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Insights from a project procurement strategy through an action research

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Abstract

The purpose of this paper is to describe the process of selecting an appropriate procurement method most suitable to the specificities of a building retrofitting project. The relevant literature points to the difficulties in managing design errors and mistakes in the conception phase and their negative impact on the construction phase and, ultimately, on construction project development. The regulatory framework related to these issues exists but the problems persist, alongside the absence of regulation in the project manager's functions. General contracting is the procurement method mostly used but has its caveats, particularly in risky and complex construction projects. This study adopts a Participatory Action Research methodology to describe all the procedures and decision making during the project development process, including the evaluation of the tenders and the ensuing competitive negotiation process.

The results of the study show the importance of a design consultant with skills base and experience in procurement in the process of construction project development. The competitive negotiation process allowed to a final contract price that was lower than the initial best offer. Furthermore, a revised structural project design undertaken under the responsibility of the contractor increased the quality of the project design in comparison with the initial one. The results also show some adjustments in procurement method along the procurement process.

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1. Introduction

The Portuguese Court of Auditors (PCA) is the official body responsible for auditing and controlling the accounts of public works' contracts. As construction contracts and concession works contracts represent the lion's share of government capital expenditure, the controlling procedures of public contracts have been increasing becoming more demanding. In its remit, the PCA submits *Recommendations* for public construction works, addressing the recurrent pattern of shortcomings, errors and inefficient management of taxpayer's money. McAdam *et al* [2] proposed some guidelines for public procurement in specific construction works and Mwelu *et al* [3] presented some recommendations for a regulatory framework concerning public road construction projects. The PCA's Report 17/2009 [4], for instance, specified the need for estimating construction projects global costs, by calculating the real costs of operation and maintenance in the project's life cycle. Some authors [5, 6, 7, 8] mention the problems of cost and time overruns, the need for reducing constraints and a regulatory framework for construction project management activities. Moura *et al* [9] also alluded to the frequent problems related to costs and time overruns as well as the recurring lack of quality and safety in construction works. The PCA's Report 1/2016 [10] reiterated several recommendations of the 2009 Report and some of them were a repetition from previous reports. The most pressing problems mentioned in the 2016 Report are [10]:

- Contract changes are being reported in public works contracts in just under 50% of the awarded contracts;
- In the total projects analyzed, there was, on average, an increase in contract costs of around 6.75%;
- Design alterations and modifications are a recurring pattern, especially in building retrofitting projects;
- Modifications occurred especially in architectural designs and water supply and sewage project designs;
- Deficiencies in the project design were present in 57% of all projects analyzed;
- Contractual changes resulted from unforeseen circumstances are close to 11% in the situations reported;

Problems related to the management of construction projects are a frequent pattern [11] and if it happens in public construction works where the rigour should be of high standard, then the situation is worst in private construction works [6]. General contracting is the procurement method mostly used but has its caveats, particularly in risky and complex construction projects. [7].

The paper reports on a PAR (Participatory Action Research) involving a project procurement process of a building retrofitting project in a real case [12], as well as the special benefits obtained through a strategic approach more compatible with the employer's goals. The initial project design contained severe errors and mistakes that were overcome through an adequate procurement strategy. The best cost-effective solutions and particularities were also explored during the procurement process with the different tenderers' initial offers [13]. Then, the competitors were asked to propose a project design variant which was used in the negotiation phase to reduce the contractual price and enhance the quality of the project design as much as possible [14, 15]. The initial design served as a basis for the procurement process. This was a slight modification of the design and build procurement method [11]. The design-built procurement method is recommended in exceptional cases for complex construction techniques [10, 16], but it could also be a possible solution for projects with project design problems and unforeseen occurrences, as in the case reported in this study [17]. According to Naoum *et al* [7], one of the problems is the separation of design from the construction and Lahdenperä *et al* [18] suggested that an adequate procurement system is a key factor in enabling a successful implementation of a building project.

After introducing the problems concerned with the project design and the general aspects of the procurement process, the remainder of the paper is structured as follows. Section 1 describes the procurement context in paper goals. Section 2 presents the methodology adopted in the research. Section 3 describes the Action Research study. And, finally, a concluding remark is presented in the last section.

