Section 2) served as a basis for the collection of the empirical data. To improve validity through triangulation a variety of data collection methods and information sources were utilized [38]. In addition to the interviews, approximately 50 hours of document studies were performed. The document studies focused on domestic articles and reports that could shed further light on the procurement strategies and the railway sector of each country.

3.3. Data Analysis

The literature review and the theoretical framework informed the analysis of the empirical material. The transcribed interviews where first analyzed for each country. When the empirical data from the interviews had been analyzed and summarized into a written within-case story for each country, the texts containing the empirical description of each country was sent to one or two of the respondents in the particular country. Each respondent then had the opportunity to read the text to verify the content and in some occasions, they added and clarified the text to give a more accurate description of their procurement strategies. This approach was conducted to improve the reliability and validity of the findings. However, it is important to note that a weakness of this study, as with most other qualitative studies based on nonprobability sampling, is that the results are heavily dependent on the selection of respondents. Hence, a different set of respondents may have produced somewhat different findings. In order to reduce this risk, several respondents in each country have been interviewed and any inconsistencies have been discussed with the respondents. In a second step, a cross case analysis where executed during which the findings from each country where compared to identify similarities and differences among countries. The structure of empirical findings as well as the analysis is based on the theoretical framework including delivery system, reward system, contractor selection and collaboration model.

4. Empirical Findings

4.1. Introduction to the investigated countries

4.1.1. Sweden

In 1988 it was politically decided that the Swedish state railway should separate railway infrastructure and the train operations in two governmental units. In another step 1998, the supply part of the rail administration was separated from the client organization and formed its own unit called Rail Production. But it was not until 2001-2002 that the market was deregulated and Rail Production was exposed to competition (i.e., privatization). Since 2010 the Swedish Transport Administration (TRV) is the client organization responsible for both rail and road infrastructure in Sweden.

In 2011, TRV initiated a change process towards a more professional client that leaves more freedom and responsibilities to suppliers in designing and executing projects through the use of DB contracts. The change process aims to develop the supplier market towards improved innovation and productivity [39], which becomes necessary due to increased infrastructure investments. TRV has also encouraged larger international companies to enter the Swedish market. The changes have, however, been implemented to a larger degree in road production than in railway, mostly due to formal responsibilities and regulations related to safety making it more challenging to implement change. DB-contracts may become less constrained in the future, which is considered critical to enhance creativity and innovation from the contractors.

4.1.2. Germany

In 1994, Deutsche Bahn AG was founded as a public company during a big railway reform. The aim of this reform was to liberalize the railway sector, induce competition, increase railway traffic and relieve the federal government's budget [40, 41]. When it comes to infrastructure procurement the system is vertically integrated, which means that the infrastructure and operation/traffic are separate entities under the holding of Deutsche Bahn, although the units are not separate companies [40]. Procurement of infrastructure is conducted by a central procurement department at Deutsche Bahn AG. The client organization holds a lot of resources in several departments and is performing much design and development work in-house, only outsourcing the construction work to the supply market. One reason is the difficulties in obtaining the planning and building permissions and Deutsche Bahn does not want to transfer that risk to the contractor. A structural change in the coming years is not likely since changes means alterations in regulations and rules and consequently a large lobbying process.

New infrastructure, which means new lines and stations, is funded by the federal government, i.e., the ministry of infrastructure. There are some new lines in the pipeline, e.g., a high speed link between Munich and Berlin and from Stuttgart to Wendlingen/Ulm. However, most of the projects are smaller in terms of closing gaps in the already existing network.

4.1.3. Norway

Since 1996 the National Rail Administration, Jernbaneverket (JBV), is responsible for developing new parts and maintaining existing parts of the railway system. Investments in new railway infrastructure are considered critical and at the core of the reform of the railway sector. Hence, JVB will increase the investment level for railways with more than 50 % per year compared to the 2013 budget. This also includes a 100 % increase of investment in large projects [42, 43].

Although JBV is significantly enlarging their project portfolio, they will not enlarge their client organization accordingly. Hence, they must allocate more work to contractors. New procurement strategies for infrastructure projects have therefore been adopted to provide more efficient implementation. The aim is that projects will be completed faster, have lower development costs and attract contractors to invest in long-term productivity improvements and organizational development [42]. The overall aim of the procurement strategy is to reduce the total costs while at the same time include precision, flexibility and speed (JBV, 2015). To achieve this, JBV has initiated a change process, going from primarily using DBB contracts to an approach where more responsibilities are given to the contractors using DB contracts. In addition, JBV strives to attract international competition on the Norwegian rail market. This is done by increasing the contract sizes and avoiding allocating too much risk to the contractors. The ongoing Follo line megaproject is the main vehicle for driving this change process.

