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Advantages, disadvantages and risks in the adoption of design-build contracting method in the Brazilian public sector

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ABSTRACT

Objetivo – This paper aims to identify advantages, disadvantages and risks involved in the adoption of design-build contracting method in the Brazilian public sector.

Design/methodology/approach – qualitative case study, in which were made documentary and field research in the form of semi-structured interviews. About the documentary and field data was used content analysis and triangulation of sources and collection methods.

Findings – The theoretical basis of this research lies in the Brazilian legislation for contracting works and studies conducted by various authors in which address the advantages of design-build procurement method (a single contract for design and construction) regarding the design-bid-build method used in Brazil, which hires design and construction separately.

Practical implications – The research identified advantages, disadvantages and risks associated to the adoption of the design-build method, enabling the development of coping strategies if it is deployed.

Originality/value – managers aware of these aspects could use coping strategies by adopting measures to reduce or eliminate their effects. The results can contribute not only to a possible implantation of the method in contexts even other than the public sector but also to improve the processes regarding the project and execution of works.

Keywords: project and building, design-build, projects risks, public sector.

I INTRODUCTION

It is evident that there has been an increasing number of works in Brazil in the last years, both in civil and heavy construction. Brazilian Institute of Geography and Statistics (IBGE, 2011) data, released in 2011 and published on the Annual Survey of Construction Industry, 2008, showed that the value of works

and/or services provided by national construction companies increased between the 1994 and 1998, declined in 1999 and increased again from 2000. Figures vary between R\$ 13 and 127 billion. The number of companies considered for this study, i.e., those with 40 or more employees, grew more intensely since 2000, ranging from 1,553 (1994) to 8,947 (2008), as can be seen in Figure 1.

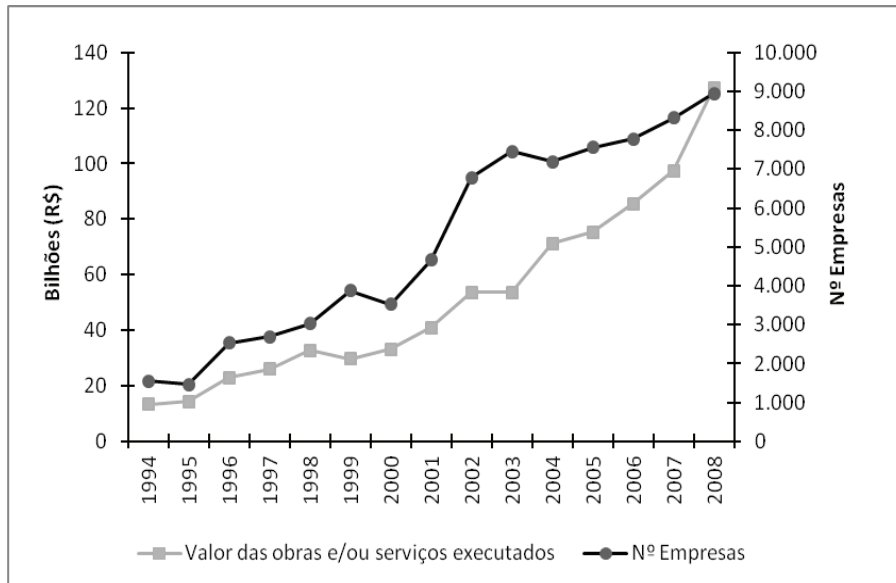


FIGURE 1 – Number of companies and value of works and/or services provided by national construction companies.

Source: Adapted from “Pesquisa Anual da Indústria da Construção”, IBGE, 2011. Retrieved from http://www.ibge.gov.br/home/pesquisa/pesquisa_google.shtm?cx=009791019813784313549%3Aonz63jzsr68&cof=FORID%3A9&ie=ISO-8859-1&q=P AIC&sa=Pesquisar&siteurl=www.ibge.gov.br%2F&ref=&ss=636j13 4930j4

In order to observe public works importance for the construction sector economy, it is sufficient to analyze the IBGE (2011) data shown in Figure 2, which showed that, from

2000 to 2008, between 42% and 52% of revenue originated from works and/or services execution came from constructions for bodies or companies belonging to the federal, state or local government.

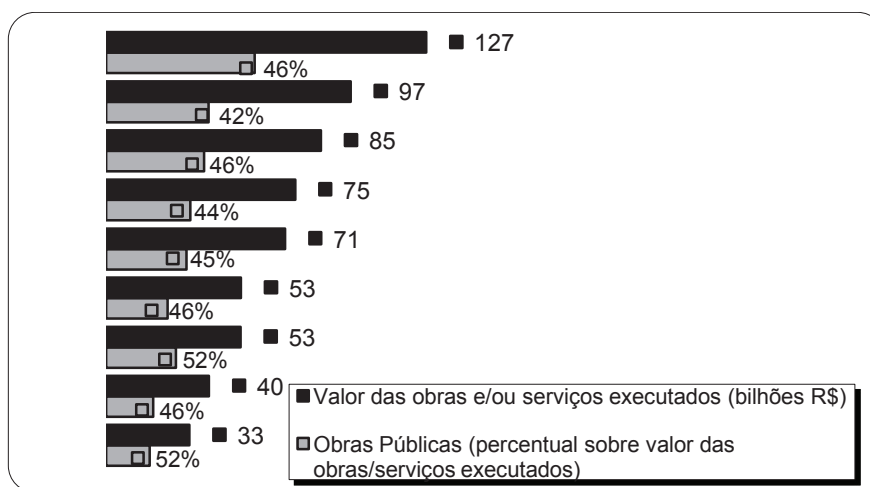


FIGURE 2 - Public works participation percentage in the amount of works and/or services provided by national construction companies between 2000 and 2008