Nomenclature

PAR	Participatory Action Research
PCA	Portuguese Court of Auditors

2. Procurement context

The simplest definition of procurement is the process in a construction project to create and manage contracts [19]. According to ISO 10845-1:2010 [20], procurement is the “process which creates, manages and fulfils contracts relating to the provision of goods, services and engineering and construction works or disposals, or any combination thereof”. Other writers [21] define it as “a process where price and other key factors are considered in the evaluation and selection process to minimize impacts and enhance the long-term performance and value for construction”. A procurement process must be fair, equitable, transparent and competitive, between the owner and different tenderers, to result in a cost-effective outcome in price, time and quality and also enable the system to be controlled and managed. Obviously, an adequate strategy is required in procurement procedures [18]. A procurement strategy [22] “refers to the process used to take a building project from its early planning phases to completion and occupation by the building’s users”. The simplest way of procurement procedure is based on construction performance by the contractor only. But in some procurement processes, many owners or employers explore the ways to include beyond price factors, other qualitative and quantitative factors to motivate contractors not only to improve their skills and performance during the construction phase, but also to build value into the end products of construction [21]. Many evaluation criteria can be devised, such as [23]: quality of performance, timeliness of performance, customer satisfaction, on-budget performance, ability to minimize change orders and prepare plans, technical capacity, qualifications, and ability to assess and minimize risks.

However, different procurement methods present some advantages and disadvantages, but they also must be adjusted according to complexity, price and project type. A prudent action is of paramount importance in some procurement procedures, especially in highly complex project designs, which could result in the increase of the initial contract price. A procurement strategy solution for these cases could be the design and build method, in which the risk of project design errors and mistakes is, in general terms, passed to the contractor [22, 24].

Some important factors will determine the most adequate procurement strategy for a project, such as [25, 26]:

- The key objectives (scope, cost, time, quality, sustainability, innovation, contribution), particularities and constraints (time, budget and physical constraints, resources, skills, market, policies);
- The risks that may arise during the project delivery and how could they be dealt with.
- The complexity level (size, duration, scope, stakeholders, technology level, innovation, market conditions).

Table 1 presents the characteristics of the two main procurement methods [25, 27, 28] referred to in the study.

Table 1. Procurement methods

Method	General Goals	Utilization conditions and advantages	Possible risks
General contracting	Design and construction developed separately by a design team and a contractor.	- High degree of certainty. - Quality increase. - Construction under a detail project design.	-Depends on constraints and uncertainty levels: Cost, time, omissions, extra works, quality.
Design and build	Design and construction developed by the contractor	- Maximum price guaranteed; - Scope, functionality and quality are specified. - Recommended for high level uncertainty	- Higher costs than in the competitive market; - Quality of project design; - Omissions and Project conclusion; - Initial time could delay final project.

There are some other procurement methods with interesting particularities for some specific proposals [7, 13]. Each method is more oriented for specific projects types, but in some circumstances a project could be develop from different procurement methods [27]. In all procurement methods, there is some degree of competition between different tenderers’ offers. Some of them could have a more restricted use such as the negotiated procedure, which is a specific kind of competition relationship [14, 28]. According to ISO 10845-1:2010 [20], a “competitive negotiation procedure is a procurement procedure which, through a series of negotiations, reduces the number of tenderers competing for the contract until the remaining tenderers are invited to submit final offers”. The negotiated procedure used in the process showed a real value for money and it was intended to give accountability to tenderers [29]. However, the negotiated procedure could have some disadvantages, such as [30]: unrealistic market prices, lack of project team communication, price variations needs and tender offers tend to overlook the quality detail.

On the other hand, the negotiated procedure could be a solution to solve some project design problems detected in the earlier phase of the process [14] and, according to Naoum *et al* [7], can be seen as an alternative to the management contracting and construction project management methods [31]. Despite general contracting being the procurement method mostly used in construction procurement, possible risks, constraints and uncertainty levels could result in an unsuccessful project development. Unconsciously, this adjustment or chosen method is applying some goals of Green Public Procurement [5, 30].

3. Research methodology

The paper follows a PAR (Participatory Action Research), which is a qualitative research methodology option that requires understanding and specific consideration [32] between research and a real procurement process. According to Carr [33], a PAR is considered a democratic, equitable, liberating, and life-enhancing qualitative inquiry that remains distinct from other qualitative methodologies, particularly concerning the roles played by the researcher and the participants [34]. In particular, the qualitative features are revealed without control or any manipulation from the researcher individual's feelings, views, and patterns [35]. Furthermore, Qualitative research reflects the values of subjectivity, individualism, holism, relativism, and interpretation [36]. Besides, this research methodology is in its essence exploratory and suffer some changes to the descriptive or explanation present in other common qualitative research [37]. An action research challenges include a separation between research from action [38]. The paper include a research used a PAR in a procurement project before retrofitting works, figure. 1.