4.1.4. The Netherlands

ProRail is a public company and has the responsibility for railway infrastructure, including construction, management and maintenance, in the Netherlands. Since 1995, ProRail has changed from being a large organization with engineers and contractors employed in-house to a smaller organization that today outsource 80-90 % of the yearly turnover. Initially, the focus was to start the change from traditional DBB contracting to DB contracting in civil engineering work, but during the last 5-6 years the same strategy has been applied to other disciplines, such as railway controlling systems, etc. The aim was to provide an increased quality incentive to the contractor by changing the reward structure. Instead of being paid per hour, a lump sum payment is used to improve efficiency.

Almost every project is procured in an early stage and based on early involvement of the contractor. The change also led to a transfer in the responsibility of the design phase and project risk, from client responsibility to contractor responsibility. However, in turn the contractor has been given the possibility to influence the development and design of projects and their systems to a larger extent than before. It has also resulted in an increased responsibility of the total performance, i.e., money and time.

4.1.5. The UK

The railway sector in the UK started its journey to privatization in 1994. In 2002, Network Rail (NR) took over as owner and operator of Britain's railway infrastructure. It became a not-for-dividend company that owned and maintained the rail infrastructure. Several accidents occurred and structural changes were made. NR was earlier a heavily regulated private company but became a government body in 2014, implying more control by the Ministry of Transport. The company is responsible for timetabling, access to the network and projects on the infrastructure throughout England, Scotland and Wales.

Most projects are managed and controlled by NR and then they seek suppliers in the market place for different aspects of the project. Consultancy support is used to define and manage the projects. NR has got its own national supply chain part of the business, which supplies a lot of the resources to major projects. NR has used DB contracts for many years to allocate more freedom but also responsibilities to the supply market. In recent years, they have also changed towards more collaboration with contractors and NR is aiming for earlier contractor involvement to identify the best value for money and the required outcome. The increased focus on collaboration is a step to go from transactional to more relational arrangements since the transactional approach has not proven fruitful in terms of certainty of outcome, efficiency of outcome, nor sustainability of the supply chain.

4.2. Cross-Country Comparison

4.2.1. Delivery System

In many countries, contracts regarding infrastructure investments have become increasingly performance-based to trigger innovative activities that are less likely to occur under conditions of the traditionally highly specified DBB contracts [2]. The traditional delivery system for all investigated countries is DBB, but most of the countries have moved away from this type of contract. In general, there is a trend towards decreasing the use of DBB contracts and trying to incorporate more DB contracts, especially for large and complex infrastructure projects. See Table 3. for a comparison of delivery systems.

Table 3. Delivery systems compared across the five countries

	Competition: Design by contractor (DB) or by client (DBB)	**Coopetition: Early involvement in joint design, contractor (DB) or client (DBB) is responsible**	**Cooperation: Joint design with shared responsibilities (ECI)**
Germany (Deutsche Bahn)	DBB is mainly used. All planning and design performed in-house; contractors are executors.	Not used.	Not used.
Netherlands (Pro Rail)	DB is most common for new investments but DBB is still used for re-investments.	Contractors involved early but there is no standard.	Not used.
Norway (JBV)	Traditionally, DBB is most common and is still used for e.g. preparatory work on parts with much traffic. DB becomes more common. JBV strives for fewer and larger contracts, with fewer interfaces between actors.	Contractors are procured earlier now and a dialog in the early stages is important especially with foreign contractors. Client is often involved in the contractor's design work	Not used.
Sweden (TRV)	DBB is the traditional system, but becomes less common. Aim at 50 % DB contracts. DB will increase for track work and civil engineering. In reality sometimes similar to DBB.	TRV try to leave much design work to the contractor but sometimes the client is more involved in the design work anyway. Sometimes the contractor is procured early and involved in design work based on DBB contracts.	Has been tested.
UK (NR)	DBB is the traditional way but becomes less used. DB is most common, but in reality sometimes similar to DBB.	Sometimes client is more involved in the contractor's design work in DB contracts.	Striving for ECI but struggles with contractor selection for this.

Large DB contracts are perceived to encourage international contractors to enter smaller Scandinavian markets in Norway and Sweden. TRV has started a change process towards increased use of DB contracts, but DBB contracts are still common in some regions. In Sweden, bridges and some other civil engineering works are mainly procured by DB contracts, but there are now several examples of DB contracts used for other parts of railway construction as well. In the future, DB may be used more frequently in large scale complex projects. However, the historical usage of DBB contracts has resulted in inexperience among many contractors regarding the market for consultancy services and how

to manage the design stage. Furthermore, the large set of rules regarding railway construction limits the freedom in design for DB compared to the road sector. JBV in Norway is also using DB contracts to an increasing extent, and here as well a change process is taking place within the railway sector where DB contracts have been well received. In the Netherlands and the UK this change process has been going on for a much longer period of time. Hence, the most common delivery system for large construction projects in these two countries is DB, and DBB has become less and less used. However, in the Netherlands, DBB is still used for reinvestments.

In some of the countries (e.g., in the UK and Sweden) the DB contracts are in practice sometimes similar to DBB contracts since they may be rather detailed and specified. In Sweden, this was especially apparent in the beginning of the change process where detailed DBB contracts were rebranded to DB contracts. It is important to point out that, at least in Sweden, highly specified DB contracts are very similar to DBB contracts, both in practice and from a legal point of view, since the client has to take responsibilities for the specified solutions in DB contracts [17]. This type of hybrid approach may be counterproductive, by hindering contractors to improve both innovation and efficiency.