Source: Adapted from “*Pesquisa Anual da Indústria da Construção*”, IBGE, 2011. Retrieved from http://www.ibge.gov.br/home/pesquisa/pesquisa_google.shtm?cx=009791019813784313549%3Aonz63jzsr68&cof=FORID%3A9&ie=ISO-8859-1&q=PAIC&sa=Pesquisar&siteurl=www.ibge.gov.br%2F&ref=&ss=636j134930j4

Public sector works are related to highway, railway, urban work and special art work construction (bridges, viaducts, tunnels, etc.), electricity, telecommunications, water, gas and sanitation supply provision infrastructure works and civil works, such as schools, hospitals, prisons, administrative buildings and dwellings financed with public funds.

Such works are contracted through a lowest overall price or lowest unit price public bidding process type. Originally contracted prices, if not majored by overbillings and overpricing (TCU, 2009), are majored by amendments or by economic and financial rebalancing. Contract price increase due to value amendment amount is caused by intentional solution changes, project errors and technical specification failures, which alter the initially budgeted services/material, or their amounts. When this happens, it is also inevitable to have a deadline amendment.

Work execution delays take place, according to Amaral (2000), due to three factors: 1) original project need for alterations and adaptations, 2) properties that will be affected in some way

by construction expropriation and 3) planned financial resources availability. On original project adaptations, the author stated that two facts often contribute to aggravate the situation: the fact that the project does not contain all prescribed elements by the current legislation and that the fact the project is not updated when the respective work is in progress.

Nevertheless, some authors (Konchar & Sanvido, 1998; Palaneeswaran & Kumaraswamy, 2000; Songer & Molenaar, 1996) assign a great deal of design alterations and adaptations to the lack of interaction between design and construction teams. The work contracting method used by most Brazilian public entities is named *design-bid-build* (DBB) by these authors. This method relates to a traditional system to contract enterprises in which the owner separately signs contracts with design and construction companies (Konchar & Sanvido, 1998). With lack of technical personnel in its staff, the public entity performs the bidding process with all relevant documentation based on a draft project, in order to hire the company that will develop

the basic and executive projects and, in possession of these, performs the bidding process that will contract the respective work executor. Except for works carried out by public-private partnerships, all other public work contracts must conform to what is prescribed by Public Procurement Law no. 8.666/1993 (2004) and its amendments.

Some authors state that DBB contracting type can lead to some problems, such as: 1) dealing with two contracts (one for design and another one for construction) increases the possibility of project alteration when the work is being executed due to the occurrence of any unplanned event in project phase, what would result in extra cost (Songer & Molenaar, 1996), and 2) more time for work completion would be needed (Konchar & Sanvido, 1998; Palaneeswaran & Kumaraswamy, 2000). Similar problems are common in enterprises contracted by the Brazilian Public Administration regarding works.

An alternative to DBB is the *Design-build* (DB) method. In this model, an entity or consortium is contractually responsible for the work design and execution (Hale, Shrestha, Gibson, & Migliaccio, 2009; Songer & Molenaar, 1996). Konchar and Sanvido (1998) and Palaneeswaran and Kumaraswamy (2000) stated that the primary reason to select the DB method is its potential to reduce total development time, given the overlap in a certain stage of design and construction phases. This time reduction would also result in cost reduction. These, among other advantages, have enabled the method to be well accepted compared to other possible ones.

Although used in private sector and public-private partnerships, design and construction DB contracting method finds obstacles in the Brazilian legislation regarding its possibility of being adopted by the public sector. Basic – and executive in some cases – design mandatory requirement prior to work contracting prevents its use. However, studies such as the ones by Molenaar and Gransberg (2001), for example, approach similar situations in some US states, which are adapting their legislation in order to

fully benefit from the advantages provided by DB. The same panorama is verified in countries such as the UK, Korea, Japan and Oman. When considering DB many advantages compared to DBB, it is possible that the same happens in Brazil, initially on a trial basis and, after advantages confirmation, definitively. However, there can be no implantation without method benefits, risks and critical points refined study.

Given this need, this study aims to identify industry executives' perception concerning *design-build* contracting method use, advantages, risks and disadvantages, in order to make it possible to be adopted by the Brazilian public sector. From this study, it is possible to propose coping strategies which are necessary in case this approach is adopted. For this, advantages, risks and disadvantages mentioned in the researched literature will be addressed, as well as the ones likely to happen according to the opinion of 19 professionals from the construction industry. It should be noted that the focus of this research will be on these aspects occurrence between public works design and construction phases.

In order to reach the main objective, the study was divided into the following sections: section 2, concerning the DB contracting method, its main characteristics, advantages, disadvantages and inherent risks; section 3, regarding the used research method; section 4, concerning results; and section 5, regarding final conclusions and considerations, including research limitations and future study suggestions.

2 DESIGN-BUILD CONTRACTING METHOD

Design-build is an enterprise contracting system in which the contracting party, or owner, hires a company to perform both design and construction under a single contract (Konchar & Sanvido, 1998; Molenaar & Gransberg, 2001). Arditi and Lee (2003) added that this method facilitates innovative and flexible approaches use, such as construction and new material technologies knowledge gradual introduction.

