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EXPLORING FACTORS OF SUCCESFUL TENDERING PRACTICES USING QUALITATIVE COMPARATIVE ANALYSIS (QCA) – THE STUDY OF ORGANIZATIONAL REPETITIONS

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ABSTRACT

The purpose of this paper is to introduce and evaluate Qualitative Comparative Analysis (QCA) as a method for exploring the complexity of practices of project organizing and management combining the benefits of top-down and bottom-up research strategies. The QCA method is used in order to describe combinations of factors leading to particular results of tendering practices. Empirical material collected through data mining in previously completed project records (quantitative data) is supported by data obtained from project managers of a general contractor company (qualitative data) in order to holistically describe the combination of conditions resulting in particular tender results. As a result of the analysis, a solution set is found explaining the path leading to project contract winning; previous work experience between client and general contractor together with either previous work experience between architect and general contractor for design-bid-build projects or senior project responsible involvement from the contractors side in design-build projects. The analysis illustrates how QCA is a powerful strategy for exploring the complexity of project practices being able to bridge the divide between top-down and bottom-up research strategies.

KEYWORDS: Organizational repetition, project organizing, QCA, successful bid, tender practices.

INTRODUCTION

It is widely acknowledged e.g. Cicmil & Hodgson (2006) and Blomquist *et al* (2010) that the structural approach traditional has dominated research in project management. This is characterised by being structured, mechanistic, top-down, system-model-based approaches to project management that rely on systems design, tools, methods, and procedures (Blomquist *et al.*, 2010, pp.6) and usually studies using quantitative methods for collection of data and hypothesis testing.

In contrast to the structural perspective, a growing amount of research has been focusing on understanding project organizing and management as situated and contextual practices. This was initially driven by a Scandinavian school of research into project management and temporary organizing (Morris, 2013) but has recently sparked a development of a pure bottom-up research perspective focusing on what individual actors actually ”do” when they work on projects - viewing project as practice (Blomquist *et al* 2010).

The different perspectives make the study of practices of project organizing and management a matter of choosing the proper method using either (1) large amount of quantitative data and well defined hypothesis testing (top-down) or (2) qualitative data and more explorative research questions.

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The purpose of this paper is to introduce and evaluate Qualitative Comparative Analysis (QCA) as a method for exploring the complexity of practices of project organizing combining the benefits of top-down and bottom-up research strategies. This is done by a study of the tendering practices form a major Danish contractor.

QCA methodology allows researchers to draw different combinations of conditions leading to create a particular outcome. Thereby it lies between quantitative and qualitative research approaches for testing hypothesis combining statistical analysis and case studies (Jordan et al., 2011).

The research question therefore is; what are the combinations of factors leading to successful tender results for a bidder (general contractor) in construction projects?

The premises for using QCA are a careful selection of relevant cases and an in-depth understanding of the research in terms of identifying interesting outcomes and relevant independent variables. Thus are QCA always based on a rigorous mapping of the current state of the art combining literature reviews and empirical investigations (Ragin, 1987; Rihoux and De Meur, 2009). Hence, the paper opens with a literature review of tendering practices followed by a detailed introduction to applied methodology QCA. Subsequent the analysis of the selected cases is presented and the results are discussed. Finally, a solution set together with implications of the findings has been presented in the conclusion section.

LITERATURE REVIEW: TENDERING PRACTICES

There exists a large body of literature covering contractor prequalification and decision-making in the project tender phase from the client perspective (e.g., Hatush, and Skitmore, 1997; Russell, 1992; Diekmann, 1981 and Nieto-Morote & Ruz-Vila, 2012); however, there is a gap in the literature when it comes to investigating the factors leading to contract win or lose from the contractor's side. This paper addresses this gap by studying the complexity of tendering practices from the bidder perspective.

It is a well-celebrated fact among academics and practitioners that decisions made in the beginning of a project have the most significant consequences for the success or failure of the project. Becker (2004) addresses the circumstance that uncertainty in decision-making is problematic, because the likelihood of each outcome from a set of possible specific outcomes is initially unknown, as it is the case in the early project phases (see Figure 1). In handling the uncertainty it is important to understand the tender phase and contractor prequalification. As seen in Figure 1 presented by Winch *et al.* (1998) uncertainty is dominating the early stages of projects and certainty gradually increases by time and as completion approaches. Therefore, the tendering phase can be regarded as a critical stage in the realization of projects.

