Performance of Construction Projects:
Essays on Supplier Structure, Construction Costs and Quality Improvement

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iii
ABSTRACT

The performance of the construction industry and its contribution to the welfare of society in comparison to other industries such as the manufacturing industry has lately been the focus of many commissioned reports and academic research publications. The so-called “iron triangle” of time, cost and quality have been the most important metrics of construction project performance, especially for the selection of appropriate procurement methods. The perceived inefficiencies emanate from, among other things, increasing construction costs, conflicts and client dissatisfaction, the fragmented nature of the industry, low competition, cost overruns and delays, and lack of quality improvement. There is observed disparity in increases in housing construction costs and an apparent lack of quality improvement of infrastructure transport projects. In Sweden, metropolitan regions experienced higher construction cost increases, while small regions showed less costs increases during economic booms. In order to address these perceived inefficiencies, numerous strategic and project level decisions that influenced the way that publicly owned properties and projects are procured, constructed, operated, and maintained have been made. The decision to transfer quality-related activities and quality assurance responsibilities from client to contractor approximately 25 years ago is one of the decisions that could have an impact on current quality of infrastructure transport projects. The disparity in increases in construction costs and quality improvement concerns could not only influence the performance of construction projects, but also can affect the way different actors in the sector interact with each other and achieve their divergent objectives.

The aim of this study is twofold. First, it tries to explain the observed disparity increases in construction costs between big (metropolitan) and medium/small regions. Second, it attempts to ascertain the extent of quality problems in infrastructure transport projects after the transfer of quality assurance responsibilities from client to contractor approximately 25 years ago is one of the decisions that could have an impact on current quality of infrastructure transport projects. Surveys and interviews were used as a means to collect data concerning both supplier structure in relation to housing construction costs and quality of construction projects. Other empirical data from a secondary source were also used.

The first part of the research offers an understanding of the behavior of contractors in specific economic situations, specifically by taking into consideration the long-run relationship between contractors and owners/developers. It ascertains that if contractors/subcontractors display opportunistic behavior during the economic boom, the result will be increased higher construction costs. We utilized transaction cost theory in exploring construction sector structures in an attempt to understand changes in the sector from an efficiency perspective. The analysis can also enrich the current understanding of the governance structure of Swedish construction firms and how they could influence construction costs.

As the response from the survey suggests, quality of infrastructure projects has not decreased after the transfer of quality assurance from client to contractor. However, the high number of respondents that indicated quality is the same as before the transfer raises a concern of lack of quality improvement. Respondents have overwhelmingly indicated that the lack of public client competence was one of the contributing factors of quality problems. It is argued that with client competence it is important to build-up through proper knowledge management, incentive systems, and training. Further, the retention of new skilled and experienced workers is an essential element for continuous quality improvement goals and objectives. A second opinion practice from independent experts and committees that focuses on the quality aspect of the projects can be introduced in the provision of infrastructure transport projects. Finally, it is argued that without client competence and a company culture that creates the right incentives, no procurement method can guarantee high quality.
Table of contents

- Thesis overview

- Part 1: Supplier structure and housing construction costs
  - Paper 1: Construction costs – central concepts, categories and determining factors. Author: Abukar Warsame
  - Paper 2: Long-run relationships, Vertical Integration and International competition: Can they contribute to explaining regional construction cost differences? Author: Abukar Warsame
  - Paper 3: Organizational modes in the residential building sector in Sweden. Author: Abukar Warsame
  - Paper 4: The effect of subsidy on housing construction in various regions of Sweden. Authors: Abukar Warsame, Mats Wilhelmsson and Lena Borg

- Part 2: Quality improvement methods for infrastructure transport projects
  - Paper 5: Quality in infrastructure projects: concepts and framework for explanatory and exploratory studies. Author: Abukar Warsame
  - Paper 6: Decision-making theories in relation to quality of infrastructure transport projects. Author: Abukar Warsame
  - Paper 7: Framework for quality improvement of infrastructure projects. Author: Abukar Warsame
  - Paper 8: Procurement type and quality in infrastructure projects. Authors: Abukar Warsame, Hans Lind and Lena Borg
  - Paper 9: What can the client do to improve the quality of infrastructure transport projects? Authors: Abukar Warsame and Hans Lind
Thesis overview

1. Introduction

The construction industry is the backbone of the economic activities in many developed countries, where around 5-11 percent of their GDP is spent yearly on various types of construction projects and related activities (Bennett, 2003: 3). It was the biggest industrial employer in Europe with 30 percent of the workforce in 2007 (FIEC, 2008). Construction projects can be broadly categorized as building construction, engineering construction or industrial construction (Halpin, 2006; Bennett, 2003). Engineering construction is further divided into highway and heavy construction depending on whether the owner and designer are public or private. Public sector entities often own engineering construction projects and facilitate their provision.

The housing sector is one of the major sectors in the construction industry and will therefore determine the success and failure of this industry. It plays a large role in the economy of many developed countries. Twenty-six percent of the European Union’s construction activities was from housing construction (European Construction Industry Federation, 2005). Housing construction was normally used as an economic stabilizer in many countries. The construction sector, especially residential, was used by Sweden’s central government as a cyclical stabilizer when keeping with Keynesian economic theories (Swedish Industry, 2004).

As Abowtz and Toole (2010) pointed out, construction projects are a by-product of a social process involving many actors. Different actors are involved in the realization of a common object (infrastructure or building project) in exchange for monetary or social value depending on their objectives and goals. Clients, consultants and contractors are often the three main actors in construction projects. The degree of involvement for each actor in the provision of a specific building or infrastructure project and their expected role in delivering the desired performance of the project is governed by the contractual agreements. The client as an initiator and owner of projects uses consultants for project planning and design activities (if an in-house team is not used), and then contracts construction activities with contractors. The contractual relationship between the three main actors and how they interact with each other
varies from one form of contract to another. Thus, it not expected that performance metrics such as time, cost and quality remain unchanged between different forms of contracts and procurement methods.

It is noteworthy to mention that the terms contract and procurement are often used synonymously, but they could in fact have different meanings. Procurement refers to strategy or method covering the whole process of delivering a project from the planning and development phase to the construction and completion stage, even extending to the warranty period. It could also include other stages such as operation and maintenance. Contract seems to refer to the unidirectional relationship between actors such as consultancy contract (between client and consultant), building contract (between client and contractor) or form of payment such as fixed price and cost-reimbursement contracts. When our unit of analysis is the organizational level and supplier structure, rather than individual projects, we use the two aforementioned terms interchangeably.

The performance of the industry and its contribution to the welfare of society in comparison to other industries such as the manufacturing industry has lately been the focus of many commissioned reports and academic research publications. Bernold and AbouRizk (2010) mention two clusters of performance measures: efficiency and effectiveness. While efficiency focuses on operational ratio and productivity matters in the short term, effectiveness comprises measures focusing on long-term improvement goals such as the amount of rework and owner satisfaction of completed projects. The so-called “iron triangle” of time, cost and quality have been the most important metrics of construction project performance, especially for the selection of appropriate procurement methods (see El Wardani et al., 2006); however, other factors such as safety and environment impact were also considered.