Contractually, DB provides a single responsibility point for design and construction services, which is true from the contracting party's perspective, but not from the contracted company, which may subcontract services of which they have no expertise, or join a companies' consortium (Chang, Shen, & Ibbs, 2010; Park, Ji, Lee, & Kim, 2009; Puerto, Gransberg, & Shane, 2008; Oyegoke, Dickinson, Khalfan, Mcdermott, & Rowlinson, 2009). However, some contracting parties require these subcontracts plan.

In addition to the single responsibility point, the method has other features. Park *et al.* (2009) mentioned the method characteristic of being more often applied in large and complex enterprises, once they allow, among other benefits, good coordination and communication. According to other authors, the main advantages of DB contracting method rest in the fact that it provides better time (Hale *et al.*, 2009; Konchar & Sanvido, 1998; Molenaar, Songer, & Barash, 1999; Park *et al.*, 2009; Yates, 1995), cost (Konchar & Sanvido, 1998; Park *et al.*, 2009; Yates, 1995) and quality (Park *et al.*, 2009) performance, less claims, conflicts, disputes and legal actions (Molenaar, Songer, & Barash, 1999;

Park *et al.*, 2009; Yates, 1995) incidence, less administrative work, clarification requests and changes (Yates, 1995), better constructability¹, more innovation and better decision-making (Molenaar *et al.*, 1999; Yates, 1995). Concerning design alterations, Perkins (2009) stated that there are two significant advantages in the DB method: design errors cease to be a construction phase alteration source and the joint work of designer, constructor and contracting party enables skills sharing in cost reduction and deadline shortening.

Songer and Molenaar (1996) identified that the main reason to use the DB contract, according to interviewees from public and private sectors, was the short duration, followed by, in assigned importance order: cost fixation and reduction, constructability and innovation, schedule securing, claims reduction and design complexity level. The authors highlighted that, although the short duration appears as the main motivation, any of the aforementioned factors can become preponderant in particular enterprises. In order to fully enjoy these benefits, it is necessary, among other initiatives, to observe the DB method own selection process, which is called two-steps, as shown in Figure 3 (Migliaccio & Shrestha, 2009b).

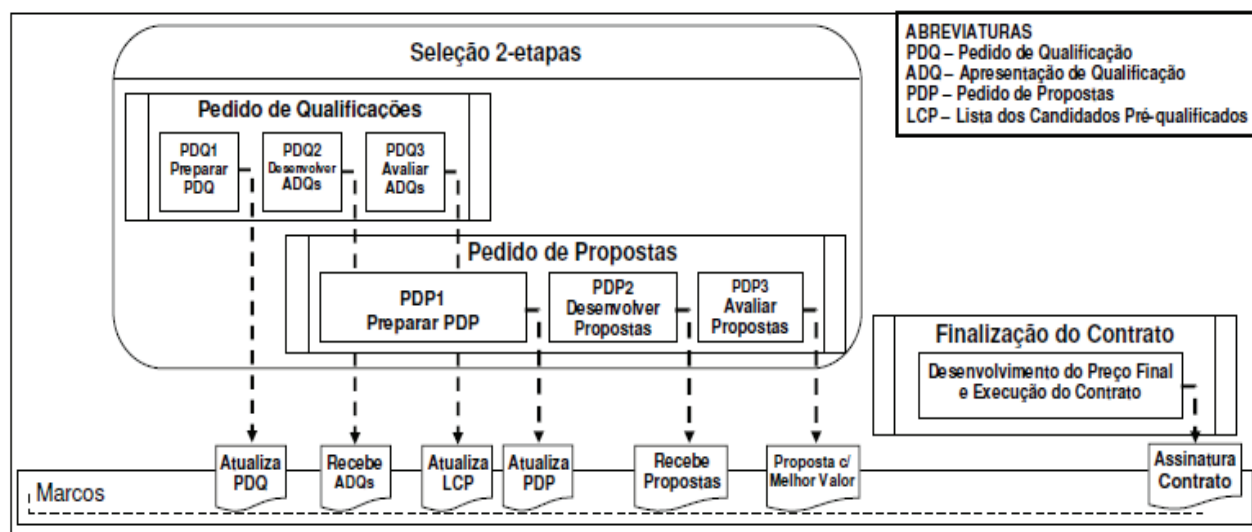


FIGURE 3 – Two-step selection process for *design-build* method contracting

Source: Migliaccio, G. C., & Shrestha, P. P. (2009b). Analysis of design-build procurement activities durations for highway projects. (p. 231). *Proceedings of the ASCE Construction Research Congress*, Seattle, WA, USA. doi: 10.1061/41020(339)24

Prior to the Request for Qualifications (RFQ), Migliaccio, Gibson, & O'Connor (2009a) reported the study of feasibility, cost-benefit relations, funds/financing sources, among others. RFQ stage objective is to select proponents who have the required qualifications to execute the enterprise, in order to assure the participants number is between three and five, a reasonable number for the contracting party's hiring staff, considering the following phases' administrative workload. This phase result is the list of pre-qualified candidates to continue in the bidding process.

In the RFP – Request for Proposals – phase, proponent instructions, DB draft contract, technical requirements development (environmental impact and preliminary engineering) and its attachments are set. Subsequently, there is the proposal request draft release for industry acknowledgement, which may suggest changes by submitting a written document or discussing in meetings (two to three rounds, depending on the project). At the same time, technical review committees and subcommittees are formed with assigned roles and responsibilities, and the rules to evaluate proposals are designed. In this stage, the complete proposal request is originated and, after competent authorities' approval, it is released for companies that take part in the list of pre-qualified candidates.