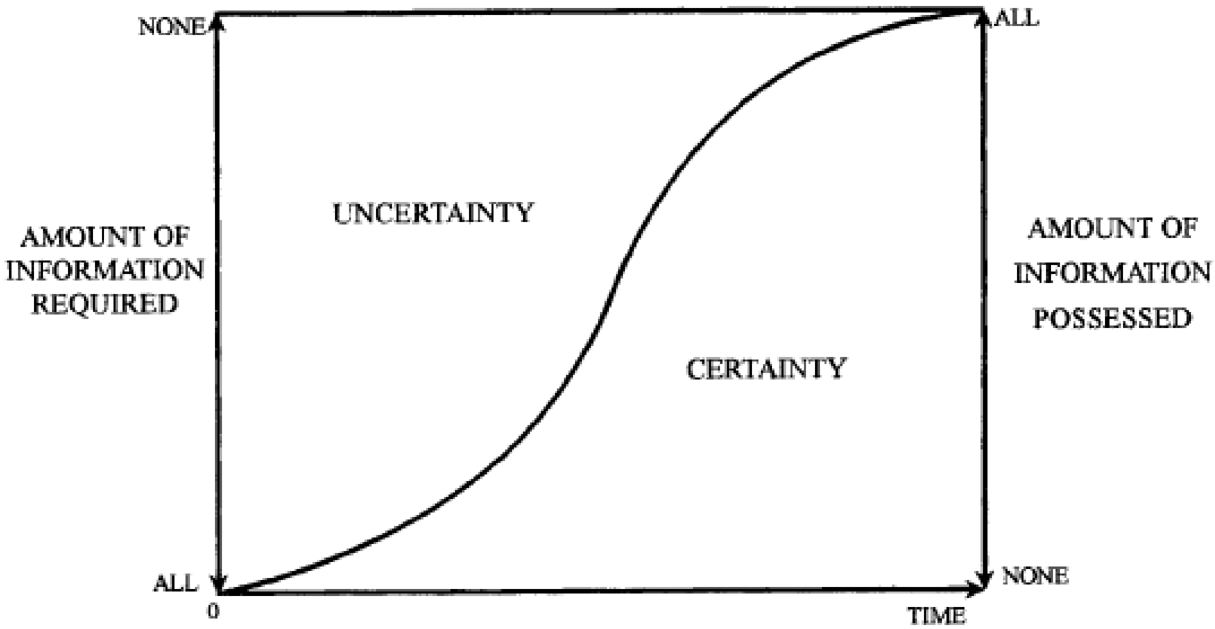

Figure 1 The project process (Winch *et al*., 1998)

Moreover, project parties, including owners, architects, and contractors, all with their separate backgrounds and separate agendas, have to come together in order to carry out their normal project practices. This is performed through traditional contractual arrangements (Cornick and Mather 1999). Thus, there are obvious uncertainties in the early project phases, especially during tender phases, since different organizations and different organizational entities come together to share and create information for the first time.

Tenders are complex and they involve many engineers and managers who have to work as a team, share information and deal with the interface problems that arise between the various responsible subsystem-engineers (Bernold and AbouRizk, 2010). The decision on who should be awarded the contract is made according to the prequalification criteria, the contractor's attributes and the prequalifier's judgment. Despite the effort made by researchers, contractor prequalification remains largely an art where subjective judgment, based on the individual's experience, becomes an essential part of the practice (Nguyen, 1985).

Subjectivity is the most difficult attribute encountered by researchers and practitioners due to a diversity of prequalification criteria (see Table 1) and the variability of the same contractor's ratings, which is differently assessed by different prequalifiers according to their own perceptions. One tool that has been developed in order to track and control the uncertainties better is the so-called multi-attribute utility functions. These are used in an attempt to list the criteria for the decision-maker's preference (Diekmann, 1981; Hatush and Skitmore, 1998). Following this more and more advanced tools for contractor selection have been developed (e.g. Cheng & Li 2004). However, they all reflect the decision-maker's perspective.

Main Criteria and Sub-criteria for Contractor Prequalification

Criteria	Sub-criteria
Technical capacity	1. Qualification of staff 2. Experience of staff 3. Innovate method 4. Labor and equipment
Experience	1. Type of past project completed 2. Size of past project completed 3. Number of projects completed 4. Experience in local area
Management ability	1. Organisational culture 2. Management knowledge 3. Quality policy
Past Performance	1. Quality level of projects performance 2. Projects completed on time 3. Projects completed on budget
Financial stability	1. Financial soundness 2. Credit ranting 3. Liquidity
Occupational health and safety	1. Management safety accountability 2. Safety performance

Table 1 Decisive conditions in the contractor selection (Nieto-Morote and Ruz-Vila, 2012)

Taking the uncertainty in the projects or, more precisely, in the tender phases into consideration, the necessity of investigating factors affecting the bidding success becomes evident.

Stability provides safety to achieve the targeted results and increase predictability (Langlois, 1992; Tyre and Orlikowski, 1996). In the construction projects each party has its own mundane practices and agendas, which are not necessarily known to the others. In the process of construction the different parties develop certain working habits and practices that create a bound between one another (Marshall, 2014). Moreover, as mentioned by Nelson (1994), whenever there is a change in the participants, understandings or contracts, a mode of executing a particular task needs to be identified and adjusted. This always has an additional cost aspect.

In situations of uncertainty, routines and already known solutions have an important effect on the way decision makers, in this case qualifiers, make their choices (Gersick and Hackman, 1990; Langlois and Everett, 1994; Becker, 2004). In a recent case study on hospital construction projects in Norway and USA, the importance of informal mechanisms to stimulate collaboration between project parties in decision-making processes was emphasized .(Bygballe et al., 2015). This suggests that previous contact and collaboration between the general contractor, client, architect and consultant are important factors affecting the result of the tender practice.