The perceived inefficiencies in the construction sector emanate from, among other things, increasing construction costs, conflicts and client dissatisfaction, the fragmented nature of the industry, low competition, and cost overruns and delays (Latham, 1994; Egan, 1998; Flyvbjerg, 2003; Toakley and Marosszeky, 2003; Lind, 2003). Swedish housing construction costs have risen more than the rate of inflation during the last decade (1994-2004). In Flyvbjerg’s (2003) report to the British Department for Transport, he noted that transport projects are inherently risky due to the long planning horizon and complex project interface, which often induces changes related to uncertainty at the early project stages, technical
standards, and geotechnical conditions. Furthermore, the fragmented and short-term nature of construction projects coupled with numerous stakeholders with different objectives makes it difficult to achieve high-level and consistent quality (Toakley and Marosszeky, 2003).

Increasing construction costs affect households’ welfare in terms of housing affordability, and it weakens the relationship between developers and contractors, possibly destabilizing the housing market as well as the whole economy. Sweden’s metropolitan regions experienced increasingly higher construction cost, while small regions showed less cost increases during economic booms. The effect of construction costs escalation was not evenly felt in all regions, and there was also an imbalance of housing stocks in various regions (Atterhög and Lind, 2004). The supply of new residential apartments stagnated, while at the same time construction costs were high, particularly in the metropolitan regions where the housing demands were stronger. Higher construction costs reduce residential construction, and thus affect the movement in house prices and rent levels (Somerville, 1999).

Quality improvement concerns of infrastructure transport projects have also been an issue that demanded closer examination. In order to curtail these shortcomings or the failure of transport projects in meeting their objectives, interested parties (government and private sector) put into practice different procurement and contracting strategies, as well as various construction management approaches. Numerous strategic and project-level decisions that could influence the way publicly owned properties and projects are procured, constructed, operated, and maintained must be made by senior management and project managers. An example is the decision to transfer quality-related activities and quality assurance responsibilities from client to contractor approximately 25 years ago.

Trade-off decisions between allocated budget, schedule and specifications are also involved in the process of procuring projects. These decisions can have both short- and long-term effects on how public client organizations interact with other actors in the construction industry such as contractors, subcontractors and consultants. Furthermore, the internal resource and competence of public client organizations and municipal housing companies, which play a major role when choosing the most appropriate methods for carrying out housing and infrastructure transport projects, could also affect the cost and quality of projects.
The dominance of different supplier structures in certain regions or economic conditions could shape the selection of delivery method made by the client, which in turn could impact how the skills and experience of the client organization’s workforce develops in the long run and ultimately the performance of the construction projects that these public organizations provide to the public. Similarly, heavy reliance on a single procurement method such as traditional Design-Bid-Build in the provision of infrastructure transport projects combined with the shortage of skilled and experienced workers can have a negative impact on the quality of construction projects. Furthermore, the delivery process of construction projects and hence their performance could be influenced by:

- The contractual and supplier structure of different entities involved in the project such as the use of consultants, general contractor or all-in-one contract.
- The political and legal system of the client organization such as lowest price policy, competition regulations, and internal resource capacity of the client organization.
- Other market forces such as competition, technology and overall economic environment.

These were some of the issues that we intended to investigate in our research. Based on observation of abnormal construction cost increases among Swedish regions and concerns for quality improvement after quality assurance transfer, a number of research questions were formulated. They will be presented in the next section along with detailed and more elaborated objectives of the thesis.

2. Aims and objectives of the thesis

This observed increasing disparity in housing construction costs and apparent lack of quality improvement of infrastructure transport projects are two issues that could not only influence the performance of construction projects, but also can have an impact on the way different actors in the sector interact with one another and achieve their divergent objectives. There is a large volume of literature dealing with the problems of high construction costs, but only a few studies tackle this issue within the context of the changing economic conditions and the governance structure of construction firms. The type of relationship between developers and
contractors, the firm structure (such as developer-contractor or independent developer/contractor), and the level of foreign supplier competition found in these various regions might, among other aspects, explain the disparity in increasing construction costs. The difference in cost increases offered the opportunity to compare the regions and investigate numerous factors—contractual relationship, firm structure, foreign supplier and government policy such as subsidies—that can exist in some regions but not in other regions or have different magnitude of influence. The identified factors could alleviate or exacerbate construction costs.

Similarly, there is an enormous body of literature that deals with quality concerns of construction projects; however, the impact of quality assurance transfer on a public client organization and quality improvement methods of infrastructure projects has not been thoroughly examined. Thus, the aim of this study is to answer the following questions:

1. How can we explain the observed disparity in construction cost increases between big (metropolitan) and medium/small regions?

2. What can a client do to improve the quality of infrastructure transport projects?

In addition to the above questions, sub-questions that further highlight the cost and quality attributes are discussed in the thesis. One of the questions this study will attempt to address is: Are there common understandings of what constitute costs or how we define quality? The effect of subsidized interest rates on housing construction costs in different regions is another example of sub-questions that is considered in this thesis. The impact of the quality assurance transfer must be first investigated and assessed before any attempt to study different, possible quality improvement methods.

This research comprises two separate topics (supplier structure in construction in relation to construction costs and quality improvement) but one common goal of addressing construction project performance. The more specific research objectives are:

*Construction costs aspect:*

- To gather and synthesize construction cost-related concepts in a way that makes it easier to identify factors behind increasing construction cost and disparities among the regions.
• To discuss the role that the previous working relationship and the strength of the relationship between developers and contractors play in the construction costs of building projects.

• To explore how developers perceive the behaviour of vertically integrated firms and the organization patterns in the construction industry in relation to construction costs.

• To analyze the level of foreign suppliers, imported materials and labour during the study period, and the impact that increased competition could have on construction costs.

• To explain the various specific organizational forms that could emerge in response to changes in economic and market conditions.

• To investigate the role of government subsidies for housing construction.

**Quality improvement aspect:**

- To gather and synthesize quality-related concepts in order to single out factors that could have contributed or hampered quality improvement the public client organization desired.

- To explore the extent of quality improvement after the transfer of quality assurance-led responsibilities from client to contractors.

- To investigate unintended consequences that could result from this quality assurance transfer and are detrimental to the quality of infrastructure transport projects. In other words, can we explain these consequences if we combine some of the mainstream decision-making and organizational theories related to quality attributes?

- To analyze and explain the role of procurement methods and public client characteristics (such as client competence and its internal processes) on the delivery of the desired quality level.