In the proposal development stage - RFP2 -, pre-qualified companies interact with the commission through clarification requests, answered in meetings (usually two or three meetings, but it may also be more meetings in the case of more complex enterprises). In this phase, pre-qualified companies may suggest alternative technical concepts, which are evaluated by committees and subcommittees and, when accepted, alter the proposal request. This stage

final landmark is the receiving of proposals from pre-qualified companies in sealed envelopes, one for competition according to technique criterion, and another one for competition according to price criterion.

In the proposal evaluation stage - RFP3 -, the best value evaluation procedure is adopted, in which technical and price criteria are weighed at the contracting party's discretion. Each envelope goes to the respective evaluation committee, which cannot comment anything about it, not even within committees, until the scores are assigned. This stage result is the announcement of the best value contracting proposal. Some companies in the US public sector have a sub-phase, the evaluation stage, in which they negotiate prices and allow proponents to mend the irregularities noted in their proposals. Only after that the grades are calculated, and the winner, announced.

In the last phase – contract finalization – the committee can negotiate alternative technical concepts proposed by a pre-qualified company or several pre-qualified companies, but which had not won the bidding process, provided that the (negotiation) procedure has been previously approved in the proposal request preparation stage. Once alternative technical concepts are negotiated, the company is compensated and the commission remakes the final price, comprising the change. After negotiation, the commission concludes the winning company hiring and, after competent authority approval, the contract goes to the administration phase.

Regarding each phase duration, Migliaccio and Shrestha (2009b) conducted a study with a sample of 19 highway work enterprises performed according to the DB method, with a cost range between \$ 9 million and \$ 1.3 billion, conducted between 1997 and 2006, with the results shown in Table 1.

TABLE 1 – Two-stage selection process phases duration

Statistics type/ Estimated time	RFQ1 ^a	RFQ2	RFQ3	RFP1 ^b	RFP2	RFP3	Contract Finalization	Total duration
Average	2.6	1.9	1.0	7.4	3.3	1.8	2.0	12.4
Minimum	1.0	0.9	0.2	2.7	1.1	0.7	0.1	4.5
Maximum	4.7	6.0	2.0	15.0	6.0	8.0	3.0	27.6
Standard deviation	1.02	1.18	0.78	3.7	1.63	1.9	2.2	5.8

Note: ^aRFQ = Request for Qualification ^bRFP Request for Proposal

Adapted from "Procurement of design-build services: two-phase selection for highway projects," G. C. Migliaccio, G. E. Gibson, E. and J. T. O'Connor, 2009a, *Journal of Management in Engineering*, 25, 29-39. "Analysis of design-build procurement activities durations for highway projects," G. C. Migliaccio, and P. P. Shrestha, 2009b. *Proceedings of the ASCE Construction Research Congress*, Seattle, WA, USA, p. 229-238.

In the study by Rosner, Thal, and West (2009), with data from 278 DB enterprises and 557 DBB enterprises performed between 1996 and 2006, it was found that the DB method significantly improved regarding total time extrapolation and enterprises cost throughout the years. This suggests that the know-how acquired by the contracting party improves time and cost method metrics. One should also consider that certain procedures standardization with method extensive use is time and resource-efficient.

3 DESIGN-BUILD METHOD DISADVANTAGES AND RISKS

Aiming at a possible method implantation, it is necessary to know success critical points, negative aspects and inherent risks.

In order to fully enjoy the benefits, it is necessary to pay attention to critical success points in the DB method which, if ignored, can configure specification nonconformity and cost and deadlines extrapolation risks. Lam, Chan and Chan (2008) cited contracting party's (the staff or consultants) and construction team's competence, management action effectiveness (communication, control and management systems and organizational structure), working relations among teams, contracting party's contributions (experience and knowledge), contracting party's deadlines and costs focus,

and innovative management approaches use. Regarding contracting party involvement in the scope definition stage and in cost, deadline and quality control throughout the enterprise, Molenaar and Songer (1998) claimed that the absence of this may result in nonconformity in relation to initially established specifications. Park et al. (2009) cited the existence of a contracting party system to measure and control contracted party performance as a critical success point in the DB method.

Concerning the risk, the DB contracting method is better applied, according to some authors (Konchar & Sanvido, 1998; Park *et al.*, 2009), to large and complex enterprises. However, it is important to mention three perspectives, according to which Miller and Lessard (2001) suggested their intensity analysis in enterprises of this sort ballast coping and training strategies. These perspectives are related to completion, market, social and institutional risks, which in turn vary simultaneously in intensity, according to the authors, depending on the enterprise type. It is pertinent to note that the «risk formation» term deals with the possibility of the risks being caused to provide a positive repercussion on the enterprise.

Enterprise completing risks can be: technical - those that are usually related to designs that generate the enterprises, or used technologies; of construction - those which contracting party, contracted party and sponsors are subjected in the

enterprise construction phase; and operational - those related to the possible income stream non-materialization or the possibility that the enterprise have not met the expected profitability. Such risks “can be substantially reduced by selecting an operator with economic interest in improving the returns and control costs” (Miller & Lessard, 2001, p. 439).