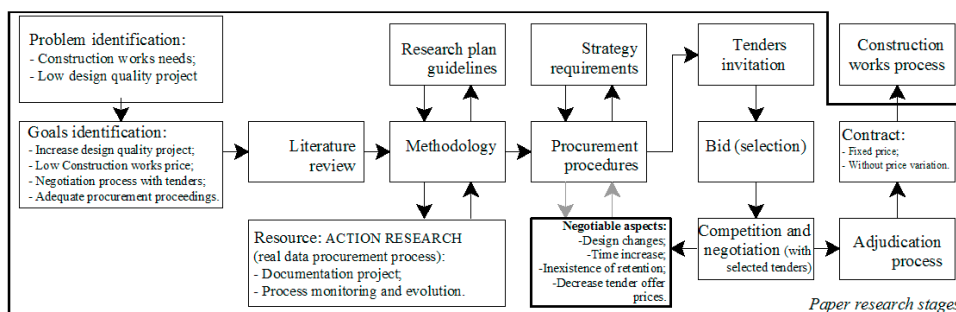


Fig. 1. Research methodology used

The problems identification required an adequate methodology for attaining the goals to resolve completely or soften those problems. Some literature review is always required as an auxiliary way to define an adequate orientation methodology during the process. A guidelines plan was defined in the research which combined adequate strategies articulated from Action Research of a real procurement project. The research work was undertaken directly in real time with a focus on a real project following the appropriate procurement procedures needs. A critical category happens always in a specific type of action research that adopts critical approach towards business processes and aims for improvements of that research proposal [39].

The evaluation criteria were based on the lowest price only, and not all the invited tenderers presented their offer. However, the procurement procedures defined some degree of competition and negotiation, the rules of which could be used before the contractor selection [14]. A number of contractual arrangements could be discussed in the negotiation tendering process, such as: Design changes; Time increase; Retention elimination; Decrease in the contractual cost. The main goal was to pass the project design responsibility to the contractor, thus solving the initial problem, and also to reduce the probability of increasing price during retrofitting works. After the competition and negotiation process, the contractor selection's decision was taken and then the signing of the contract was finalized. The ensuing operational decisions could find the best technical solutions for the project, even at a fair cost. All qualitative data collection was archived during the procurement process to prove the benefits and particularities of procurement procedures when applied by strategy. Furthermore, a PAR methodology is reciprocity (implies give-and-take), reflexivity (self-awareness) and reflection-on-reality (evaluating the action, gathering new insights, planning the next step and modifying the overall plan) [40].

4. Participatory Action Research study

4.1. Building retrofitting works characteristics

The project analysed in this study consists of a seventy-year old original building, which belongs to a private property owner located in the North of Portugal. The law does not oblige private owners to follow public contract.

This building has 3 floors with 572m² each and a floor below level 0 with 150m², totalling 1,766m². The external walls are in local stone and granite stone. The floors structures are in wood and the internal walls are also in wood with lime mortar. The existing building has the external walls in good maintenance conditions but has several problems with rain permeability in the roof, no thermal and acoustic insulation as well some technical fails in hydraulic networks, and also fire safety is compromised, especially in electrical networks. The employer decided to maintain all external walls and demolish original floors, roof, internal walls and all networks installations. The new project design solution involves a new structural frame and roof, internal walls adapted to new needs for wheelchairs mobility, new networks installations, thermal and acoustic insulation, fire safety protection, all according to regulatory requirements. The retrofitting project has some additional floor areas:

- Each floor with 595m² (construction of a new stair in the posterior façade);
- The floor below level 0 has 360m² (removal of soils and rocks) and use of cover roof in 450m².

All area retrofitting works has a total of 2,595m² (an additional 829m² compared to the original before works).

4.2. Retrofitting project design conception fails and revised

The building retrofitting project design was developed by a design team chosen under 6 local companies. During project design approval in Town hall, the employer were detected more than 300 conception fails, errors, mistakes and omissions This action was resulted from a report review of the project design by an expert [24]. Reason *et al* [41] cited “the failure of planned actions to achieve their desired goal, where this occurs without some unforeseeable or chance intervention”. Rahman *et al* [24] considered in a study 5 manifest variables about possible errors and mistakes, namely: frequent design changes, mistakes and errors in design, incomplete design at the time of tender, poor design and delays in design, and delay in preparation and approval of drawings.