In order to find answers for the aforementioned research questions and achieve the above objectives, a methodical research approach that is clearly established in the construction research community is needed. Our intention in this section is not to get deeply involved in
the philosophical debate of which paradigm or research approach is more suitable to any specific construction related topic such as construction or project management. However, we need to explain why our research approach is suitable to answer our research questions, and thus could produce justifiable results that not only contribute to the existing body of knowledge in this field but also provide some answers to practical questions with regard to the quality improvement of construction projects. However, first an overview of research methodology, the different research paradigms, and the assumptions behind them, as well as a review of the methodological debates that have taken place in this field for the last two decades, will be presented.

3. Research design

There is no undisputed agreement on what constitutes good research that satisfies and prevails over the theoretical and philosophical differences among researchers in the construction and built environment discipline (Amaratunga et al., 2002). Some of the major issues that are behind these differences have their roots in what should be the object of analysis, what approach or method is more appropriate for certain research question, and how to collect and analyze data, as well as how to interpret the findings. In other words, the underlying basic question boils down to whether construction-related research is more in line with natural or social science, and whether theories and approaches discerned from one specific paradigm is more appropriate to answer certain research questions and exclude the use of other paradigms. In order to develop a convincing argument for our choice of research methodology and methods, we need to review these competing research paradigms, research types, and refer to how various scholars argued their preferred paradigm and research methodology. Jonker and Pennink (2010) presented a research pyramid that explains how different actions in the research are systematically interconnected. The pyramid has four levels:

- Research paradigm level: the researcher expresses their basic approach and how they view the reality.

- Research methodology level: the researcher decides on a way to conduct their research that is tailored to the research paradigm.
- Research method level: the researcher identifies specific steps of actions that is needed to be executed sequentially.

- Research technique level: the researcher specifies practical tools for generating, collecting and analyzing data.

Our brief research review process follows a similar approach to Jonker and Pennink’s. We also describe the classification of some of the major research types and how they are related to specific types of research problems.

**Research paradigms**

First, the word *paradigm* needs to be defined. Fellow and Liu (2008) define paradigm as “a theoretical framework which includes a system by which people view events”. They added that paradigms serve to determine what views are adopted, and the approach to questioning and discovery. Bryman and Bell (2007) gave a similar but slightly different definition of paradigm, explaining it as “a cluster of beliefs and dictates which for scientist in a particular discipline influence what should be studied, how research should be done and how results should be interpreted”. Guba and Lincoln (1984) proposed a definition of paradigm that is based on answers given by the proponent of any given paradigm to three interconnected fundamental questions. They define paradigm as the basic belief systems or worldview that guides the investigator not only in choices of methods but answering:

- **Ontological question**: what is the form and nature of reality?

- **Epistemological question**: what is the nature of the relationship between the knower or would-be knower and what can be known?

- **Methodological question**: how the inquirer goes about finding out whatever they believe can be known?

From the above definitions of paradigm, several significant points can be interpreted. First, paradigms shape the views or beliefs that, as researchers, we hold with regard for our research questions. Second, these beliefs will influence our research process and how we collect and analyze data, and how we present our research findings. Thus, it is important as a researcher
to recognize the research paradigm that would eventually determine your research process, ultimately distinguishing it from other paradigms.

Two major paradigms dominate the debate surrounding which research approach is suited for the construction sector: positivism and interpretivism. Positivist researchers are defined as researchers that only recognize non-metaphysical facts and observable phenomena that are rooted on quantitative approaches, and are closely related to rationalism, empiricism, and objectivity (Fellow and Liu, 2008: 17). Interpretivist researchers are defined as researchers that emphasize that truth and reality are socially constructed and thus influenced by persons involved (Fellow and Liu, 2008). Interpretive research is likely to feature in qualitative studies, wherein people with a positivist tradition often question its objectivity (Fellow and Liu, 2008: 27).

Seymour et al. (1997) advocate the use of a more qualitative and interpretivist approach in construction research. They suggested that researchers in construction management need to concentrate on interpretive methods, since it recognizes the viewpoints of practitioners rather than positivist approaches, which heavily depend on causality relationship results. The article did not only generate a great deal of criticism and strong reactions from other authors, but it also started (as intended) a constructive debate on the subject itself. Abowitz and Toole (2010) agree with the argument of Seymour et al., and state that construction is essentially a “social” process where “construction can be considered to be the application by people of technology developed by people to achieve goals established by people involving the erection or retrofitting of infrastructure and buildings”.

Runeson (1997) argued against the claim of Seymour et al. (1997), explaining that the object of study are people. He also rejected the suggestion that construction management is not amenable to an objective and verifiable casual relationship. Runeson (1997) insists that “positivist research methods are our best insurance against bad research”. Wing et al. (1998) stated that an interpretivist approach could be suitable for certain types of problems, but a positivist approach is more likely to produce general practical solutions. Smyth and Morris (2007) reviewed 68 papers from the International Journal of Project Management that were published in 2005 and found that positivism was the most dominant research epistemology (66%) in the sample. Based on analyses of 107 papers and notes published in Construction Management and Economics, Dainty (2008) also found that 76 of the papers used quantitative
methods. Both Dainty (2008) and Smyth and Morris’s (2007) papers acknowledged that their selection of papers and analysis could be biased. Nevertheless, this historical dominance toward a positivism approach might suggest that positivism is the most appropriate methodology for the practitioner-oriented discipline like project management (Wing et al., 2007).

The debate over paradigms was not confined to researchers’ preference between only positivism and interpretivism. Other alternative approaches have also been promoted. Interpertivist researchers have been criticized for their tendency to seek specific explanations with limited powers of generalization, while positivists are criticized for their reliance on identifying general patterns based on cause and effect that marginalizes the particular (Smyth and Morris, 2007). Positivist methodology fails to address many project issues except in a few cases, while interpretivists understand perceptions well but poorly address the general (Smyth and Morris, 2007). Two possible means to address these shortcomings or criticism of the two dominant paradigms are:

- To exploit another approach such as critical realism that simultaneously recognizes the reality of the natural order and the events and discourse of social order (Smyth and Morris, 2007; Bryman and Bell, 2007). Critical realism, also known postpositivism (Guba and Lincoln, 1994) or simply realism, offers a methodology that neither seeks the particular nor the general, instead it tries to measure casual powers that explain the structure, mechanism and processes. (Smyth and Morris, 2007).

- To adopt a methodological pluralism approach, and combine both positivist and interpertivist approaches when solving the research problem in order to compensate for the weakness of each approach (Bryman and Bell, 2007; Dainty, 2008; Amaratunga et al., 2002). Without endorsing the criticism that Seymour et al. (1997) laid on the appropriateness of positivist methods in construction management, Dainty (2008) echoed the dominance of positivism in this field and the need to embrace other methodological perspectives in order to gain richer insight and a more complete understanding of the human aspect of the sector. The use of a mixed method approach, such as a combination of quantitative and qualitative approaches, can be a better one
in certain situations than a single method since it can improve the weakness of any single method (Amaratunga et al., 2002).