Market-related risks are often linked to financial investment expected returns in the enterprises, for which management and probability calculations are not required. Such probabilities, for projects such as oil platforms, are believed to be predictable, once there is acceptance of its products in several markets due to high demand, fungibility (it does not allow reuse) and replacement restricted to a few similar products (alcohol, biofuels). On enterprises related to roads, tunnels, bridges, airports and ports, as Miller and Lessard (2001) explained, foreseeing such return probabilities become extremely difficult, given the various alternative routes available to users.

Institutional nature risks may be originated from regulations, social acceptability and sovereignty. Regulations related to norms and laws that interfere in prices, imports and exports, for example. Applying it to the context of the study, companies which contract with public bodies are subjected to risks imposed by the Brazilian Procurement Law providing for works, goods or services contract suppressions (art. 65 of Law No. 8,666/1993), contract terminations by force majeure reason (art. 78, XVII, of Law No. 8,666/1993), contract termination motivated by subsequent event (art. 49 of Law No. 8,666/1993) and exorbitant clauses regarding contracts unilateral termination and amendment (art. 58 of Law No. 8,666/1993). (Law n. 8666, 2004).

Risks arising from social acceptability refer to those to which the sponsors are subjected in view of local groups' opposition, economic development agencies and influential groups' pressure. In regard to risks arising from State sovereignty, they are referred to the government

probability of renegotiating contracts, concessions or property rights (Miller & Lessard, 2001), or, yet, noncompliance with the agreed risks (Miller & Hobbs, 2005). These are related to the State power to renegotiate in these domains by using the public interest primacy.

According to Miller and Lessard (2001), urban transport, roads and tunnel system enterprises show high risk levels, considering the following perspectives:

- a) social and institutional - public funds use social acceptability;
- b) conclusion/technical - rock formations that may cause unforeseen situations and hinder geological and underground work.
- c) market - high risks when enterprises are funded by private sponsors and under consortia schemes.

Miller and Hobbs (2005), which are involved in the International Research Program on the Management of Large Engineering and Construction Projects (IMEC), investigated risk sources in large and complex enterprises management between 1996 and 2000. Among the most important risk sources in enterprises of that sort, they have identified: governments refraining from commitment fulfilling, slow materialization (return), insufficient markets, and legitimacy social and political challenges. They have verified that, for large and complex projects, the uncertainty level was extremely high, in part because of the large number of potential risk sources, project visibility and involved innovations. The long time for project development and implantation increased emerging risk exposure (one that was not originally planned). Each project has on average four unforeseen factors and potentially catastrophic events during the long life cycles. Examples of such events and unforeseen risks include macroeconomic risks, such as the Asian Economic Crisis, changes in the political scenario, and a partner organization facing financial difficulties and restructuring.

Another approach, which is not the one based on the studies of Miller and Lessard (2001),

and Miller and Hobbs (2005), proposed by the PMBOK® Guide (PMI, 2008), stated that all project management knowledge areas may be potential sources of risk generation. Thus, in each of the other eight knowledge areas (besides the risk area), described in the PMBOK® Guide, risks can occur due to: environmental threats and opportunities - integration area; flawed definitions - scope area; tight or unfeasible schedules - deadline area; tight or unfeasible budgets - cost area; diseases, absenteeism, high turnover, resignation - human resources area; failures or deficiencies in communication - communication

area; failures and nonconformities - quality area; low performance, poor specifications, noncompliance with deadlines - purchasing/hiring area (PMI, 2008).

Based on the approaches described in Miller and in the PMBOK® Guide, risks inherent to DB enterprises that are restricted to contracting party and contracted party were researched in the literature. The chart below shows disadvantages and risks associated with DB contracting method, classified according to risk sources covered in this section, and mentioning the studies in which they were cited.

TABLE 2 – Disadvantages/Risks to be considered in the DB contracting method

DB enterprise Disadvantages/Risks	Risk Sources
Excessive demands and the very rigorous selection process impose high costs to prepare proposals, leading to reduced number of participants and increased failure risks in competition; risks transferred to proponents increase proposed prices (Park <i>et al.</i> , 2009; Yates, 1995).	Scope, cost and acquisitions/contracting (PMI, 2008)
Excessive specifications, which are very detailed, and sometimes incomprehensible, leading to a lack of project flexibility and limitation in alternative solutions development or innovations introduction, increasing proposals price and failures risk (Park <i>et al.</i> , 2009); the quality in the process and in the final product cannot be guaranteed, once the quality monitoring is not as transparent as in more traditional hirings (Arditi & Lee, 2003); changes in the project due to problems in the specifications, and processes long revision (Chang, Shen, & Ibbs, 2010).	Scope, cost, deadline and quality (PMI, 2008)
Contracting party and contracted party inexperience in the method use initial phase; poor communication; conflicts (Chang <i>et al.</i> , 2010; Park <i>et al.</i> , 2009).	Human resources and communication (PMI, 2008)
Contracting party no involvement, with consequent quality impairment and enterprise control loss (Park <i>et al.</i> , 2009; Arditi & Lee, 2003; Yates, 1995).	Scope, cost, deadline and quality (PMI, 2008)
Institutional nature risks with regard to regulations and State sovereignty.	Miller and Lessard (2001)
Risks of governments not to meeting the agreed; emerging risks related to disasters, technical problems, changes in political and economic scenarios.	Miller and Hobbs (2005)

4 METHOD

This research is a qualitative nature case study. The case was chosen with the intent of helping the researcher to better understand the problem in question, considering relevant aspects such as: scenario (where), actors (who), events (what the actors are doing) and processes, which are concerned with the evolutionary nature of the events experienced by actors (Creswell, 2007). Thus, it was chosen to study a public body

whose activities involve contracting projects and executing works classified as heavy construction, in the domain of the state government of Pernambuco. This body has been selected to execute large and complex public enterprises, a scenario in which the DB method would be best applied (Park *et al.*, 2009).