Summarizing previously done research, it is relevant to explore the effect of repetitions and previous experiences in tendering practices in project organizing. The question is *What are the combinations of factors leading to successful tender results for the bidder?* Factors can be observed across projects that affect contract gains or losses. These factors, such as previous work experience between the parties client, architect, contractor and general contractor as well as a variety of project attributes and finally the contractor tender responsible's experience, will next be investigated holistically by means of Qualitative Comparative Analysis (QCA) method.

RESEARCH DESIGN AND METHOD

In order to explore the tendering practices this study applies Qualitative Comparative Analysis (QCA). QCA is a relatively new approach, first propounded by sociologist Charles Ragin in 1987, but its principles have since been applied extensively, primarily in the fields of sociology (Rihoux, 2006) and political science (Ragin, 1987) but also in management, economics and engineering (e.g. Jordan *et al.*, 2011) in the study of complex phenomena. Recently it has been introduced in the study of various construction practices like Public Private Partnerships (Gross 2010) and Building Information Modelling (Homayouni et al., 2011).

QCA allows researchers to draw combinations of different factors of practices (conditions) leading to a dependent outcome. As illustrated in Figure 2 the research process is highly iterative involving top-down and bottom-up strategies. Countless of iterations are used to investigate all sorts of different combinations of factors in order to draw meaningful solution sets explaining pathways leading to particular results. During this iterative process literature is revisited (top-down) and additional empirical material is gathered in order to solve occurring contradictions (bottom-up).

Thereby QCA lies in-between quantitative and qualitative research approaches for testing hypotheses, combining statistical analysis and case studies. The method, though, is closer to qualitative methods due to its sensitivity to individual cases (Rihoux and Ragin, 2009). This is also mirrored in the highly iterative processes, which to some degree is similar to the iterative interpretations within qualitative studies.

However, QCA has certain advantages and limitations that one should be aware of. These are identified by Jordan et al. (2011) in the following table 2.

Advantages	Limitations
• Ability to work with smaller set of data compared to quantitative approaches • Ability to work with large number of cases compared to qualitative approaches • Easy to understand for the reader • Transparent • Replicable	• Dichotomization of data: Transformation of data into a binary notation • Difficulty in selecting conditions (independent variables) and cases • Lack of temporal dimension

Table 2 QCA Advantages and limitations (Jordan et al., 2011)

In the following analysis section, the process given in Figure 2 will be exemplified step-by-step in a detailed way for the reader to follow the QCA research method and for future researchers to duplicate the study with different cases with different data sets.

To make best use of the data set available to describe a solution set with factors leading to particular project tendering outcomes, a crisp set Qualitative Comparative Analysis (QCA) method was chosen for this study. Contrary to the fuzzy sets that make use of partial memberships such as 0.5, the crisp set is based on full membership and full non-membership, in other words absences as 0 and presences as 1 binary notation (Thomas, et al., 2014).