Gill and Johnson (1997), cited in Fisher (2007), described how the connection between positivist and interpretivist approaches works in a methodological pluralism framework. They argue that if you take a positivist stance then aspects of an interpretivist approach could be brought in as a useful adjunct to the research but not the other way around. After positivist research identifies an association between two variables then an interpretivist approach can help the understanding of the casual connection and the mechanism, which shows in all complexities how different aspects interact (Fisher, 2007). Dainty (2008) asserts that quantitative findings may have not come to light without earlier qualitatively derived results.

Based on our research questions described in the previous section and our main objectives, we focus on selecting an appropriate research approach that could provide a solution to both research problems: explaining (the disparity of) construction costs and exploring quality improvement methods. In both parts of the thesis, a multi-paradigm research approach was deemed to be more appropriate than a single approach because of the nature of our research inquiry and object of analysis that involved both process and product. We utilized both the quantitative and qualitative methods since the findings from the quantitative paper allow us to build the theoretical foundation for the ensuing paper in that part of the thesis. Fellow and Liu (2008) claim that construction management research tends to be either process oriented, for example organizational culture or both processes, and product oriented such as studies of the impact of different procurement approaches on project and project management performance. In our investigation concerning the quality of construction projects, we used a realistic research approach. This approach enables us to acquire knowledge that would indicate what should be done in order to improve the quality without intricately defining quality from the perspective of all parties involved in projects or how to measure it. The realist approach allows the researcher to retain many of the ambitions of positivism, while recognizing the subjective nature of research and its inevitable values (Fisher, 2007). Propositions/conjectures are presented that so far can only be partly tested, but are based on information from qualitative studies.
Research methodology and methods

Methodology must be given careful consideration at the beginning of the research so that the most suitable approaches and research methods are adopted (Fellow and Liu, 2010). This statement from Fellow and Liu does not only emphasize the significance of good research methodology in the quest for knowledge contribution and finding a solution for practical problems, but it also underscores the different meanings of the two words *methodology* and *methods*. The two words are often used arbitrarily (Jonker and Pennink, 2010). It is clear from Fellow and Liu’s abovementioned statement that methodology covers more than just research methods. Jonker and Pennink (2010) define methodology as the process of defining and defending the logical order the researcher needs to follow in order to achieve a certain predetermined result such as knowledge, insight, intervention or change. They also state that methodology helps make the main outline of the approach transparent to the researcher and to academia and business. In fact, research methodology influences the actual research methods that are used to investigate a problem, and collect, analyze and interpret data (Dainty, 2008).

Methodology encompasses the rationale and the philosophical assumptions that underline a particular study (Dainty, 2008), while methods indicate specific steps or actions that should be taken in a certain order during research (Jonker and Pennink, 2010). Methods concern the techniques that are available for data collection, analysis and those which are employed in a research project (Fellow and Liu, 2008). It is expected that if the research methodology is good and the actual research is properly conducted, the resulting research would not only be useful in organizational practice but also meet academic standards (Jonker and Pennink, 2010). This notion of practical and academic needs brings up the existence of different types of research and research questions.

Fellow and Liu (2008) described several classifications of research types. One of their classifications is based on the outcome of the research. *Pure* research focuses on the discovery of theories and laws of nature, while *applied* research is directed to end-uses and practical applications. Jonker and Pennink (2010) also classified research into *scientific* (fundamental) and *applied*. A fundamental researcher improves the existing body of knowledge by generating new knowledge and insights into the basis of research, while applied research is more concerned with problem solving and strives to obtain knowledge about a particular issue that contributes to the improvement of the issue (Jonker and Pennink,
Fellow and Liu (2008) stress that although academics are often oriented to pure research and practitioners tend to pursue development work and application, the two research types are complementary to each other, particularly in the context of construction. Furthermore, Fellow and Liu (2008) categorize problems associated with applied research as closed and open-ended problems. The nature and variables involved in close-ended problems can be identified easily and a single correct solution can be reached, while open-ended problems tend to be complex and could produce many alternative solutions (Fellow and Liu, 2008: 9).

Another classification is based on the research methods adopted: quantitative and qualitative research. Quantitative approaches adopt a scientific method that relies on theory and hypothesis testing procedures, while a qualitative research objective is to gain an understanding and collect information and data that would allow theories to emerge (Fellow and Liu, 2008). As we mentioned earlier, the two methods are not mutually exclusive; however, quantitative findings could be used as a supplementary source for a qualitative enquiry in other parts of the research, and the other way around. Fellow and Liu (2008) stress that qualitative data, which are commonly subjective such as opinion surveys, can and should be analyzed objectively, often using quantitative techniques.

Fellow and Liu (2008) described another classification that is based on the purpose of the research question. This classification was an essential tool in our research process, and it is further explained below. According to this classification, the five types of research are:

- **Instrumental**: when the intention is to construct or calibrate research instruments. This type does not have that much application in our research topic and we are not discussing it any further.

- **Descriptive**: to systematically identify and record a phenomenon, process or system. Since identification is done from a particular perspective and for a specified purpose, objectivity, accuracy and comprehensiveness are important (Fellow and Liu, 2008). Commonly, a descriptive research type is carried out to enable the subject matter to be categorized, and the research may be undertaken as a survey or as a case study (Fellow and Liu, 2008). Paper 1 of the second part of the thesis exemplifies this type of research.
• **Exploratory:** when the intention is to test or explore aspects of theory. An hypothesis is an integral part of this type of research, where either hypothesis is set up then tested or variables are identified and hypotheses are produced in order to be tested in further research. Paper 2 of the first part of the thesis is an exploratory research type, where three hypotheses are put forward and partly tested.

• **Explanatory:** when the researcher is seeking to answer a particular question or explain a specific issue. Hypotheses are also used in this type of research and a theory can be used to develop the hypotheses. Paper 4 in the second part of the thesis is a good example of this type of research, where we try to explain the impact of subsidy on housing stocks.

• **Interpretive:** when the purpose of the research is to fit findings to a theoretical framework or model, and empirical testing cannot be done due to some unique aspect. In this circumstance, variables are grouped according to an assumed relationship with the intention of replicating reality as close as possible. Paper 2 of the second part of the thesis is an attempt to fit our survey finding with decision-making theories in relation to quality of construction projects.

Our research and research questions in the first part of this thesis seem to fit well with the description of the fundamental type of research, since the main objective of that part was finding theories that could explain the disparity of construction cost growth between big and small regions. The intention was to contribute to the existing body of knowledge concerning construction costs rather than finding a solution to a specific real problem. On the contrary, the second part of the thesis tries to address quality improvement concerns related to the transfer of quality assurance. It is intended to contribute to a practical solution to a real issue. Thus, this type of research could be characterized as applied research.