As data collection instruments, spreadsheets were used with the purpose of storing and organizing research documental data, and therefore identifying the intentional sample of respondents.

Thereafter, a semi-structured interview was conducted for field research, with objective and subjective questions, through which interviewees' opinions were collected regarding problems observed between design and construction, the possibility or not of DB method solving such problems, and Public Administration risks, advantages and disadvantages in adopting this method. The Brazilian procurement law prohibits DB method application, i.e., it does not allow hiring a company to draft a project (basic and executive project) and conduct the construction execution. Thus, respondents could not be asked about method practical issues, but only about issues that, according to their perceptions, could occur in case the method was adopted.

Nineteen interviews were conducted: three with public body fiscals and 16 with engineers from companies hired by the body, and selected based on prior documentary research in bidding processes carried out between 2006 and 2010. Companies were categorized according to the nature of services provided in construction companies (works performing), designing (contracted to draft the basic and executive designs) and supervising (contracted to monitor work execution, as specified in the basic and executive projects). The sample of respondents was defined as shown in Chart 2.

Two respondents selection criteria were used: 1) higher number of amendments, aimed

at collecting the opinion of respondents who had a higher number of amendments in contracts signed by the body which was object of study, since supposedly they would be more familiar with problems between design and construction that result in amendments; 2) more sizeable contracts, aimed at collecting the opinion of those hired for higher values, once these were in charge of executing supposedly more complex works. In order to maintain the source confidentiality, companies were named as presented in Chart 2. The three construction companies, selected according to the largest number of amendments, were named ECQ1, ECQ2 and ECQ3. Designers, selected by bulkier contracts, received the EPV1, EPV2, and EPV3 designation, and so forth. Project, construction and supervision groups, contracting party and contracted party diversity and data collection form, which was by documentary and field research in the form of interview, with objective and subjective questions, allowed a problem analysis through different points of view, and different opinions exploration on the matter in question (Markoni & Lakatos, 2009). It is important to emphasize that respondents have not restricted their answers only to the public body, which was the source of the study, as they provided similar services to other public bodies from different government levels; therefore, there is the possibility of results generalization.

TABLE 3 – Classification, selection criteria and names assigned to respondents.

Respondents	Criterion	Values	Interview qty.	Denomination
Constructing companies	Amendments qty.	Between 5 and 7	3	ECQ
	Contract value	> R\$ 30 mi	3	ECV
Designers	Amendments qty.	Between 3 and 5	3	EPQ
	Contract value	> R\$ 500 th	3	EPV
Supervisors	Amendments qty.	2 nd	2	ESQ
	Contract value	> £ 2 mi	2	ESV
Inspectors	-	-	3	FISC

Note: *Only two contracted more than once.

After transcribing the interviews, the content analysis was applied to the transcriptions. The idea of theme was used in register units prior identification, which is a signification unit that naturally emerges from an analyzed text

(Bardin, 2011). Later, registration units were organized into thematic categories related to DB method advantages and disadvantages foreseen by respondents. The procedures for this study are outlined in the following figure.

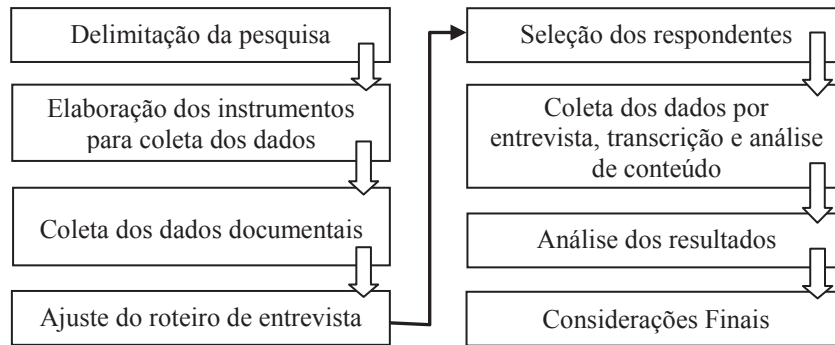


FIGURE 4 – Procedure to conduct the research

5 RESULTS

Among the research subjects, 11 respondents were emphatic in stating that the DB method would not solve all problems between design and construction. Others cited the positive contributions that it would ensue, focusing, however, on problems which were envisaged with method adoption. The following aspects were cited as benefits that method adoption could bring to work execution in the studied context:

- a) construction and design executed/ developed in parallel;
- b) problem reduction between design and construction;
- c) design modifications reduction and problems elimination with obsolete designs;
- d) conditions improvement to modify and monitor the design;
- e) design mastery by the construction team;
- f) faster construction;
- g) ease to respond for any damage or defect (a single responsibility point);
- h) design problem elimination in the construction phase (project adaptation to the work reality, carried out by supervisory company);

- i) incentive to the emergence of companies with the appropriate structure; and
- j) less administrative problems.

The relevant points to be considered when using the DB method, in the respondents' opinion, are described in Table 2, as well as the absolute frequencies of the categories, identified through content analysis. It is important to highlight that results were obtained from respondents' perception about the DB contracting method implications in public works execution, and can only be validated in the case of implantation in Brazil.