In Germany, all planning and design is done in-house by Deutsche Bahn engineers. DBB is therefore the main delivery system and the respondents believe that this type of contract will remain most common. When the degrees of freedom are very limited, it may be better for a competent client to use DBB contracts and specify the design themselves. This seems to be the case in Germany and the contractors are thereby seen as construction firms, rather than providers of competence. A main argument for keeping most of these activities in-house is the difficulties of obtaining the building permissions and that such risk is expensive to transfer that to contractors.

In Norway, the coopetition strategy is apparent as contractors are now procured earlier and the design is the result of an informal collaboration between client and contractor. To have a dialog in an early stage is especially important for JBV when working with foreign contractors. Furthermore, it is especially important in complex construction projects for knowledgeable clients to get involved and contribute to joint development work (Jacobsson & Roth, 2014). Close collaboration in the design stage in DB contracts can thereby be an alternative to DBB contracts when clients want to get involved in design work and affect technical solutions [17].

Also in the Netherlands contractors are involved early in new investments through DB contracts, but the exact moment for involvement is not standardized and depends on the project. In the UK, early contractor involvement (ECI) has been identified as essential to identify best value for money and required outcome. This is in line with the literature where early contractor involvement is identified as supporting innovation and development [26]. However, although Network Rail is striving for early contractor involvement, they find it difficult to select contractors based on soft criteria in early stages. ECI based on consultancy contracts has also recently been tested in Sweden to some extent, but as a few pilot projects rather than as a large scale implementation.

4.2.2. Reward System

DBB contracts with unit prices connected to a bill of quantities are used in all five countries, but most commonly in Germany. For DB contracts and for projects where the uncertainty is low, fixed prices are generally used in Sweden, Norway, the Netherlands and the UK. In the Follo line project in Norway, a fixed price is determined for a baseline situation, a price that is then adjusted in the case of exceptional ground conditions. In Sweden, fixed price is explored and tested for DB contracts but only when it is possible for contractors to calculate their costs with sufficient accuracy, that is, when projects are rather straight forward and not too complex and uncertain. Then, the risk premium does not become too high.

In the UK, the majority of the larger contracts in the railway sector are based on incentives connected to a target cost, supporting collaborative working. The gain and pain is shared, typically split 50/50. The target cost can be adjusted during the contract and the reason for not using a fixed price is that it seldom becomes the final price. In reality there are no truly fixed prices since they are adjusted due to changes. A related challenge when using target cost is that contractors can spend too much time trying to drive up the target cost rather than to reduce the actual costs. This has caused a lot of friction in the UK between the client and contractors. A known disadvantage for incentive-based payment is that adjusting the target cost often gives rise to discussions or even disputes similar to those of adjusting a fixed price [21-23]. This is also the reason for why this type of reward system is not used in Norway. In the Swedish discussion regarding target cost, this drawback has been acknowledged and a split 80/20 to the client is now suggested, because this sharing mechanism provides sufficient incentives for contractors while reducing their risks and thereby conflicts between actors. The reward systems used for each country is presented in Table 4.

Table 4. Reward systems compared across the five countries

	Competition: Fixed price	Coopetition: Cost reimbursement with incentives and target cost	Cooperation: Cost reimbursement with bonuses
Germany (Deutsche Bahn)	Fixed unit price connected to a bill of quantities is mostly used as it offers flexibility during contract time.	Not used	Not used
Netherlands (Pro Rail)	Fixed price is most common for DB and DBB.	Not used	Cost reimbursement with bonuses is under discussion, however uncertain improvements.
Norway (JBV)	Fixed unit price has been most common. It provides flexibility when there are uncertainties regarding quantities of materials. Fixed price is used for large projects where risks are predictable. Fixed price will increase and become more common than unit price.	Cost reimbursement with incentives and target cost is typically not used as it may drive sub-optimizations.	Cost reimbursement with bonuses is typically not used as it may drive sub-optimizations and are hard to objectively assess. Bonuses are sometimes introduced later in projects to highlight certain aspects.
Sweden (TRV)	Fixed unit price is traditionally used for DBB and for projects with large uncertainties. Fixed price is becoming more common in DB contracts for tracks and civil engineering works. Fixed price will increase when DB contracts increase.	Cost reimbursement with incentives and target cost is sometimes used for complex uncertain projects.	Cost reimbursement with bonuses is sometimes used for complex uncertain projects.
UK (NR)	Fixed price has become an unusual reward system but is used for small and simple projects.	Cost reimbursement with incentives and target cost is used for the majority of larger contracts, with or without contractor's design.	Not used