Before we undertook our research, we considered the difficulties and challenges that we may encounter when obtaining information related to construction costs and quality of specific construction projects. We also contemplated the usefulness of these unique projects attributes, related to cost and quality, to the main questions of understanding construction cost factors and improving the performance of construction projects. Surveys and interviews were used as a means to collect data concerning both supplier structure in relation to housing construction
costs and quality of construction projects. Other empirical data from a secondary source were used in some of the papers. SPSS and STATA were utilized in our data analysis.

Though the response rate of both the semi-structured survey in the first part of the thesis and the survey in the second part are considered to be high compared with the typical questionnaire surveys of the construction industry, the inference power of the responses were limited due to uncompleted answers, disproportional participants of public developers, and respondents’ disparate opinion about what constitutes quality.

The following research methodology (Figure 1), which is quite similar to a methodology adapted by Arditi and Gunyadin (1998) in their investigation of factors that affect quality, is envisioned to produce the desired contribution of knowledge and practical proposals to address quality improvement questions.

![Figure 1: Research methodology of part 1 and 2 of the thesis.](image-url)
4. Summary of the papers

As the above figure illustrates, this thesis contains two parts of research that have been carried out at two different times. With regard to context, the two parts cover a common subject—the performance of construction projects—but each part deals with a specific issue. Part 1 deals with supplier structure in relation to housing construction costs, and part 2 focuses on quality improvement methods for infrastructure projects. The first part of the thesis concerns a research project funded by FORMAS (The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning). It is inspired by a research question that was based on observation of the disparity in construction cost increases among metropolitan and other small and medium regions of Sweden. It comprises four theoretical and empirical papers, and it was mainly completed in 2006 as a part of licentiate fulfillment, except for Paper 4 and the empirical part of Paper 3.

The second part concerns quality improvement methods for infrastructure transport projects and is funded by the industry actors (Trafikverket, SBUF, and NCC) through the Centre for Operations and Maintenance (CDU). After the transfer of quality of assurance of the public project from client to contractor almost 25 years ago, the industry has recognized the need to investigate quality control and quality assurance responsibilities. This part of the thesis consists of five interrelated papers. It starts with a more conceptual paper and ends with recommendation of what needs to be done in order to improve quality of infrastructure projects.

Part 1: Supplier structure and housing construction costs

The cost concepts and categories, as well as clarification of cost and price terminology contained in the first paper, served as a catalyst for the other papers of this part, where a number of more specific factors that could influence construction cost and organizational structure ramifications were examined. Paper 2 is a typical quantitative research study where theory, hypothesis testing and deductive approach are followed. The empirical study presented in Paper 2 indicated the importance of the organization structure that is analyzed in the third paper.
The original version of the third paper that was included in the licentiate presentation is not included in this thesis because the theoretical part of that paper is supplemented with empirical results from a survey and follow-up interviews generated the version of the paper included here (Paper 3). Paper 4 was carried out at a later stage when more data concerning construction costs and other explanatory variables became available.

**Paper 1: Construction costs – central concepts, categories and determining factors**

The first paper of this part is intended to review various construction cost concepts. Unclear descriptions of what constitutes cost and what the building price is made up of is a common source of confusion and may hinder any attempt to single out the source of increasing construction costs. A direct and indirect cost structure seems to include most of the cost components incurred by the various actors in the construction process and indeed enhances the distinction between cost and price in relation to supplier structure.

The factors influencing construction costs were formed into four groups/layers: project-specific factors, client-contractor-related factors, competition and market conditions, and macroeconomic and political factors. The grouping is based on the extent to which the construction actors, especially contractors and clients, could influence the factors. By aggregating many factors influencing construction costs into four groupings, it is easier to analyze a specific situation as one can first determine what type of factor or layer to focus on.

The usefulness of each group of factors in explaining the disparity of regional cost growth breaks down to whether the impact of these factors is confined to a specific project region or the whole country. Project characteristics and client requirements such as size and quality could influence both the amount and the unit prices of the input resources needed to undertake a project and could increase the direct cost portion of the estimated construction costs. However, the issues related to the direct costs are mainly dealt with locally. Import of materials and labor mobility may resolve shortages of resources.

The impact of project-specific factors on regional construction cost differences could mainly be linked to the indirect cost portion of the construction costs, where client-contractor-related factors such as contractor/client type and the extent of the relationship between contracting parties seem to influence these costs. Besides, not all client-contractor-related factors are helpful to explain regional cost increase differences. Contractor and client type as well as
procurement method do not differ greatly between metropolitan and small regions. The client-contractor relationship is the only factor in this layer that presumably influences construction costs through indirect cost components, where a long-run and strong past relationship between the parties could reduce transaction costs and the incentive to price according to current demand.

Client-contractor-related factors are very susceptible to the level of competition and the intensity of construction activity. The level of competition and construction activity influences the cost of inputs and could also have an enormous impact on indirect costs. Competition and market conditions affect both the direct and indirect costs, but their impact on the latter is more exacerbated when client-contractor-related factors are taken into consideration. Macroeconomic and political factors such as inflation and interest rate fluctuations, as well as labor laws, general labor conflict and building regulations can impose heavy costs and delays in a building project. Most of the factors in this layer are uncontrolled but clients and contractors can predict them.

Two groups of factors are considered in our analysis of construction cost differences. Client-contractor-related factors as well as competition and market conditions seem to contribute to explaining the observed increased cost disparities and will be the focus of the next paper. The other two layers—project-specific factors and macroeconomic and political factors—are, respectively, mainly confined to a specific project or in most cases not confined to any specific region. Thus, their contribution to the analysis of regional construction cost differences is deemed to be negligible.

**Paper 2: Long-run relationships, Vertical Integration and International competition:**
*Can they contribute to explaining regional construction cost differences?*

The second paper covers the empirical part of the research. It contains the responses from the developers (interviews and posted questionnaires), and the analysis of the following three hypotheses that were postulated in order to examine the observed construction cost increases.

1. A long-run relationship between contractor and client tends to a lower cost increase during the boom.
b) If the contractor in the rental housing market is also active as a developer in the same market, the construction costs tend to be higher.

c) If it is easier for foreign suppliers to enter the market, then cost increase will be lower.

The cyclical pattern of housing construction activities could induce one of the contractual parties—developer or contractor—to enhance their economic position at the expense of the other when there is no long-term relationship between them. Thus a short-term relationship may inhibit collaboration between the contractual partners and induce higher transaction costs that would ultimately inflate housing construction costs. The first hypothesis postulates that the existence of a long-run relationship between the actors in the housing building sector is a key factor in the fluctuation of construction costs. A long-term relationship curtails the opportunistic behavior associated with changing economic conditions of the housing construction sector. The presumption here is that contractors do not unreasonably increase the construction cost for short-term gain and sacrifice the fostered relationship with the client that could lead to repeated work in the future. The client will eventually have the upper hand in a recession or in economic downturns, and the contractor will then be in a position to have to accept lower construction costs or compete with other contractors and face uncertainty.