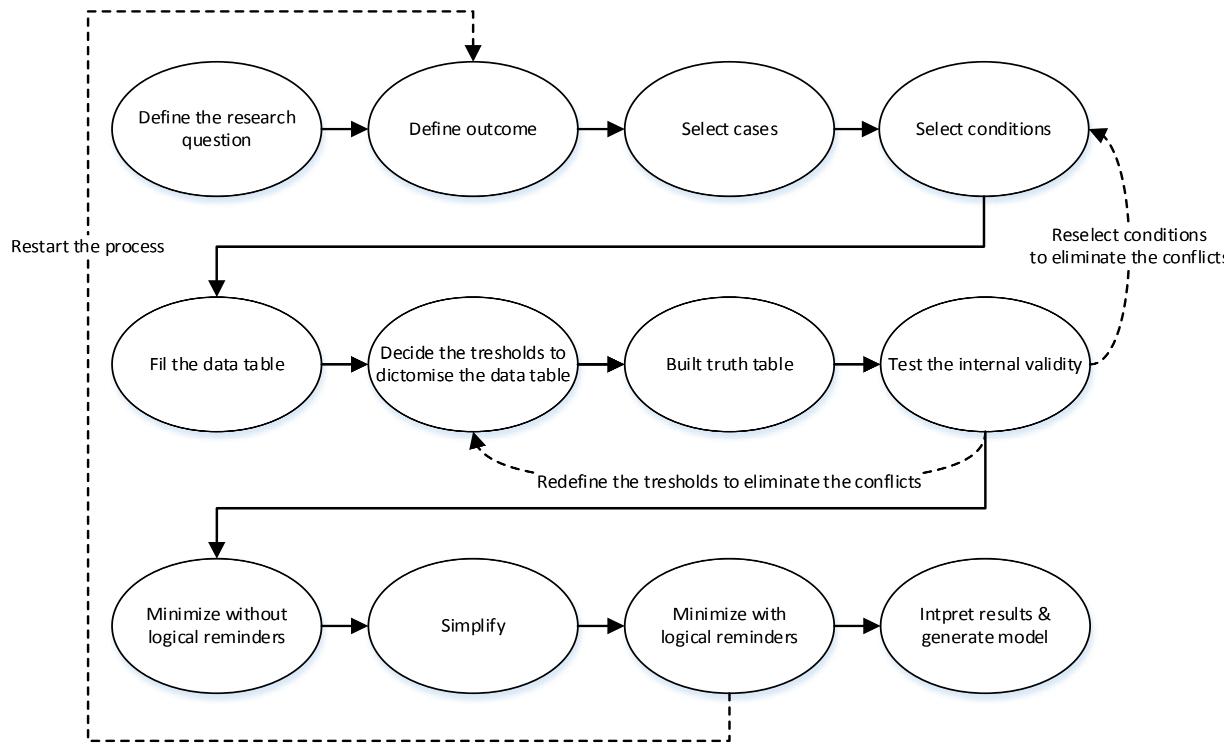

Figure 2 QCA Research Process

However, as there has previously been difficulties in understanding some papers using the QCA method, the research process illustrated in Figure 2 is explained in detail, and frequencies and descriptive results are presented in the appendix. In doing so it is intended for the reader to follow the preliminary results and changes in the data set, as before and after, on the way to the final solution.

The results presented in this paper derive from a combination of quantitative and qualitative data. On one hand a quantitative set of data was obtained through a data mining work conducted in the database of a general contractor company based in Denmark. The company's project data base consists of all completed, ongoing projects and projects that was given an unsuccessfull bid. The data base contains information on project type, project size, location, contract type, parties involved such as clients, architects, consultants etc., contract price, project responsible, tender responsible and many other factors. For the sake of comparibility only the building projects within the last 5 year's time frame were chosen. This amount of data was then combined with a collection of qualitative data: six of the cases from the data base were elaborated through in-depth semi-structured interviews with their given project responsibles. A similar number of other cases from the quantitative data set were cross checked and elaborated through brief phonecalls and conversations with project responsibles. All the project names together with names of the responsibles were fully anonymized. A description of the concrete case selection process will be presented in the next section.

ANALYSIS

The initial step of any QCA analysis (see Figure 2) is to select the outcome (dependent variable) to be investigated in order to answer the research question. For the purpose of this study, to investigate the combination of conditions (independent variables) leading to project tender results for a construction company, it was straight-forward to identify the outcome as whether the company won or lost the projects. This is simply represented in the dichotomous table as 1 for the project contract won and 0 for the project tender results lost.

The second step of QCA is to select cases (see Figure 2) in other words sampling. Case selection is critical in QCA just like in other statistical or qualitative methods. The selected cases should be diverse enough to ensure explanatory strength in the QCA minimization, while still having comparability (Jordan *et al.*, 2011).

First of all, in order to maintain the comparability aspect only building projects have been considered. Secondly, only projects from during the last five years were chosen, in order to be able to cross check or elaborate their data through interviews with the project responsibles, still employed in the company. Thirdly, a pareto analysis was conducted in order to eliminate the relatively less turnover generating projects. All the 178 projects’ tender price amounts were added together and as a result of the pareto analysis, the 22 building projects creating 80% of the total tender prices (in this case an approximate turnover of 1 Billion Euro combined) were selected. Finally, two cases were excluded from the analysis, because the projects were financed by the general contractor himself. The remaining 20 cases are all currently in the execution phase or warranty period, which made it possible to contact the project responsible in order to verify the data or ask more information in order to judge the case qualitatively.

For the lost cases, in order to keep the balance with win cases, the 22 biggest lost and dropped cases according to the total project prices were chosen within the last five years period. One of the cases was discarded from the analysis as it was later found out that the project has not been realized at all as a consequence of the landlord’s bankruptcy. As a result, 21 lost or dropped building project cases were selected with an approximate turnover of 1.5 Billion Euro all together.

41 Cases represent only a very small portion of the entire population if one considers the total number of cases about 10.000. However, the strength of QCA is based on its workability with relatively small amount of data sets compared to the other statistical tools (Jordan *et al.*, 2011). Moreover, by the use of QCA, it is intended to draw patterns resulting in particular outcomes rather than identifying correlations between independent variables and the dependent variables (Ragin, 1987). Recently, Boudet, et al. (2011) performed a QCA study with 26 infrastructure cases to define the factors leading to conflicts in in developing country infrastructure projects. This is a typical example of a QCA study working with a middle range data set.

The third step of the QCA is to select the conditions. For the causal conditions (independent variables) selection Yamasaki and Rihoux (2009) present a list of strategies to follow. These are;

1. The comprehensive approach, where the full array of possible factors from existing theory is considered in an iterative process.
2. The perspective approach, where a mixed set of conditions representing two or three theories from empirical literature are tested.
3. The significance approach, where the conditions are selected on the basis of statistical significance criteria.
4. The second look approach, where the researcher adds one or several conditions that are considered as important although dismissed in a previous analysis.
5. The conjuncture approach, where conditions are selected based on joint interactions among theories, which predict multiple causal combinations for a certain outcome.
6. The inductive approach, where conditions are mostly selected on the basis of case knowledge and not on existing theories.

For the purpose of this study, a mixture of the comprehensive and the inductive approach was applied: conditions were to some degree selected on the basis of existing theories, but mostly on the basis of case knowledge (Yamasaki and Rihoux, 2009). The literature study summarized in Table 1 was used as inspiration in the selection process. However, following the observation that the reviewed literature covering tender practices reflects decision makers' perspective only, the inductive approach favouring case knowledge and i.e. also the bidders' perspective, was preferred.