As shown in the table, the main and most discussed points were the benefits that the construction company would bring to itself in order to design the project and execute it, and the structure that public bodies should have to exercise effective control. Nineteen records described the concern with the benefits that the construction company would obtain by being responsible for the design and the execution. According to respondents, the construction company could draft a project making use of inadequate equipment, poor quality material and disqualified labor in order to minimize costs. Fraud in public procurement, unfinished works, works that showed problems

just after being concluded due to failure in its execution, or that showed problems some cases even in its design phase, all widely known, suggest that such concerns are well-grounded. In addition, the lack of expertise in projects would make the building companies adjust prices according to those risks, and decisions on the project would be made by the construction company in first place and not by the requesting body, as it currently happens. Regarding the control that the construction company has on the enterprise in the DB method, Molenaar and Songer (1998) emphasized that the contracting party's involvement is of paramount importance to minimize it.

With regard to the structure the bodies should have to exert proper control, respondents mentioned active and qualified inspection, detailed project analysis and objectivity to define

the scope. Among DB method disadvantages, Arditi and Lee (2003), Park et al. (2009) and Chang et al. (2010) mentioned the difficulty of the contracted party to manage the enterprise and ensure quality. Without proper structure, including the clear definition of the several procedures involved when monitoring a DB enterprise, there will be consequences such as low project quality, poor communication, lack of contracting body prerogative in project definition, high prices, time-consuming administrative processes, among other interferences. On the other hand, the several stories about procurement and public work execution frauds, so recurrent, may have led ECQ1 to explicitly state that strong and effective management absence by the contracting body may lead to illicit acts occurrence (see the Fairness in procedures/commitment topic in Table 2).

TABLE 4 – Respondents opinion on *design-build* implantation relevant points (to be continued)

Categories	Discrimination	Constructing companies		Designers		Supervisors		Inspection
		ECV	ECQ	EPV	EPQ	ESV	ESQ	
Construction company benefit	Construction company would benefit from the project when defining equipment/services, material, quantities, prices and deadlines.	1	1	2	3	1	3	8
Lack of structure/qualification by the body to exert due control	The public body would have no structure to exercise due inspection.	1	2	2	3	1	1	1
Companies extinction, merger, restructuring	Companies would close because they could not meet the demand. Distinct <i>expertise</i> originates mergers and/or restructuring companies.	2	2			1		1
It would cause subcontracting	Construction companies have <i>expertise</i> in projects, which would lead them to hire designers.	1		1		1	2	
Error identification problems	Another company's errors could not be identified.			3				1
It would not be the solution to the problems caused by delay	It would not minimize problems such as expropriation delays, utilities relocation, resources transfer and licensing.	1						
Smoothness in procedures/commitment	It requires good management by the contracting agency to maintain fairness and commitment to good results.				1			
Problems with regulatory agencies	It would cause more problems with regulatory agencies.		1					

The need to adjust the companies to the new demand would, in respondents' opinion, lead to extinction, merger, restructuring and even subcontracting among segment companies, which is ratified by Puerto et al. (2008), Park et al. (2009), Oyegoke et al. (2009) and Chang et al. (2010), when they mention that companies contracted by DB method may subcontract services for which they have no *expertise*. Concerning the difficulties found by companies, Park et al. (2009) cited the fact that there are few trained or qualified companies as a DB problem. Chang et al. (2010) cited the lack of experience with construction and with design by the designer and the builder, respectively, concerning the qualification issue required from these companies. The assertion that construction companies would hire designers lies in the fact that nowadays, at least in the studied sample, companies clearly have distinct expertises, design or construction, what would lead them to, *a priori*, subcontracting.

EPV and FISC2 designers mentioned error identification problems. Nowadays, the supervisor analyzes and adapts the design prepared by the designer to the reality of the work. Thus, they identify some mistakes which went unnoticed by those who drew the design. Then, it was hypothesized that when drawing up and executing the project, the construction company could not notice some errors. Designers who were interviewed see supervision companies' performance from a positive point of view when revising projects, because errors can be identified and corrected. In the DB method, revisions should be carried out by the contracting party's technical team. The absence of this team could collaborate for error non-identification on the design prepared by the contracted party.

ECV 1 pertinently noted that the DB method would not be the solution to the problems caused by several delays. The origin of these problems lies in the lack of planning and control by administration. As FISC1 mentions (FISC1 transcription, answer 22), there are expropriations which take a long time to be made

due to legal issues, and due to the fact that required documentation for the negotiations sometimes is not in the owner's possession. Thus, how to foresee and plan for these cases? In other cases, environmental permits specifically, it is discovered during the execution, due to the identification of a rock formation that was not verified in the design, that the road should have a different route and go through an environmental preservation area. So, how to anticipate and be prepared to face such a situation? You must agree with FISC1 regarding these points. However, having had previous planning, facts are likely to happen as the mentioned ones referred as emerging risks, and should certainly be foreseen, with procedures to be taken in case they happen, and the necessary time to solve them. Besides, contracted design data *in loco* verification by the inspection team or by the body technical team would enable the identification of aspects which went unnoticed by designers, such as an improper rock formation.