Apart from the benefits of competition, it is reasonable to contemplate that the concentration of a few vertically integrated firms (contractor-developer type) in metropolitan regions is one of the sources of the increased construction costs observed in these regions. Vertically integrated firms must take into account the price effects that the new projects could have on the existing properties developed by this firm or projects undertaken by the same vertically integrated firm. In Sweden, a few large companies dominate the construction of rental apartments and condominiums. Some of these companies are not only contractors but also active to a large degree with project development for their own accounts (Swedish Industry, 2004).

The two above characteristics of Swedish residential construction—few companies (oligopoly) and governance structure (vertical integration)—might have some effects on the construction cost of rental apartments and condominiums. In other words, those few companies might have a market power to control the construction costs of residential building projects contracted by property companies and/or municipalities. The focal point of the
second hypothesis is to examine if there is a connection between the higher construction cost observed in these regions and the share of the vertically integrated construction (contractor/developer) firms operating in these regions.

The final hypothesis is intended to check the impact that foreign firms could have on construction costs. The higher the presence of foreign suppliers in a region the higher the competition and the lower the construction costs increases will be. The shares of foreign firms active in Swedish housing construction such as contractors, major subcontractors or suppliers, and the regions that they are active in are the focus of this hypothesis. Though foreign competition and globalization of the construction industry can lead to borderless activity, geographical location of a region or cities, and convenience of main transportation lines, are still important. For instance, the impact of foreign competition could be different in terms of labor and construction materials to a city bordering another country, for example Malmö as compared to a city that is located further inland.

In order to test these hypotheses, data were collected from a number of rental housing projects from six cities in different regions. In non-metropolitan region, the long-term relationship between a developer and contractor is a crucial strategy and incentive mechanism when securing repeated work for contractors and lower construction cost increases for the developers. The short-term relationship, and normal and adversarial relationship, was more prevalent in the metropolitan region. The working relationship is also affected by the level of construction activity and project characteristics (size, complexity, etc.). Many rental housing developers of rental housing did not recognize the effects of vertically integrated contractors on construction costs, and hence the relevance of concentration levels of vertically integrated firms in any region became inconsequential. The involvement of foreign contractors was not reported in any project considered in the study, and the usage of imported materials was almost non-existent.

**Paper 3: Organizational modes in the residential building sector in Sweden**

Paper 3 describes various organization structure models and their implications on construction costs, as well as the interdependence that exists among construction actors. A holistic approach for analyzing the housing industry in relation to different possible organizational patterns may enable us to understand bearers of risk and incentives, responsibility and control
mechanisms, consequently shedding light on construction cost determinants. Several criteria are utilized in a theoretical evaluation of the efficiency of the organization patterns in the building sector. The analysis examines how risk is allocated among the actors, and how various supplier structures influence competition in the market, the degree of flexibility to respond to macroeconomic changes, and the needed competence level of actors.

The use of existing theories such as transaction cost theory and resource-based view allowed us to conceptualize various organizations in the construction sector. In response to market and economic changes, as well as competitive pressure and necessary competence to compete efficiently, major actors in the construction sector may undergo processes of integration and separation. Owner, developer and contractor integration might increase the competence and competitiveness of the integrated organization, but it may also limit the flexibility of the amalgamated organization to adapt to economic changes. On the other hand, a separate developer, contractor and specialist contractor may allow these actors to adapt competitively to the economic environment, leading to a better risk allocation. However, the required competence of each actor may increase in order to engage contracting processes efficiently and autonomously. Thus, the need for flexibility in adjusting unstable economic and market conditions may lead to less integration of construction actors.

Two organizational structure patterns that represent the two extremes of possible models and three transitional models are proposed. The first organization form, which is called the base model, contains an integrated owner, developer and contractor with no outside contracting. This organization model is exposed to both market risk (development and construction businesses) and the risk emanating from not subcontracting and the subsequent higher fixed costs that could be transformed into variable costs by changing the organizational pattern. The base model is mirrored by another organization model that contains similar actors but is totally separated and where subcontracting is central. The other three models emerge when the major actors in the building sector integrate or separate, and subcontracting and the services of specialty contractors and consultants are considered.

Based on the analysis of the results from the survey and the follow-up interviews, we can conclude that frequent developers tend to contract directly with specialty contractors and get the opportunity to work repeatedly and build long-term relationships. In the absence of a strong relationship with contractors or subcontractors, infrequent developers that are not
integrated may rely on the services of consultants and utilize the expertise and resources of the consultants that could otherwise be costly for this type of developer to acquire. In either case, the prevailing organization structure depends on, among other factors, the economic environment, the competence demanded by the preferred organizational mode, and the degree of flexibility in terms of business and construction activity associated with different organizational modes.

**Paper 4: The effect of subsidy on housing construction in various regions of Sweden**

Though this empirical paper does not say as much about the issue of organizational structures as the other three papers, it highlights how other factors such as a subsidized interest rate contributed to overbuilding of multi-family apartments in metropolitan regions. That could partially explain construction cost differences among different regions in Sweden. We hypothesize that housing stock is a function of many variables, including construction and production costs, as well as the subsidy interest rate that indirectly affects both costs. If we are able to empirically validate that subsidy interest rates have an impact on the housing stocks of different regions and preferences of various tenures of properties, then we can deduce that the observed disparity of construction cost growth among various regions of Sweden can be partially explained by the construction cost differences due to the subsidy interest rates.

A balanced quarterly panel data that covers six regions of Sweden was analyzed. The data shows that more multi-family units were produced in the three metropolitan regions (Stockholm, Gothenburg and Malmo) than in small regions; however, significant differences in the production of single-family houses existed. Furthermore, significant production costs differences were observed only between multifamily houses among different regions.

**Part 2: Quality improvement methods for infrastructure transport projects**

As our research methodology in Figure 1 describes, the approach we take in carrying out this part of the thesis “Quality improvement methods for infrastructure transport projects” is partly identical to the first part of the thesis except for the use of a realistic research approach in defining and delineating quality attribute. Two important considerations that this part of the thesis benefited from is a pilot survey and the use of a steering or reference group with well-informed persons from the sector. Fellow and Liu (2008) recommend that all questionnaires
should be piloted initially and discussed with a supervisor and other researchers in order to ensure that they are free from mistakes, easy to answer and unambiguous. Fellow and Liu (2008) also pointed out the increasing popularity to form a steering group of researchers, industrialists and practitioners in applied research. The objective is to ensure the combination of rigorous research with practical relevance (Fellow and Liu, 2008).