Going over the interviews with project responsibles, certain elements, such as 'previous work experience between the general contractor and other parties' and 'seniority of the project responsible' turned out to be decisive throughout the material. Moreover, 'organizational working history' as well as certain project attributes like 'project delivery system', 'contract form', and 'client type' were consistently referred by project responsible as conditions having decisive effect in the way the tendering processes are run. Therefore these factors were chosen for the final conditions selection.

Gccl	The previous collaboration between the general contractor and client
Gcarch	The previous collaboration between the general contractor and architect
Gccon	The previous collaboration between the general contractor and consultant
Cltyp	Client type as private or public: Public (1), Private (0)
Delsystem	Construction delivery system: design and build projects (1), others (0)
Saanc	Contractor's case responsible: >10 years (1); <10 years (0)
Taanc	Contractor's tender responsible: >10 years (1); <10 years (0)
Prwnls	Outcome as whether the company won or lost the projects: won (1), lost (0)

Table 3 Final conditions table used in the analysis

Table 3 represents only half of the initial conditions. In order to illustrate the calibration process of collected data the steps taken from the initial set of conditions to the final conditions table will be presented below.

As described by Berg-Schlosser and De Meur (2009), there exists no predefined proportion for the number of conditions and cases, thus the number of combinations and cases should be determined in most applications through a trial and error process. To exemplify, for an intermediate-N analysis containing 10 to 40 cases, from 4 to 6–7 conditions can be selected. (Berg-Schlosser and De Meur, 2009) Each condition is tested together with other conditions separately in 2, 3, 4 and 5 conditions sets to detect the less complex meaningful pathways, combination of conditions leading to an outcome.

The initial selection of conditions with their thresholds for this QCA study looked like the following:

- The previous collaboration between the general contractor and client within the 10 years: if there is take 1; if not take 0
- Client type as private or public: for public clients take 1; for private take 0
- Construction delivery system: for design-build projects take 1; for the others take 0
- Project type: for residential projects take 1; for the others take 0.
- Contractor's case responsible: for number of years in the company 10 and more than 10 take 1; for less take 0
- Contractor's tender responsible: for number of years in the company 10 and more than 10 take 1; for less take 0

After building the initial above mentioned table it was noticed that the number of years in the company was not a good indicator as only in 28 cases out of 82 the number of years spent in the company were equal to 10 or more than 10. This contradicts the common sense notion that tender and project responsibles are mostly gray haired, experienced professionals. The data was revisited to find out the actual number of years' experience in the field rather than the numbers years in the company. The corrected table for general contractor's tender professionals has now 47 persons with the same 10 years threshold.

The conditions mentioned below were not distinctive, and therefore were not used in the analysis. The first two derived from the literature presented in Table 1 and the third derived from case knowledge:

- Previous experience of a similar type of project: general contractor has wide range of experience in almost all different types of projects
- Technical capacity of the general contractor: similarly the general contractor has both human resources and equipment to realize the projects given a bid
- Project type as residential, office, hospital, hotel vs.

After making these corrections the truth table based on binary codes was formed. Certain contradictions were observed for cases having the same conditions, but giving different results. The truth table including contradictions is presented in the appendix section as the first truth table. This step is shown in Figure 02 as the "Internal validity test". In order to eliminate the contradictions the methods offered by Rihoux and De Meur (2009) are addressed:

1. Add conditions to the model. This should be done cautiously and in a theoretically justifiable way.
2. Remove one or more condition(s) from the model and replace it/them with another condition(s).
3. Re-examine how the conditions are operationalized and where the threshold values were placed.
4. Reconsider the outcome variable. If the outcome is too broad, it is possible that contradictions will occur.

5. Re-examine the cases in a more qualitative way to determine what differentiates the contradictory cases but has not been considered in the model.
6. Reconsider whether all cases are truly part of the same population.
7. Recode the outcome of all contradictory con figurations as [0]. This treats all contradictory configurations as 'unclear' and accepts fewer explanatory configurations in exchange for more consistency.
8. Use frequency criteria to 'orientate' the out- come. For instance, if a contradictory configuration leads to a [1] outcome in eight cases and a [0] outcome in one case, all of the configurations would be considered as having a [1] outcome. Even so, this probabilistic method is disputable from the case-oriented perspective.

From the above list, suggestions number 1, 2, 5 and 6 were used to eliminate the contradictions in the truth table. The process is an iterative trial and error process and here the steps that have a positive effect will be mentioned only.

First of all, two additional conditions were added to the analysis. They are relevant to the hypothesis claiming that organizational repetitions affect the project outcome. Similar to the previous collaboration between the general contractor and client, previous collaborations have been investigated between architect and consultants of the projects chosen as cases. In cases the architectural works and consultancy services are provided by partnerships and consortiums, the general contractor's case responsible were asked about the qualitative differentiation of the data to identify previous collaboration between parties. The conditions added to the analysis are;

- The previous collaboration between the general contractor and architect within the 10 years: if there is take 1; if not take 0
- The previous collaboration between the general contractor and consultant within the 10 years: if there is take 1; if not take 0

Moreover, as a result of the deeper qualitative investigation of the data two cases were distinguished from the rest of the sample population. One of the contradictory cases was designed as public-private-partnership project that does not follow the ordinary tender processes. The other contradictory case was part of a bigger project executed in phases and thus it could not account for an independent project.