Bonus opportunities linked to other soft aspects are not used to a large extent in the five countries. In the UK, KPIs are mostly used to discuss if a contractor is doing well or not in an area, instead of as a basis for economic rewards. However, there are a few cases where KPIs have been used to influence the payment to the contractor. Future reward system factors such as customer satisfaction during the project, attitudes towards passengers and sustainability are discussed in the UK. Linking bonuses to such non-economic aspects is a more collaborative way of using bonuses [5, 24], and NR is aiming for increased collaboration with the contractors. In Sweden, bonuses have been used in some occasions. Examples of bonus criteria are: timeliness, temporary traffic, cooperation, and environmental performance. In the Netherlands, bonuses are seen as a mechanism that often causes sub-optimizations and it is found difficult to objectively assess when bonus criteria are fulfilled. Therefore, incentives and bonus criteria are typically not used, except for the time parameter to minimize the time a section is shut down due to work. However, the discussion in the Netherlands regarding bonuses is ongoing. In Germany, bonuses for early delivery are not on the agenda since it is not possible to take railway into service earlier than planned. Furthermore, it is believed that tax payers' money should not be used to reward performance covered by the original contract.

4.2.3. Contractor Selection

Selecting capable contractors is a critical task for clients [25, 26]. Contractor selection, in terms of bid invitations and evaluations differ somewhat among the countries. However, pre-qualification is used in all five countries to receive well prepared bids from capable contractors. As such, the purpose of prequalification is often twofold: 1) to increase the chance of selecting contractors with strong capabilities and avoid poorly performing contractors, and 2) to motivate capable contractors to dedicate sufficient time and resources to prepare bids with high quality. All client organizations seem to adopt a view that it is better to receive a few strong bids than a larger amount of bids with highly varying quality. See Table 5. for a comparison of contractor selection methods.

Table 5. Contractor selection

	Competition: Open invitation, high focus on lowest price	Coopetition: Pre-qualification, lowest price and soft criteria	Cooperation: Direct negotiation, high focus on soft criteria
Germany (Deutsche Bahn)	Traditionally 100 % price, but during recent years soft criteria have been introduced.	80 % of the projects use pre-qualification. Qualification period 3-5 years. Soft criteria for quality and delivery performance are in the pipeline to strengthen life-cycle cost. 30-40 % soft criteria has been tested	Negotiation used when only on pre-qualified contractor is available.

Netherlands (Pro Rail)	High focus on lowest price is most common. The price and soft criteria ratio varies depending on the projects.	Pre-qualification is always used. Contractors are selected for a certain time (3 yrs) and scope is not for a single project. Soft criteria are often 10-30%, but will increase. Common soft criteria: contractor's project solutions, experience and capabilities, CO2-ladder for climate friendly construction process.	Not used
Norway (JBV)	High focus on lowest price is most common. 5-10% weight on soft criteria in DBB contracts. High focus on soft criteria often avoided since it has to be defended internally and towards losing bidders.	5-6 contractors are pre-qualified. 15-20% soft criteria in larger uncertain and complex projects with DB contracts. Trend towards using more soft criteria in general. Examples of soft criteria: organization and resources, project planning and execution, earlier relevant experiences and references, safety, political risks	Not often used, but in rare occasions up to 50 % soft criteria in very complex projects.
Sweden (TRV)	High focus on lowest price is most common. Soft criteria can be 5-10% in many projects. Management, organization, risk, management model, collaboration model, realization plan etc.	Pre-qualification is used and 4-6 contractors are pre-qualified. Larger weight on soft criteria (10-20%) in large, uncertain and complex projects. More subjective and risk for appeals.	Not used
UK (NR)	Pure focus on only lowest price is not common because tender price is typically 25-40 % lower than actual final price.	For large complex projects soft criteria are more important, as much as 40% weight. Common soft criteria: technical aspects (methodologies, people and programs), safety and sustainability. For large complex projects passenger journey time, handling capacity and disruptions during building process are more important than price.	Direct negotiation is used for larger projects if the specifications need adjustments or if the clients want to make changes.

As for bid evaluation, lowest price is still the most important evaluation criteria but all countries include soft criteria as well to some degree. One major reason for this focus on price is that the clients fear appeals from the losing contractors, stating that the evaluation has not been performed in a transparent and objective way. This is also supported by the literature, stating that lowest price is often the most important bid evaluation criterion, especially among public clients due to the fear of appeals [17]. However, although lowest price selections have been dominant, this is starting to change and many respondents across the studied countries believe that soft criteria will become more important in the future.

In terms of soft criteria, the focus in Sweden is on organization and management as well as risk management, collaboration and realization plan. Organization and planning is included in Norway too, as well as experience and safety. In the Netherlands, the main focus is on a climate friendly solution and reduction of CO2 emissions. The "CO2-ladder" developed by ProRail is one way to make soft criteria less subjective and easier to evaluate in transparent and objective ways. In the UK, a sustainability factor is included but the measurements for this criterion are under development. Methodologies and organizations are also included. In Germany, logistics and planning are included to complement the price criteria.