**Paper 5: Quality in infrastructure projects: concepts and framework for explanatory and exploratory studies**

The precise definition of the word *quality*, as many similar words such as *reality* and *truth*, are elusive. The first paper of this part of the thesis was intended to review various definitions and concepts of quality. After a thorough literature review of quality, we were able to establish a conceptual definition that is easily related to construction projects in a more general sense. Quality was classified as relative and absolute, where relative quality is based on the expectation of the client and the contract terms, while absolute quality refers to standards and specifications that all interested parties could agree to be the best and highest quality. Furthermore, we considered other dimensions of quality that could influence how we classify quality. This other dimension, the extent that an attribute of quality is measurable (easy or difficult), allows us to put forward two hypotheses that are designed to provide possible explanations of different scenarios. We have envisioned that quality is either low in absolute terms but not necessarily in relative terms, or it is low in relative terms but not necessarily low in absolute terms if the ambitions of the project were very high (see Table 1). The hypothesis also outlines that low relative quality more often occurs when measurability is low.

<table>
<thead>
<tr>
<th>Quality level</th>
<th>Absolute</th>
<th>Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Scenario 1: Low</em></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><em>Scenario 2: Low</em></td>
<td>Yes/No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

In the first scenario, the client has been provided what they have contacted for, but the absolute quality is rather low, as this is what they could afford to pay. This scenario was not given further discussion since both quality attributes (easily or difficult measurable attributes)
do not influence this perceived lack of quality. However, the client’s goals caused the low quality. If there is dissatisfaction it is only because the client was unaware of what was contracted.

In the second scenario, quality is judged to be low in relative terms but not necessarily in absolute terms (and perhaps especially quality attributes that are more difficult to measure). In order to explore factors that could explain why construction project experience low relative quality (our second scenario), we have utilized a Fishbone or Ishikawa diagram. This diagram allows us to systematically put together various factors that could influence how construction projects are managed, and explain how these factors could affect the outcome of each phase of construction projects.

Figure 2: Fishbone or Ishikawa diagram on factors leading to Low Relative Quality.

An online survey questionnaire was administered based on factors developed from the Fishbone diagram analysis. The survey was also intended to find the extent of quality of current infrastructure transport projects compared to before the transfer of the quality assurance system. The results of the survey suggest that quality has not declined after the transfer but a good number of respondents indicated that it is the same level as before. The
absence of a quality level increase can either be positively associated with consistency of keeping up with technical and environmental changes or lack of quality improvement. The second aspect, lack of continuous quality improvement, is the focus of this paper since this concern was the basis for carrying out this research. Other variables or factors that could contribute to explaining this quality improvement stagnation were mentioned in the survey, and further investigation was carried out in subsequent papers.

**Paper 6: Decision-making theories in relation to quality of infrastructure transport projects**

The success of a decision does not only depend on whether that decision was the efficient one, but whether it was effectively implemented by the subordinates who were entrusted to carry it out. A decision to transfer quality assurance of construction of infrastructure transport projects from the client to contractors, in this case the Swedish Transportation Administration Trafikverket (formerly known as Vägverket and Banverket), was taken approximately 25 years ago.

As the result of the survey in the first paper suggests, the outcome of that decision is somewhat mixed and there are signs of lack of quality improvement. There could be many reasons behind this quality assurance transfer, but it is beyond the focus of this research. One can assume, however, that this decision was not intended to compromise the quality of construction projects. However, unintended consequences can arise if there is a trade-off between cost and quality during the planning and design phase. There could be another kind of trade-off between the schedule to complete a project and the desire to achieve a certain quality level during the construction phase. Anderson (1992) claims that the quality of the project manager is one of the many factors that affect the quality of a project. Project managers decide whether certain product quality attributes meet the highest required threshold or if a lower quality level is accepted.

In this short paper, decision-making theories were reviewed in order to find out whether, at the project level, quality-related decisions during construction and inspection stages have produced unintended consequence. The answer to either question is not straightforward. However, a general discussion of decision theories in relation to quality of construction projects and the response from certain questions of the survey are adequate to explore the impact of these decisions on quality improvement aspirations.
Respondents from the survey indicated that the quality problem of the completed structure depends largely on how well the project actors have done their job, the competence of the client, and the quality of the tender/bid documents. They also suggest that project managers can accept project quality levels that are lower than those specified by the contract but still fall within the acceptable limits. From a theoretical perspective, conflict avoidance was seen as one of the reasons that this kind of decision is taken. Conflicts could make future relations worse and thereby create more problems. Lack of communication between major actors and less involvement of personnel and management on-site were also reported.

We can denote from these responses that decisions made by management at each level of the organization in relation to the provision of project might have inadvertently affected the quality level of projects. It is also possible that quality improvement goals were compromised when the client’s representative accepted sub-optimal quality level in order to avoid conflicts.

**Paper 7: Framework for quality improvement of infrastructure projects**

Numerous authors have tried to determine the causes of decreasing quality of construction projects. The Fishbone diagram in Paper 5 describes some of these factors that could lead to low quality. Inappropriate mechanisms of project delivery such as poor consultant and contractor selection, bad design and inadequate project supervision are some of these factors that could negatively affect the quality of construction projects. One common denominator that has some bearing on the majority of these factors is the level of client competence and their involvement in the process. It is the client who is in charge of identifying their own needs, selecting qualified consultants and contractors, choosing appropriate procurement methods, and delegating quality-related activities such as quality assurance. We are not saying that other actors in the sector have no role in quality level determination, but public clients such as initiators and owners of the public projects have the main responsibility of delivering high performance projects.

While the same number of respondents from the survey suggested that the quality level of construction projects are either the same level as before the transfer or better than before, respondents have overwhelmingly indicated (81%) that lack of public client competence was one of the contributing factors of quality problems. This lack of client competence raises several questions:
What are the main causes or contributors of this reported lack of client competence?

Did the quality assurance transfer contribute to the client competency deficiencies?

Does this lack of client competency influence the choice of appropriate procurement method?

Against this backdrop, the paper was intended to look at the extent to which different procurement methods can contribute to the desired quality of infrastructure projects. An important question is how these procurement methods respond to the perceived lack of client competence, since each one of them not only demands a certain level of client involvement but also specific skills and knowledge. In Sweden, the majority of public construction projects are procured with traditional Design-Bid-Build (DBB), although other procurement methods such as public-private partnerships and those that are performance-based have been recently promoted. These other procurement methods have thus far not gained any prominence in public sector procurements in Sweden.

Shortage of skilled and experienced workers in the sector could partially explain this reported lack of client competence and might have contributed also to the perceived quality stagnation. Heavy reliance on DBB coupled with the shortage of skilled workers might have further exposed the client’s lack of competence since DBB requires a high level of client involvement. We have not empirically substantiated the reasons behind the heavy reliance on DBB in public construction projects, but several theoretical explanations were found in the literature. Familiarity of DBB and its ability to satisfy public accountability, as well as higher client control of the project’s outcome in terms of cost and design, are some of the explanations mentioned in the literature.

The use of warranties might have lessened some of the concerns of quality problems since it can give the public client more assurances that completed projects will meet the desired quality level even if the public client is facing a shortage of skilled workers. In the United States, state agencies have used warranties when they faced staff and budget shortages. Warranties can, however, be problematic when attributes are difficult to measure.