ECQ1, due to DB enterprise complexity, mentioned that the method adoption would cause further intervention by regulatory agencies, and EPQ 3 emphasized the need for fairness and commitment by both involved parties, contracting and contracted. These statements have to do with work price and/or basic budget spreadsheets elaboration. Nowadays, the designer company drafts the work basic budget and, when taking part in the bidding, the contracting company must organize their pricing spreadsheet in line with such a budget. However, after the bidding is won, many constructing companies require pricing spreadsheet readjustment, what involves service items quantity increases and decreases on the grounds of adapting services to the local reality. Nowadays, with the design and the construction being carried out by different companies, regulatory agency actions have identified spreadsheet preparation irregularities with respect to arbitrary prices and quantities. In the case of a single company, similar practices could become more difficult to be identified, and therefore attract more careful audits performed by regulatory agencies.

6 CONCLUSIONS AND FINAL CONSIDERATIONS

Throughout the years, government agencies gradually moved from public work performers, whose main activity was executing works, to company contracting parties that would design, inspect and build these works. Such contracts generally take place by means of lowest overall price or lowest unit price public bidding. It should be noted that, although the lowest price culture is still in force, the originally contracted values are sometimes increased by amendments or by economic and financial rebalancing. In value amendments case, nonsense is observed, since, if there is concern with the lowest contracting price, the lowest price should be sought also in the execution, ensuring that deadlines and contracted values are met. However, it is not what happens. These bodies do not contract execution and basic project because the legislation does not allow it, what contributes to the lack of experience on the respondents' part regarding the studied method. Even in the private context, which companies had already performed DB enterprises was not either identified.

Although the DB method is not used by the Brazilian public sector, its implementation could bring many benefits according to executives in the segment, such as: problem reduction between design and construction, project modifications reduction, problems with obsolete projects elimination, better conditions to modify and monitor the design, design mastering by the construction team, faster construction, construction and design executed/developed in parallel. Moreover, DB method adoption would contribute to take accountability of any damage or defect (a single accountability point), eliminate the design problem in the construction phase (design adaptation to the work reality, carried out by the supervisory company), incentivize the creation of companies with the necessary structure, and involve less administrative work, due to the single accountability point.

However, authors such as Yates (1995), Konchar, and Sanvido (1998), Molenaar (1999), among others, indicated that the best time

performance is among the main advantages of this method. It is undeniable that great works in Brazil take a considerable amount of time to be concluded. As an example, one can mention the São Francisco River transposition and the Transnordestina highway construction, which is still not finished up to this moment. Countries such as the UK, Korea and Japan have shown time and cost reduction in services contracted by the DB method. This study assumes that this method may also, in Brazil, optimize time, reduce costs and improve public works quality.

As mentioned in the study of Molenaar and Gransberg (2001), US states are changing their laws to contract enterprises which comprise design and construction activities jointly. The advantages offered by the method are numerous, and proven by the cited studies. However, before implanting it, it is prudent to note the negative aspects and probable risks, in order to draw on these coping strategies, eliminating or reducing its effects.

Professionals from the work inspection and contracting fields would have to be hired and/or trained according to the method demands. In addition, the processes must be redesigned and the necessary resources, provided - ongoing training, organizational structure, equipment, IT tools. When considering the processes redesign in order to improve communication and interaction between contracting party and contracted party, it would take some time until both would get used and this process advantages would be noticed.

Regarding the DB method selection process, this involves several stages and considerable time to prepare the bid and select and contract the best offer. There is still administrative resources interposition by the proponents, which can make the selection process longer. Soon, it would be imperative, before method adoption, that contracting teams were trained and equipped with all necessary infrastructure to prepare specifications and public notices, in order to minimize appeal occurrences, as well as enabling quick responses.

Finally, a considerable restriction is related to the lack of planning and controls on

performance, quality and scope by the contracting party, deficiencies that must be corrected before the method in question adoption, since, above all, due control exercise is a critical success factor. By generalizing the limitations mentioned for all public bodies, it would not be advisable to have any initiative in implanting the DB method in public enterprises contracting in the Brazilian context without first eliminating or minimizing their risks and weaknesses. In this sense, these findings will be useful to adopt preventive measures.

The results may still contribute not only to a possible method implantation even in different contexts from the public, but also for the improvement of processes concerning works design and execution. In addition, this study offers contribution as a suggestion to make the legislation flexible according to potential gains from the DB implantation, especially due to known delays and overpricing in the various Brazilian public work enterprises, namely: World Cup/2014, Growth Acceleration Program (PAC-1 and PAC-2), My House, My Life program (MCMV), among others.

As used research method limitations, it is visualized, *a priori*, study performance with a state public entity which would hinder the conclusion generalization drawn from the study. However, in order to answer questions, respondents were based not only on their experiences with enterprises carried out by the bodies which were object of this study, but also in other experiences acquired in similar enterprises in various bodies. The intentional sample composed of three (3) professionals of each company category is also a limiting factor, since the selected companies may not be the most representative of the studied universe. Despite this, as noted in Table 2, respondents selection was detailed considering the amount of amendments and higher contracted amounts, and diversified considering construction companies, designers, supervisors and inspectors of the studied public entity works.

With regard to the DB method identified restrictions implantation, it is possible that

the study in another public entity would allow different conclusions. However, considering that the observed restrictions are inherent to the great majority of public bodies in the country, it is unlikely to happen. However, more studies on the method, in a private scope or in public-private partnerships could be conducted, whether or not to confirm the advantages and disadvantages verified in the studies of the consulted authors. In addition, most of related studies could confirm, refute or add possible disadvantages and risks to DB method adoption. In contexts using the DB contracting method, it would be possible to verify whether the time spent in the selection and contracting process influences work execution time reduction.

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