The most expressive conception fails presented in the report are:

- Lack of description of materials or construction products;
- Building bathrooms with reduced area and some of them without capacity for people in wheelchairs;
- Cargo elevator without adequate dimensions, elevator output with obstacles and with other collision points;
- Metal structure without fire protection painting;
- Some structural pillars without characteristics description and part of them were not in correct positions;
- Drainage pipes below ceiling level and lack of ducts between different floors;
- Water networks pipes non-conforming to regulatory and without any sustainable solution for rain water uses;
- Thermal, ventilation, heating and cooling project designs missing;
- Missing/incomplete drawings, drawings without measures, errors in bill of quantities errors;

Many meetings were hold between the employer, the consultant and the design team, following authors recommendations [8]. The project design did not match the building retrofitting works requirements, but part of detected errors was not solved, and the employer wanted to begin retrofitting works as soon as possible.

4.3. Procurement procedures required for tenderers

A general contracting procurement method with the project design separated from the building retrofitting works was used initially [7]. However, the building retrofitting project design could bring lots of problems to the client, especially increased costs and uncertainty for bank financing. The works in this phase comprised demolition, structure, roof parts and building masonry and finishing exterior. And, the main strategy was to define procurement procedures with restrictive rules for tenderers to protect employer’s interests [13], such as:

- Documentation required in a public procurement process with prequalified tenderers;
- Evaluation criteria including weighting for “financial offer only” and time submission limit.

- Tenderers had 10 days to present claims for project design errors and an additional 10 days after award contract;
- Regulatory requirements in labour safety, construction and demolition waste, site works organization and requirement of civil insurance above the €1000,000.00 threshold;
- Tenderers and employer accorded that price adjustments for changes in the market prices as wells the claiming for project design errors and omissions or additional works were not allowed during contract;
- Employer is entitled to engage in a negotiated tendering procedure with some tenderers after the selection of offers, and then opt for a project design variant that provides advantages for the employer’s interests.

4.4. Evaluate Tenderers’ offers

The tenderers offers evaluation was described in the notice of intended procurement. Particularly, according to Bresnen *et al* [42] and Löfgren *et al* [43] defend tender partnering to increase the possibility that projects are completed within budget, on time, with the least number of conflicts, claims and work defects, and with a good client-contractor relationship. The single criteria used in tenderers offer evaluation was “financial offer only;”, namely best price tenderers offer. This kind of method is denominated by method 1 “Financial Offer” in standard ISO 10845-1:2010 [20]: “Rank tender offers from the most favorable to the least favourable comparative offer; Recommend highest ranked tenderer for the award of the contract.” All tenderers’ offers were reduced to a common basis, described in procurement documents, and ranked between 1 to 5, following a linear transformation by mathematical expressions (1) [44]. The maximum price limit was the budget estimated by employer and corresponded to minimum rating with value 1. The value 5, for the minimum price limit, was calculated at 70% of the maximum price limit. All tenderers’ offers must be above the minimum price limit and below the maximum price limit. The offers that laid off these limits were excluded.

$$OS = \frac{(MaxR - MinR)}{(MinPL - MaxPL)} TO - [MinR - \frac{(MaxR - MinR)}{(MinPL - MaxPL)} \times MaxPL]; OS = MaxR - \left[\frac{(TO - MinPL)}{(MaxPL - MinPL)} \times (MaxR - MinR) \right] \quad (1)$$

Mathematical expressions description: OS–Overall Score (between 1 to 5); TO–Tender Offer; MaxR–Maximum Rating (5); MinR–Minimum Rating (1); MinPL–Minimum Price Limit; MaxPL–Maximum Price Limit.

The maximum price of the building retrofitting works, calculated by employer, was €990,125.00 and minimum price was €693,098.50 (30% below maximum price). All mentioned prices were presented without VAT. The employer invited 10 construction companies to present offers but only 6 provided them. Only two tenderers presented claims on the errors and omissions in the project design but all of them passed in a prequalified tender. The tenderers’ offers are presented in Table 2 and Figure 2 illustrates the tenderers’ offers positions and ratings.