In this paper, we have extensively explained how important client competency is in determining quality attributes and hence the most appropriate procurement methods.
Furthermore, we have clearly stated that whatever procurement method must be employed requires strong client competence, skills and expertise in order to effectively deal with private sector counterparts.

**Paper 8: Procurement type and quality in infrastructure projects**

This short conceptual paper discusses the same issue that has been treated in the preceding paper but from a particular aspect. The discussion in Paper 6 was centered on people from the organization and how their decisions affect the quality of the project. In Paper 7, we started discussing the process (procurement methods) and product (quality of the project), as well as certain aspects of people (competency and client workforce). In this paper, the focus is mainly on the quality of the product.

The central arguments in this paper relate to the following questions:

1. Is it possible to increase the quality level of a project by using a specific procurement method?

2. Is there a specific procurement method that consistently results in lower quality?

If either of these two questions has positive answers then we would have solved certain problems related to the quality of construction projects by choosing or avoiding the use of that specific procurement method. The hypothesis argued for in the paper is, however, that the answer to both questions is no.

General contract theory and transaction cost theory were used as a framework for our discussion. After a schematic description of major procurement methods, two central questions were identified: how quality could be affected by who is responsible for the design and how quality is affected by bundling of construction and operation/maintenance activities. In the first issue, coordination gains by letting the contractor do the detailed design stands against the incentive problems when there are attributes that are difficult to observe. In the second issue, the stronger incentive for life-cycle cost when construction and maintenance are bundled stand against a problem specifying functional characteristics in long-term contracts. The possibility and incentives for the contractor to build up knowledge of the relation between construction characteristics and life-cycle cost is also a problematic feature for the bundled alternative.
Regardless of who is responsible for the design of construction projects, a competent client can mitigate potential quality problems that can arise during design or construction phases. Furthermore, client competency gives more flexibility and knowledge capacity to choose whatever procurement method is deemed appropriate for any particular project.

In conclusion, there is no quick fix when it comes to improving quality in infrastructure projects, and there is no procurement method that can guarantee a better quality than others. However, client competence and a proper incentive system cannot only increase the prospect to build projects with a high quality level, but also reduces a client’s heavy dependence on other actors in the sector for the provision of these projects.

In order to build the required competence and skills, as well as expertise and experience, public client organizations such as Swedish Transportation Authority must have a sustainable knowledge management system. This issue will be the focus of the next paper.

**Paper 9: What can the client do to improve the quality of infrastructure transport projects?**

Public sector clients play different roles in the provision of transport infrastructure projects. They are responsible for identifying the needs of end-users, determining performance objectives of projects and ensuring that the most appropriate procurement method that minimizes risks and optimizes outcomes is chosen. Public sector clients could also have a major influence on the actions and behaviors of other actors in the sector, ultimately improving the overall performance and productivity of the construction sector. It is expected that only a public sector client with a skilled and experience workforce supplemented by appropriate knowledge management can fulfill these responsibilities.

In this paper, we argue that a perceived lack of client competency in the public construction sector in Sweden could have its roots in inadequate knowledge management within the client organization, especially when the public sector is experiencing a shortage of skilled and experienced workers. The importance of the incentive structure and the “company culture” within an organization is also underlined. This then must shape the internal processes of the client organization such as design type, procurement method and construction procedures.

Thus, a more structured and proper knowledge management will not only minimize the loss of tacit knowledge and enhance the public sector’s internal process capacity, but it will reduce
reliance on specific procurement methods without economic and technical justifications. Furthermore, certain strategies such as incentive schemes, post-review reporting for accountability and transparency purposes could improve the public sector’s knowledge assets. A second opinion from independent experts and committees that focuses on quality and ensures that a proper procurement method is chosen can be introduced in the provision of infrastructure transport projects.

5. Research contribution

The harmonization of cost concepts, categories and the clarification of important terms can be seen as a step forward that will smooth the progress of identifying the factors affecting the construction costs that could ultimately explain the cost escalation and differences among the Swedish regions.

The contribution of this part of the research is also to offer an understanding of the behavior of contractors in specific economic situations by taking into consideration the long-run relationship. It ascertains that if contractors/subcontractors display opportunistic behavior during the economic boom, the result will be an increased higher construction cost. The analysis can also enrich the current understanding of the governance structure of Swedish construction firms and how they could influence construction costs. We attempt to utilize transaction cost theory when exploring construction sector structures, which should be seen as a first step in trying to understand changes in the sector from an efficiency perspective. The contributions are unique in the sense that neither the behavioral relationship between client and contractor nor structural analysis of firms has been fully investigated. The third hypothesis of the second paper invigorates what many academics and professionals already pointed out, which is the need for increased competition and more foreign supplier participation in the sector in order to ease the increase in construction costs.

As the response from the survey suggests, quality of infrastructure projects has not decreased after the transfer of quality assurance from client to contractor. However, the high number of respondents that indicated quality is the same as before the transfer raises a concern of lack of quality improvement. Smyth (2010) contends that in order to achieve continuous
improvement that implies consistency, knowledge must be transferred across projects and embedded as a capability or competence. The shortage of skilled and experienced workers in the public client organization might have undermined knowledge transfer opportunities and thus contributed to the perceived lack of quality improvement in public construction projects.

A project manager’s decisions with regard to quality specifications and standards during the construction phase of projects can also influence continuous improvement goals if project managers frequently resort to an acceptable quality level that is not optimal in order to avoid or minimize conflicts with contractors or the displeasure of senior managers.

The desire to increase the use of other procurement methods such as PPP seems to be wishful thinking at the moment, when it is interpreted as reducing the need to have a public client with a highly skilled and competent workforce that can not only deal with the technical aspects of construction projects but are also trained to manage the nuts and bolts of long-term contracts from legal and financial aspects.

Longer warranty periods and the use of performance-based contracts could improve the current procurement system and produce the desired quality level if client competence is built-up through proper knowledge management and incentive systems. This includes training and retention of new skilled and experienced workers that are essential elements for continuous quality improvement goals and objectives.

In summary, competence, whether it is a developer’s competence in housing production or client competence in the provision of public infrastructure transport, seems to play a significant role in determining what kind of housing supplier structure developers adopt in different economic situations and the level of involvement that clients can bestow on the production of infrastructure projects. Public clients that are less competent, skilled and experienced will most likely rely on what procurement methods the market offers, the same way a less competent developer or infrequent developer with a shortage of skilled and experienced workforce will be best served by consultants or other forms of housing supplier structures. Competence cannot, however, be discussed separately from the incentive structure and organizational culture, as these determine whether competence will be developed and used.
References:


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1 This version of the paper is published as a part of the book “*Performance improvement in construction management*”, edited by Atkin and Borgbrant, Spon Press, 2010, pp. 115-127.