Some respondents discussed the ambiguous importance of soft criteria. One the one hand, soft criteria often don't affect which contractor is selected. That is, even when soft criteria are evaluated the contract is often awarded to the contractor with the lowest price. However, the inclusion of soft criteria is argued to improve the quality of the bids since soft criteria make contractors really think through and plan the project more thoroughly during the bid preparation phase. A challenge using soft criteria is that the evaluation is more subjective and therefore can lead to appeals from losing contractors. In Norway, a large focus on soft criteria is therefore avoided in mainstream projects.

Soft criteria increase in importance in complex and uncertain projects, especially if the contractor is procured early in the project. In Norway, the soft criteria can constitute up to 50 % of the total criteria in rare occasions if it is deemed necessary. It is especially vital that tender evaluation focuses on soft criteria in complex projects or when the contractor is expected to contribute to innovation in the design stage [29].

4.2.4. Collaboration

In general, formal partnering agreements are not commonly used in the five countries, except for Sweden and the UK. TRV has traditionally not used partnering in railway projects. However, since 2015 a formal policy states that a basic collaboration model should be used in all contracts. Hence, the current strategy explicitly involves formalized cooperation, although the basic model is not very extensive. However, an extended collaboration model has been developed and is now implemented in very complex and uncertain projects. In the UK, there is a clear collaborative approach, due to a perceived need to move towards more relational rather than transactional arrangements. Alliances

are used to generate the best ideas and to get early contractor involvement to decide the best way forward. Joint objectives enhance the development of a win–win situation in which all project participants together strive to improve project performance as formulated in objectives [36].

In some countries, there is an emphasis on more informal collaboration. In Norway, there are no formal collaborative arrangements but JBV find cooperation important and some of the contracts have a cooperation phase in the beginning to ensure well-prepared and coordinated teams. JBV strives to obtain good relationships and cooperation with contractors in informal ways. Some collaborative tools and activities are used, such as teambuilding activities and workshops to align contractual understanding and cultural awareness. Collaborative arrangements are not used by ProRail, apart from a light form of project alliance that is currently under development. The risk is however not fully shared in these alliances due to safety restrictions. Deutsche Bahn in Germany does not focus on any formal collaborative arrangements with suppliers when projects are federally financed due to the public tendering law and the anti-cartel management. Due to historical and cultural reasons, Deutsche Bahn is very hesitant to engage in collaboration with external suppliers; focusing on competition is considered more appropriate and less controversial. Table 6. presents the collaboration models in terms of tools and activities.

Table 6. Collaboration

	Competition: No collaborative tools/activities	**Coopetition: A few collaborative tools/activities**	**Cooperation: Many collaborative tools/activities**
Germany (Deutsche Bahn)	No collaborative arrangement due to the public tendering law.	Informal long-term relationships with regular meetings, performance reviews, feedback, etc. BIM has been initiated and will open up for collaboration and transparency.	Not used.
Netherlands (Pro Rail)	No formal collaborative tools or activities except for applications to control the amount and the progress of different projects.	BIM is on an experimental stage in smaller projects. Partnering not used and project alliances are rare.	Not used.
Norway (JBV)	No formal collaboration agreements.	Initial cooperation phase to ensure well prepared and coordinated teams. Informal cooperation based on trust and transparency. Team building activities and workshops are used and joint IT-tools.	Trend towards ECI.
Sweden (TRV)	Not used.	Since 2015 the basic cooperation level includes joint objectives and risk management, conflict resolution methods, workshops and partnering facilitator. BIM is used since 2015.	Extended collaboration model is implemented 2016 and includes ECI, soft criteria, rewards systems.
UK (NR)	Not used.	A need for more relational than transactional relationships is identified due to inefficiency.	Working towards long-term relationships with contractors. Alliances to generate ideas and achieve ECI. Standardization of alliance agreement on-going.

In the UK and in Sweden, there is an outspoken belief that collaboration will become even more important in the future, especially in Sweden due to the newly developed collaboration policies. In Norway, the Netherlands, and Germany the respondents do not foresee any strong trend towards partnering in the future, but some informal cooperation is considered important.

5. Concluding Discussion

5.1. Change Processes in the Five Countries

The procurement strategies in the five countries vary, as illustrated in Tables 3-6. Traditionally, procurement strategies are in many countries based on detailed DBB contracts and competitive tendering focusing on lowest price [20, 21]. This competitive focus is still noticeable in Germany, where regulations, culture, and history work against the trends towards allocating more responsibilities to and collaborating with external suppliers. However, these competitive strategies are also in stark contrast to the trend towards an increased use of cooperation and partnering arrangements in the construction industry in many countries during the last decade [33, 36]. Coopetitive and cooperative strategies are adopted by TRV, JBV, ProRail, and NR when they try to increase the suppliers' responsibilities and contract freedom through the use of DB contracts. By getting involved and supporting the contractors in the design work, the clients can achieve sufficient extent of direction of the process and customization of the end product, at the same time as contractors have possibilities to adopt efficient technical solutions and production

processes. It can also be a way to decrease potential friction on the market by using more relational arrangements, which is the case in the UK.