Finally, after trial and error the condition concerning the project type was found redundant as it did not have an effect in building the truth table without contradictions. For the sake of simplicity, the condition 'Project type: for residential projects take 1; for the others take 0', was taken out of the analysis. The final dichotomized table is presented in the appendix in order to give the reader an overview of the data set. Moreover, the final software analysis can be found in the appendix section as well.

It is important to note that the project type was found redundant for this particular data set combination. Other projects of the same general contractor or another contractor might give different results.

In the next results and discussions section, only solutions with full consistency, based on the final contradiction free truth table will be presented.

RESULTS AND DISCUSSIONS

It is important to remark that the software does not recognize cases but rather the configurations specified in the truth table. Thus different from statistical methods, the number of cases in each configuration is not relevant in the course of the minimization process (Rihoux and De Meur, 2009). They are treated as a representative of a possible configuration in the logic space.

As a result of working with 7 conditions describing a solution space=128 solutions (2^n with n being number of conditions), the final function of this study was a complex one.

prwnls = f(gccl, gcarch, gccon, cltyp, delsystem, saanc, taanc)

The frequency cut-off is 1.0000 meaning that all cases were taken into consideration even though the sample size was relatively large, 39 cases, to conduct QCA analysis. The following solution space was found as a result of the standard analysis with a solution consistency of 1.000 since all contradictory cases were eliminated. The solution sets are presented in the appendix.

To simplify the complexity further, the two pathways represented below were used. Each of the solutions has 0.40 coverage with total 80% of coverage together making a satisfactory solution coverage according to the csQCA expectations that are above 0.750 (Jordan *et al.*, 2011).

The two pathways are:
gccl*gcarch*~delsystem
gccl*delsystem*saanc

To extract the solution sets, previous work experience between client and general contractor (gccl) was a necessary but not sufficient factor, as it existed in both solutions together with other factors. One can conclude that it is the most important factor as it is present in both solution sets. Moreover, in the first solution path, the previous work experience between architect and general contractor (gcarch) is decisive in the cases that another project delivery system is chosen different from the design-build system such as the traditional design-bid-build. In the projects where the design-build delivery system is applied, the seniority level of the general contractor's project responsible (saanc) plays a decisive role. As in the design-build delivery system, the design task is expected to be delivered or coordinated by the general contractor alongside the construction execution. Therefore, the experience of the project responsible plays a more important role.

The factors not presented in the solution are actually counter intuitive. The previous work experience between consultant and general contractor is expected to be an important factor as well; however, it is not present in the solution set. This might be because of the limited number of consultants undertaking such big projects included in the data-set. The same consultant groups in the country where this paper's case company operates mostly undertake the consultancy works of projects above a certain size.

Another factor absent in the solution set is client type, describing whether the client is public or private. The public sector as project client makes out only 28% of the client types in the final data set. This unbalanced distribution might be the reason for the factor's absence in the solution set.

Although some factors are not present in the solution set it is still important that all factors are considered together holistically in order to obtain a contradiction free data set leading to the end solution.

As a result, we can combine two pathways using Boolean algebra into one:

gccl*(gcarch*~delsystem+ delsystem*saanc)

The solution is highly reliable as it has coverage of 80% which is above the csQCA acceptable limit (0.75) and has a consistency of 1.0000. Moreover the solution has a necessary (but not sufficient) condition to high coverage: gccl= previous work experience between client and general contractor in the last ten years.

That necessary condition, gccl= previous work experience between client and general contractor in the last ten years should be supported by either gcarch= previous work experience between architect and general contractor in the last ten years for projects that are not planned to be delivered as design and build; or saanc= contractor's case responsible having more than 10 years of experience for design and build projects.

It makes full sense to have previous work experience with the architect in non-design-and-build cases, in other words in traditional delivery systems where tasks are separated, meaning simply that the architect designs and the contractor builds. Whereas, for design-and-build projects the general contractor's project responsible plays an important role as the design works are expected to be performed by the contractor as well together with the construction project execution. The performance of both tasks under the same roof means more responsibility and risk for the general contractor. This special condition is therefore expected to be handled by the more senior project responsibles.

A similar analysis was performed in order to describe combination of conditions leading to loosing contracts. In order to conduct this analysis the same conditions and cases were used but this time the outcome was set into the negation.

~prwnls = f(gccl, gcarch, gccon, cltyp, delsystem, saanc, taanc)

The solution set obtained has also satisfactory solution coverage being 0.79 and therefore still above the acceptable 0.75 and a consistency level of 1.00. However, this time the solution set presented below is rather a complex one making it difficult to minimize or draw meaningful results. It is therefore not included in the conclusion.

Pathway leading to losing a contract for a general contractor;
~gccl*~cltyp*saanc + ~gccon*~cltyp*~saanc + ~gcarch*~delsystem*saanc
(coverage 0.79 and consistency 1.00)

In other words, lack of previous work experience between client and general contractor together with non-governmental clients and senior case responsible or lack of previous work experience between consultant and general contractor together with non-governmental clients and non-senior case responsible or lack of previous work experience between architect and general contractor together with non-design and build contract system and senior case responsible was the long and complex solution set leading to unsuccessful tendering practices.