Table 2. Tenderers’ Offers

Tenderers	Tender Offer A	Tender Offer B	Tender Offer C	Tender Offer D	Tender Offer E	Tender Offer F
Price (€)	€821,568,70	€741,697,10	€928,697,00	€1798,977.30	€1323,982.60	€1518,820.30
Admittance	Yes	Yes	Yes	Excluded	Excluded	Excluded
Rating (1 to 5)	3.26	4.34	1.83	-	-	-
Position	2 nd (Second)	1 st (First)	3 rd (Third)	-	-	-

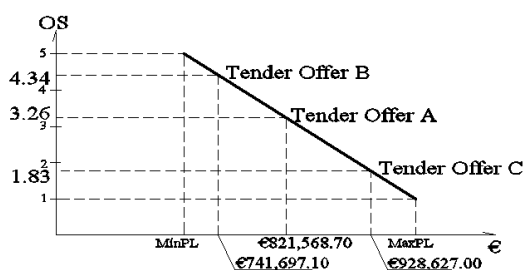


Fig. 2. Graphic with tenderers offer position

The most advantageous financial offer was tender offer B with €741,697.10€, following in second place by tender offer A with €821,568.70 and at lastly tender offer C with €988,697.30.

4.5. Competitive negotiation procedure results

After the acceptance of tenderers' offers, the employer had negotiated directly with some tenderers [14, 15] (described as a possibility in the notice of intended procurement). The tenderers' offer results were not communicated to tenderers. The employer contacted all tenderers selected and all of them were invited to present a project design variant with an offer lower than that initially presented. The main goal was to decrease the initial price offer, and most importantly, to transfer the responsibility of the building retrofitting project design to the contractor [14, 15]. This goal switched the project to a design and build procurement method from the initial general contracting, with so many shortcomings in the project design. The Standard ISO 10845-1:2010 [20] describes, "*Any negotiations or discussions with respondents or tenderers shall be conducted in an open, competitive, transparent and fair manner and shall not be used as an opportunity to trade-off one tenderer's financial offer against another tenderer's financial offer in order to obtain lower prices or to provide any tenderer with a second or unfair advantage*". According to Leu et al [45], a negotiation process must have equilibrium between partners.

Only tenderers A and B had presented new offers and a project design variant. The tender offer A decreased by 12% (€722,988.50) and tender offer B decreased by 11% (€660,110.40) when compared with the initial ones. Following a negotiation, tenderer A presented a fixed price of €701,291.10 (3% decrease) and tenderer B a fixed price of €646,908.20 (2% decrease). Thus, the contract was awarded to tenderer B. The contractor (tender B) requested an additional 3 months to the initial terms established by the employer, now without retention fund.

5. Main conclusions

This paper reported the results of an action research applied to a building retrofitting project. The project design problems detected in the procurement process are in line with the research literature concerning the negative impacts of errors and mistakes in the design phase on cost and time, and on the quality of the final product as well [41, 46]. Some authors [47, 48] have developed methodologies for errors prevention/resolution, such as the use of computer simulation software. Other writers [14, 45] recommended specific procurement methods (in particular, the negotiated procedure) for complex projects. Another line of thought advocates the development of specific strategies in the procurement process, such as the one adopted in this research [49].

Obviously, the employer could request another project design, but increased costs and uncertainty had to be balanced with the available time. A design consultant with expertise in procurement was engaged to tackle the problems, constraints and project design limitations, and develop a suitable procurement strategy to remedy the situation. The most significant procedures applied in the procurement process are the following:

Procurement procedures adjusted for the project to improve original project design;

- Procurement process quite fair, equitable, transparent, and competitive between all tenderers;
- Best offer selection looking for a real market value for money;
- The competition and negotiation procedures decrease the initial tenderers' offers and brought in accountability from the new project design variant presented by the contractor;
- Documentation upgrading such as drawings, bill quantities and scheduling;

The initial project design was an important instrument orientation for the employers' needs during procurement process, including for the negotiated procedure in the advanced phase. The negotiated procedure allowed to a final contract price reduction, and a revised project design was undertaken under the responsibility of the contractor, following the "design and building" procurement method philosophy.

However, during the process some risks and limitations were supposed to happen such as: tenderers questioning about the project design before negotiation process; tenderers' dropouts; offers with high prices; lack of contractors with interest in tender offer presentation. The goal of a value for money was successfully achieved by negotiation. Furthermore, the negotiated tendering procedure decreased the initial best offer by €94,788.90, or about 12.8% less than the initial best positioned tender offer. The final fixed price contract amounted to €646,908.20, awarded to tenderer B.

The results also shows that even for medium cost projects, independently of technical complexity and size, the employer must be supported by a design consultant with expertise in procurement. All procurement procedures must be weight carefully attending to the potential risks of the construction project. The results of the study also suggest that design teams should invest in nurturing their partnering abilities by connecting to the different partners involved in procurement process [50]. Project design revised is also an important recommendation for successful implementation of construction project development.

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