Traditionally, clients from the five studied countries have focused on enhancing competition in their procurement strategies regarding construction work. This focus stems from in-house production, which gradually has been outsourced. In a second step, also design and development work have been outsourced in some countries, but then mainly to consultancy companies. However, during recent years there is a discernible trend in Sweden, Norway, the Netherlands and the UK towards allocating more responsibilities to contractor companies and increasing the strategic focus on cooperation. This may be seen as a third step in the trend towards using the supply market, where also design and/or development work is outsourced to contractors instead of consultancy companies. The increase in infrastructure investments in these countries has put efficiency and value for money at the top of the agenda. Hence, the use of DB contracts has increased and many relationships can now be characterized as coopetition, rather than pure competition. The UK and the Netherlands are forerunners in this trend, although with different approaches, whereas Norway and Sweden is in the middle of this transition. Germany has not yet initiated this change but respondents believe that collaboration will become somewhat more common in the future for larger projects. However, cultural aspects and the strict anti-cartel laws in Germany are hindering this change. Most respondents in this study believe that their client organizations will become more cooperative in the future and that contractors will be involved earlier and given greater responsibilities. As such, the third step of the market oriented trend seems to focus on two main dimensions: degree of cooperation and degree of contractor responsibility. Figure 2. illustrates how the five countries are clustered along these two dimensions.

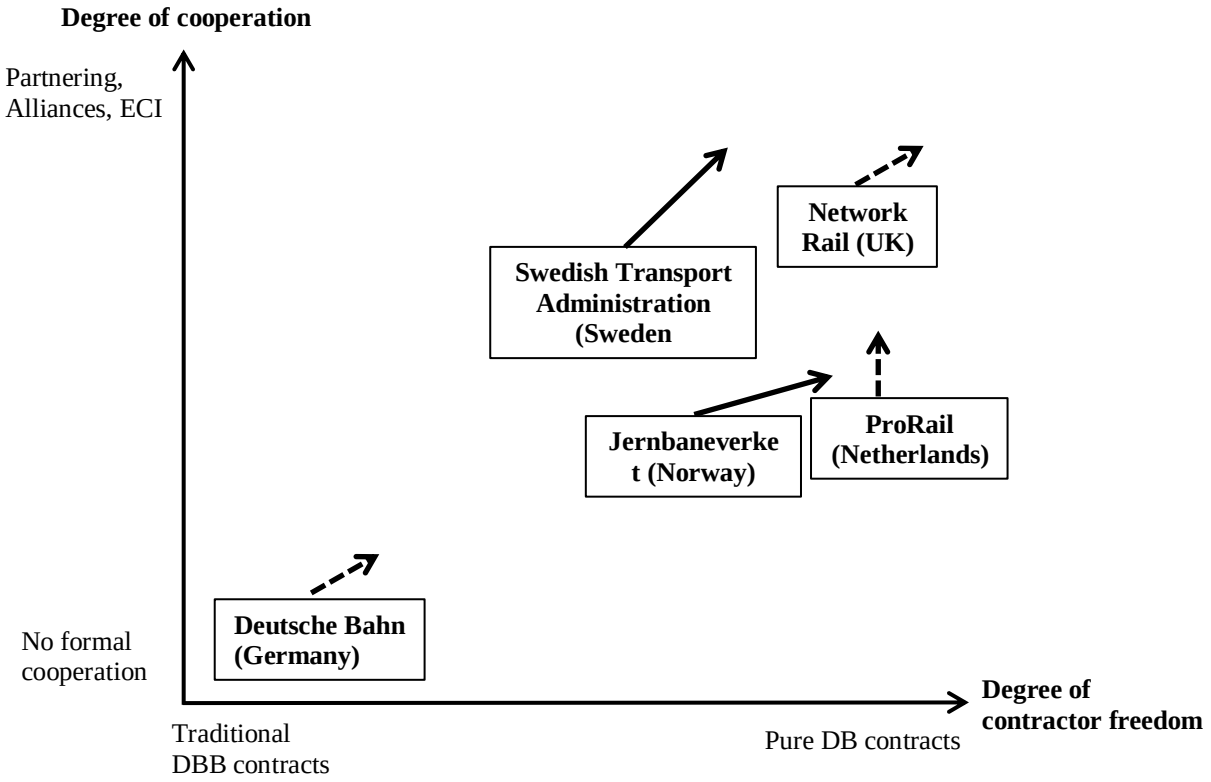

Figure 2. Change processes in the five countries

Deutsche Bahn in Germany has rather low degrees of both cooperation and contractor responsibilities, and is therefore placed in the bottom left corner of the figure. However, the respondents believe that both these dimensions may be increased somewhat in the future (illustrated by short dotted arrows). The other four countries form a cluster that has moved away from the bottom left corner during the last decade. The Netherlands and the UK were first to initiate this change but while ProRail has mainly focused on increasing the degrees of responsibilities among the contractors, Network Rail has also focused on strengthening the cooperation. The respondents believe that these changes will continue but ProRail will probably focus on strengthening the cooperation, whereas NR will probably try to increase both dimensions. Sweden and Norway are in the midst of this transition and both TRV and JBV anticipate significant changes in the near future in the same direction (illustrated by long bold arrows). However, TRV will probably focus equally on both dimensions while JBV seems to focus more on increasing the contractor involvement and freedom. If the anticipated changes play out in the five countries, it seems that the cluster of four countries will remain but move upwards and to the right in Figure 2.