As construction projects are typical examples of project-based work, companies operating in the construction sector have to deal with challenges of project-based organization. Due to the temporality of projects, the companies operating in the sector constantly need to get new projects in order to perform and survive.

Although the projects that contractors bid on depend on the current project portfolio, technical and financial ability to execute the project and the risk acceptance level, it might be beneficial for the bidder to be aware of the combinations of different factors that are more likely to result in particular outcomes. This study advocates that such combinations lead to either project winn or loss.

Finally, factors affecting the project outcomes are various and it is debatable to highlight particular ones, since projects are argued to be unique. However, 39 projects with similar size and scope along a 5 years' time frame give an opportunity to describe a pathway of factors working together to lead to a particular tender result.

CONCLUSIONS

In this study QCA was used to identify the combination of factors creating pathways leading to particular project tender results, or more precisely, to win or to loose project contracts (seen from the bidder's perspective). The QCA method enables one to work with midsize data sets (in this case 39 projects), as well as to deepen the research qualitatively combining the benefits of top-down and bottom-up research strategies.

The tender phase is the critical stage in the project life cycle where many important decisions such as contractors and subcontractors are chosen and uncertainty is the highest. In this paper, factors affecting the qualifiers' decisions covered in literature, have been researched (top-down) with the aim to name the factors might affecting the bid results.

Moreover, the importance of organizational repetition and case studies in a project based work environment in the tender phase has been researched (bottom-up). The factors investigated were; previous work experience between client and general contractor, previous work experience between architect and general contractor, previous work experience between consultant and general contractor, the type of project delivery system, project type, seniority of general contractor's project responsible, and the seniority of the general contractor's project tender responsible.

For the case chosen, two solution sets were obtained and then they were minimized to one solution set. The frequency cut-off was set as 1 meaning that all observed cases represented in the solution set have been considered.

Pathway leading to winning a contract for a general contractor;
gccl*(gcarch*~delsystem+ delsystem*saanc)
(coverage 0.80 and consistency 1.00)

In other words, previous work experience between client and general contractor together with either previous work experience between architect and general contractor for design-bid-build projects or senior project responsible involvement from the contractors side in design-build projects was the path leading to signing the contract. It is important to note that previous work experience between client and general contractor appears to be a necessary condition that requires to be supported by other factors depending on the project attributes.

The implication of the research is that QCA represents a promising research strategy for studying the practices of project organizing and management due to its ability to shed light on a complex phenomenon. The results showing the importance of working with a previously known customer are believed to be important for contractors whose survivals depend heavily on winning new contracts in order to keep performing in a project based work environment. Furthermore, this study adds the contractor's perspective to the picture. More case studies concerning e.g. conflicts or financial results may also be helpful in investigating the consequences of work repetitions in construction practices.

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APPENDIX

The final dichotomized table prior to the analyses

Project — Conditions — Outcomes

case id	gccl	gcarch	gccon	cltyp	delsystem	saanc	taanc	prwnls
1	1	1	1	0	1	1	1	1
2	1	1	1	0	1	1	0	1
3	1	1	1	0	1	1	0	1
4	1	1	1	0	0	0	1	1
5	1	1	1	1	1	1	1	1
6	1	1	1	0	1	1	0	1
7	0	0	1	1	1	1	0	1
8	1	0	1	0	1	1	1	1
9	1	1	0	0	0	1	0	1
10	1	1	1	0	0	1	1	1
11	1	1	1	1	0	1	1	1
12	1	1	1	1	0	1	1	1
13	1	1	1	0	0	1	0	1
14	1	0	1	0	1	1	0	1
15	1	1	1	1	1	1	1	1
16	0	0	1	0	1	0	0	1
17	0	0	1	1	0	0	0	1
18	1	1	1	1	0	1	1	1
19	1	0	0	1	1	0	0	1
20	1	1	1	1	0	1	1	1
21	1	0	0	0	0	1	1	0
22	0	0	1	0	1	1	0	0
23	1	0	1	0	1	0	1	0
24	0	0	1	0	1	1	0	0
25	1	1	0	0	1	0	1	0
26	0	0	0	0	1	0	0	0
27	1	1	0	0	1	0	0	0
28	0	1	1	0	1	1	1	0
29	0	1	0	0	0	0	1	0
30	1	0	0	0	1	0	1	0
31	0	0	0	0	0	0	0	0
32	1	1	1	0	1	0	0	0
33	0	0	0	0	1	1	0	0
34	1	0	1	0	0	1	0	0
35	1	0	1	1	0	1	1	0
36	0	0	1	0	1	1	1	0
37	1	0	1	0	1	0	0	0
38	0	0	0	0	1	0	1	0
39	1	1	1	1	1	0	0	0