5.2. Tailoring Procurement Strategies to Project Characteristics

Prior research has not verified that there is one best way to procure construction projects. Instead procurement strategies must be tailored to the project characteristics at hand to fit the purpose [17]. According to this perspective, a high focus on competition is suitable in simple projects with low uncertainty, where the client either has low customization requirements (DB contracts) or has the possibility and capability to design the project according to stable requirements in DBB contracts. Coopetition is suitable when complexity and uncertainty becomes somewhat higher and cooperation is required when project characteristics are very challenging; see Figure 1. in Section 2. The clients in Norway, Sweden, The Netherlands, and the UK seem to have adopted such a perspective, as the respondents pinpoint the need of tailoring the procurement strategies to the project characteristics at hand. Hence, they use a lot of different alternatives for different projects, although the general trend is towards more cooperation and DB contracts.

The change processes that several of the clients are currently undergoing call for systemic and purposeful follow-up investigations that can improve our understanding of the consequences of the changes. Due to the complex interconnections between the four procurement strategy components, it seems urgent for railway clients to test different combinations and investigate how different components interact and how various combinations work in practice in different types of projects. These results can serve as input to further improvements and change of procurement strategies.

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7. References

[1] Nathanail, Eftihia. "Framework for Monitoring and Assessing Performance Quality of Railway Network Infrastructure: Hellenic Railways Case Study." Journal of Infrastructure Systems 20, no. 4 (2014): 43-55.

[2] Geyer, Anton, and Andrew Davies. "Managing project–system interfaces: case studies of railway projects in restructured UK and German markets." Research Policy 29, no. 7 (2000): 991-1013.

[3] Eriksson, Per Erik. "Exploration and exploitation in project-based organizations: Development and diffusion of knowledge at different organizational levels in construction companies." International Journal of Project Management 31, no. 3 (2013): 333-341.

[4] Tawiah, Paul A., and Alan D. Russell. "Assessing infrastructure project innovation potential as a function of procurement mode." Journal of management in engineering 24, no. 3 (2008): 173-186.

[5] Eriksson, Per Erik, and Mats Westerberg. "Effects of cooperative procurement procedures on construction project performance: A conceptual framework." International Journal of Project Management 29, no. 2 (2011): 197-208.

[6] Chevroulet, Tristan, Liana Giorgi, and Christian Reynaud. "New approach for the assessment of high-speed rail projects and how to contain cost overruns: lessons from the EVA-TREN Project." Journal of Infrastructure Systems 18, no. 4 (2012): 297-304.

[7] Bunge, Mario. Treatise on Basic Philosophy: Ethics: The Good and The Right. Vol. 8. Springer Science & Business Media, 2012.

[8] Eriksson, Per Erik. "Partnering: what is it, when should it be used, and how should it be implemented?." Construction management and economics 28, no. 9 (2010): 905-917.

[9] Bengtsson, Maria, and Sören Kock. ""” Coopetition” in business Networks—to cooperate and compete simultaneously." Industrial marketing management 29, no. 5 (2000): 411-426.

[10] Eriksson, Per Erik. "Procurement effects on coopetition in client-contractor relationships." Journal of construction Engineering and Management 134, no. 2 (2008): 103-111.

[11] Uzzi, Brian. "Social structure and competition in interfirm networks: The paradox of embeddedness." Administrative science quarterly (1997): 35-67.

[12] Palaneeswaran, Ekambaram, Mohan Kumaraswamy, Motiar Rahman, and Thomas Ng. "Curing congenital construction industry disorders through relationally integrated supply chains." Building and Environment 38, no. 4 (2003): 571-582.

[13] Lu, Shaokai, and Hong Yan. "A model for evaluating the applicability of partnering in construction." International Journal of Project Management 25, no. 2 (2007): 164-170.

[14] Cheung, Sai-On, Tsun-Ip Lam, Mei-Yung Leung, and Yue-Wang Wan. "An analytical hierarchy process based procurement selection method." Construction Management & Economics 19, no. 4 (2001): 427-437.

[15] Koppinen, Tiina, and Pertti Lahdenperä. "Realized economic efficiency of road project delivery systems." Journal of Infrastructure Systems 13, no. 4 (2007): 321-329.

[16] Nyström, Johan, Jan-Eric Nilsson, and Hans Lind. "Degrees of freedom and innovations in construction contracts." Transport Policy 47 (2016): 119-126.

[17] Eriksson, Per Erik, and J. Hane. "Entreprenadupphandlingar-Hur kan byggherrar främja effektivitet och innovation genom lämpliga upphandlingstrategier?[Construction Contracts-How can developers promote efficiency and innovation through appropriate procurement strategies?]." Construction procurement–How may construction clients enhance efficiency and innovation through appropriate procurement strategies (2014).

[18] Bajari, Patrick, and Steven Tadelis. "Incentives versus transaction costs: A theory of procurement contracts." Rand journal of Economics (2001): 387-407.

[19] Ballebye Olesen, H. What can public procurers learn from private? An explorative study of Sweden. Forskningsrapport beställd och finansierad av Konkurrensverket (2008).

[20] Korczynski, Marek. "The low‐trust route to economic development: inter‐firm relations in the UK engineering construction industry in the 1980s and 1990s." Journal of Management Studies 33, no. 6 (1996): 787-808.

[21] Kadefors, Anna. "Trust in project relationships—inside the black box." International Journal of project management 22, no. 3 (2004): 175-182.

[22] Badenfelt, Ulrika. "The selection of sharing ratios in target cost contracts." Engineering, Construction and Architectural Management 15, no. 1 (2008): 54-65.

[23] Boukendour, Saïd, and Will Hughes. "Collaborative incentive contracts: stimulating competitive behaviour without competition." Construction Management and Economics 32, no. 3 (2014): 279-289.

[24] Love, Peter ED, Peter R. Davis, Robert Chevis, and David J. Edwards. "Risk/reward compensation model for civil engineering infrastructure alliance projects." Journal of Construction Engineering and Management 137, no. 2 (2010): 127-136.

[25] Kumaraswamy, Mohan M., and Aaron M. Anvuur. "Selecting sustainable teams for PPP projects." Building and Environment 43, no. 6 (2008): 999-1009.

[26] Caldwell, Nigel D., Jens K. Roehrich, and Andrew C. Davies. "Procuring complex performance in construction: London Heathrow Terminal 5 and a Private Finance Initiative hospital." Journal of Purchasing and Supply Management 15, no. 3 (2009): 178-186.

[27] Kadefors, Anna. "Fairness in interorganizational project relations: norms and strategies." Construction Management and Economics 23, no. 8 (2005): 871-878.

[28] Hatush, Zedan, and Martin Skitmore. "Contractor selection using multicriteria utility theory: an additive model." Building and environment 33, no. 2 (1998): 105-115.

[29] Bosch‐Sijtsema, Petra M., and Theo JBM Postma. "Cooperative innovation projects: Capabilities and governance mechanisms." Journal of Product Innovation Management 26, no. 1 (2009): 58-70.

[30] Chan, Daniel WM, and Mohan M. Kumaraswamy. "A comparative study of causes of time overruns in Hong Kong construction projects." International Journal of project management 15, no. 1 (1997): 55-63.

[31] Assaf, Sadi A., and Sadiq Al-Hejji. "Causes of delay in large construction projects." International journal of project management 24, no. 4 (2006): 349-357.

[32] Yasamis, Firuzan, David Arditi, and Jamshid Mohammadi. "Assessing contractor quality performance." Construction Management & Economics 20, no. 3 (2002): 211-223.

[33] Bygballe, Lena E., Marianne Jahre, and Anna Swärd. "Partnering relationships in construction: A literature review." Journal of purchasing and supply management 16, no. 4 (2010): 239-253.

[34] Bayliss, Roger, Sai-On Cheung, Henry CH Suen, and Shek-Pui Wong. "Effective partnering tools in construction: a case study on MTRC TKE contract 604 in Hong Kong." International Journal of Project Management 22, no. 3 (2004): 253-263.

[35] Olsen, Bjørn Erik, Sven A. Haugland, Edgar Karlsen, and Geir Johan Husøy. "Governance of complex procurements in the oil and gas industry." Journal of Purchasing and Supply management 11, no. 1 (2005): 1-13.

[36] Eriksson, Per Erik. "Partnering in engineering projects: Four dimensions of supply chain integration." Journal of Purchasing and Supply Management 21, no. 1 (2015): 38-50.

[37] Woksepp, Stefan, and Thomas Olofsson. "Credibility and applicability of virtual reality models in design and construction." Advanced Engineering Informatics 22, no. 4 (2008): 520-528.

[38] Gibbert, Michael, Winfried Ruigrok, and Barbara Wicki. "What passes as a rigorous case study?." Strategic management journal 29, no. 13 (2008): 1465-1474.

[39] Statskontoret. På rätt väg? Uppföljning av Trafikverket och Transportstyrelsen. [On the right way? Evaluation of the Swedish Transport Administration]. Rapport 2015:14.

[40] Hunold, Matthias, and Christoph Wolf. "Competitive procurement design: Evidence from regional passenger railway services in Germany." (2013).

[41] Schwilling, A. & Brunge, S.. 20 years of German rail reform and Deutsche Bahn AG – Achievements and challenges, Roland Berger Strategy Consultants, Germany (2014).

[42] Norwegian Ministry of Transport and Communication. National Transport Plan 2014-2023, English version. Meld. St. 26 (2012 – 2013) Report to the Storting (2013).

[43] Jernbaneverket. Procurement Strategy. Jernbaneverket homepage, (2015).