The results of final data set
ANALYSIS5.csv: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	N Cases	Missing
gccl	0.6923077	0.4615385	0	1	39	0
gcarch	0.5128205	0.4998356	0	1	39	0
gccon	0.7179487	0.4499982	0	1	39	0
cltyp	0.2820513	0.4499982	0	1	39	0
delsystem	0.6410256	0.47969	0	1	39	0
sagtype	0.4358974	0.4958738	0	1	39	0
sa anc	0.6153846	0.4865043	0	1	39	0
ta anc	0.4871795	0.4998356	0	1	39	0
prwnls	0.5128205	0.4998356	0	1	39	0

****
TRUTH TABLE ANALYSIS FOR WINNING PROJECTS
****
Model: prwnls = f(gccl, gcarch, gccon, cltyp, delsystem, saanc, taanc)
Rows: 32
Algorithm: Quine-McCluskey
True: 1-L

--- PARSIMONIOUS SOLUTION ---
frequency cutoff: 1.000000
consistency cutoff: 1.000000

	raw coverage	unique coverage	consistency
	----------	----------	----------
~gccl*gccon*~saanc	0.100000	0.100000	1.000000
gccl*gcarch*~delsystem	0.400000	0.400000	1.000000
gccl*delsystem*saanc	0.400000	0.400000	1.000000
~gcarch*cltyp*delsystem	0.100000	0.100000	1.000000

solution coverage: 1.000000
solution consistency: 1.000000

--- COMPLEX SOLUTION ---
frequency cutoff: 1.000000
consistency cutoff: 1.000000

	raw coverage	unique coverage	consistency
	----------	----------	----------
gccl*gccon*~cltyp*delsystem*saanc	0.300000	0.250000	1.000000
gccl*gcarch*gccon*saanc*taanc	0.400000	0.300000	1.000000
gccl*gcarch*~cltyp* ~delsystem*saanc*~taanc	0.100000	0.100000	1.000000
gccl*gcarch*gccon*~cltyp*	0.100000	0.050000	1.000000

~delsystem*taanc			
~gccl*~gcarch*gccon*cltyp *~delsystem*~saanc*~taanc	0.050000	0.050000	1.000000
~gccl*~gcarch*gccon*~cltyp *delsystem*~saanc*~taanc	0.050000	0.050000	1.000000
gccl*~gcarch*~gccon*cltyp *delsystem*~saanc*~taanc	0.050000	0.050000	1.000000
~gccl*~gcarch*gccon*cltyp *delsystem*saanc*~taanc	0.050000	0.050000	1.000000

solution coverage: 1.000000
solution consistency: 1.000000

--- INTERMEDIATE SOLUTION ---
frequency cutoff: 1.000000
consistency cutoff: 1.000000

	raw coverage	unique coverage	consistency
	----------	----------	----------
delsystem*cltyp*~gcarch*gccl	0.050000	0.050000	1.000000
~saanc*delsystem*~cltyp*gccon*~gccl	0.050000	0.050000	1.000000
~saanc*~delsystem*cltyp*gccon*~gccl	0.050000	0.050000	1.000000
saanc*~delsystem*~cltyp*gcarch*gccl	0.150000	0.100000	1.000000
saanc*delsystem*cltyp*gccon*~gcarch	0.050000	0.050000	1.000000
saanc*delsystem*~cltyp*gccon*gccl	0.300000	0.300000	1.000000
taanc*~delsystem* ~cltyp*gccon*gcarch*gccl	0.100000	0.050000	1.000000

solution coverage: 0.700000
solutionconsistency:1.000000

****
TRUTH TABLE ANALYSIS FOR LOSING PROJECTS
****

Model: ~prwnls = f(taanc, saanc, delsystem, cltyp, gccon, gcarch, gccl)

--- PARSIMONIOUS SOLUTION ---
frequency cutoff: 1.000000
consistency cutoff: 1.000000

	raw coverage	unique coverage	consistency
	----------	----------	----------
~gccon*~cltyp*~saanc	0.368421	0.368421	1.000000
~gccl*~cltyp*saanc	0.263158	0.263158	1.000000
gccl*gccon*delsystem*~saanc	0.210526	0.210526	1.000000
~gcarch*~delsystem*saanc	0.157895	0.157895	1.000000

solution coverage: 1.000000
solution consistency: 1.000000

--- INTERMEDIATE SOLUTION ---
frequency cutoff: 1.000000
consistency cutoff: 1.000000
Assumptions:
~taanc (absent)
~saanc (absent)
~gccon (absent)
~gcarch (absent)
~gccl (absent)

	raw coverage	unique coverage	consistency
	----------	----------	----------
~saanc*~cltyp*~gccon*~gccl	0.210526	0.105263	1.000000
saanc*~delsystem*~gccon*~gcarch	0.052632	0.052632	1.000000
~taanc*saanc*~delsystem*~gcarch	0.052632	0.052632	1.000000
~saanc*delsystem*~cltyp*~gccon	0.263158	0.105263	1.000000
saanc*delsystem*~cltyp*~gccl	0.263158	0.263158	1.000000
saanc*~delsystem*cltyp*~gcarch	0.052632	0.052632	1.000000
~saanc*delsystem*~cltyp*~gcarch*gccl	0.157895	0.052632	1.000000
~taanc*~saanc*delsystem*gccon*gccl	0.157895	0.105263	1.000000

solution coverage: 1.000000
solution consistency: 1.000000