Abstract

The aim of the procurement process in construction is to acquire the construction work that meets the client’s needs. One of the steps in this process is the functional grouping. The functional grouping of a project is the way in which tasks, responsibilities, liabilities and risks are divided among the construction participants. There are several types of functional groupings for construction projects that are commonly used like Design-Bid-Build or Design-Build.

For a client, the choice for a type of functional grouping that fits his needs is difficult to make. In this paper, insight is given in possibilities the client has in the decision making process for choosing a suitable functional grouping for his project. Next to that a comparison is made between the traditional Design-Bid-Build and the more integrated Design-Build.

Data has been collected by interviewing construction experts. These experts were clients as well as contractors.

Keywords: Design-Bid-Build, Client, Decision making process, Design-Build, Functional composition.
1. Introduction

Over the last decades, the Dutch construction sector has been price oriented. This has led to a construction industry in which the participants distrust each other and the several disciplines are highly separated (Maas and Van Eekelen, 2003). The last few years, a structural transition is going on. Programs have been developed, such as the PSIBouw program, that focused on alternative, more integrated procurement strategies in contrast to the more traditional ones. Although the price oriented traditional construction procurement strategy in many cases does not suffice, many large clients still choose for this strategy. As a consequence the client will often not get value for money.

It has become increasingly evident over recent years, that an appropriate choice of procurement system, while necessary for project success is not sufficient to ensure it. But appropriate procurement strategies are needed to help to achieve optimal solutions in terms of cost, time and quality (Kumaraswamy and Dissanayaka, 1998). The functional composition, which helps dividing the tasks, responsibilities and risks among participants, is considered to be the most important and leading subsystem of the procurement system (Luu et al., 2005). Therefore it is important for clients to choose the right functional composition.

Over the years many different functional compositions have been developed, which makes it difficult for clients to make a considerable choice. A model, developed at the University of Eindhoven (Maas and van Eekelen, 2003) has been taken as a starting point for this research.

The functional compositions for construction projects can be divided in more traditional and more integrated functional compositions. To help the client in making a decision for a specific functional composition it is important to get insight in the specific project situation and which type of functional composition fits best for that situation. Therefore the aim of this study is to create insight into the client’s considerations for a functional composition by analyzing the factors that influence the client’s decision making process and give insight in the differences between two functional groupings in order to guide the client through this process.

In paragraph 2, the different steps of the procurement strategy will be explained further in order to present the relationships between these steps (and the functional composition in particular) more clearly.

2. The procurement strategy

Many parties are involved in a construction project. The division of roles, tasks and responsibilities is a very important step in the construction process. In literature, the type of organization that follows from the choice of this division is called the functional grouping (Kumaraswamy & Dissanayaka 1998). The names of commonly used functional groupings often refer to the roles and tasks that are outsourced by the client to a contractor. Functional
grouping is one of the steps in the whole procurement route that has to be followed for each construction project.

Kumaraswamy and Dissanaya (Kumaraswamy & Dissanayaka 1998) state that a procurement route exists of 5 parts. In order to develop a certain procurement route, the next choices have to made:

- Work packaging
- Functional grouping
- Payment modalities
- Form of contract
- Selection methodologies

In paragraphs 2.1 - 2.5 the 5 procurement route steps will be discussed.

### 2.1 Work packaging

There are several reasons for a contractor to cut a large project into a number of smaller projects or just leave the project as it is. For example, one project might be too big or too complex to be executed by one contractor. That can lead to cutting the project into several work packages with each their own characteristics. Work packaging describes the type of project, the size of the project, the function and the location of the project.

### 2.2 Functional grouping

The functional grouping is the result of strategic and tactic considerations concerning the economical functions in the construction process and the division of roles and tasks for the different parties. The functional grouping relates the different construction process phases and relates the different parties that cooperate in the process. The choice for a certain type of functional grouping forms the structure of the project organization consisting of functional and contractual relations and the division of the responsibilities, liabilities and risks.

There are a lot of different ways to set up the functional grouping of a construction project. The traditional Design-Bid-Build process (DBB), in which a contractor is contracted based on specifications and drawings is very segmented. After finishing the design, the client hires a contractor who builds the project according to the client’s detailed specifications. This means there are two separate groups involved; the design group and the construction group (Ling 2004b) and the process functions designing and building are strictly separated. This means that
the client is responsible for the development of the final design including the detailed construction specifications. These specifications are the basis for the selection of the contractor. During the construction of the project the client normally does the supervision or quantity surveillance to make sure that the contractor executes his tasks properly.

Nowadays, more integrated delivery approaches are more and more often used by all types of clients (Regieraad Bouw, 2007 / Pakkala et al, 2007). In the Netherlands, one of the biggest public clients, the Ministry of Transportation, even prescribes the use of Design-Build (DB) contracts for new and reconstruction works (RWS, 2007). DB is a so-called integrated procurement route. This concept has deep historical roots. In ancient times, the ‘master builder’ had full responsibility for all phases of the project. Nowadays in the DB approach, it would involve a multidisciplinary team (Palaneeswaran & Kumaraswamy 2000). This type of procurement routes, in which one company or consortium of companies is responsible for the design and execution of a project, requires a totally different attitude of the contractor as well as the client.

The above-mentioned contractual forms differ from one another in the division of responsibilities, tasks and roles and functions. Next to that, they also differ in the moment on which the contractor is contracted. In the DBB process, the signing of the contract is just before the starting of the realization phase. In a DB contract, the contractor also develops a part of the design. In that case, the contract has to be signed earlier in the process. These shifts in the moment of contracting mean that each time different kind of performances are demanded of the client and the contractor. Therefore, in every single case, an other division of the roles and responsibilities is necessary.

### 2.3 Payment modalities

An important part of the procurement process, that is closely related to the choice of a certain functional grouping, is the choice of a payment modality. For example, the contractor can be hired based on a lump sum, but the client can also choose for a cost-plus-fee payment. An other choice that has to be made is the timing of the payments: per month or when certain milestones are reached.

The choice of a payment modality determines, to a large extent, how the client and the contractor cooperate. Working with a lump sum and specifications and drawings that are specified on a high level will be very different than working with paying after the important milestones of the client are achieved. This is also linked largely to the functional grouping and the selection methodology.


2.4 Form of contract

In the construction sector, there are a lot of contractual standards that can be used as the basis of every construction project. Internationally, there are the FIDIC contracts. In the Netherlands, the “Uniforme Algemene Voorwaarden” (UAV) and the UAV for integrated contracts (UAV-gc) are usually used.

Next to that, choices must be made on which type arbitration will be used in case of problems.

2.5 Selection methodologies

If a client has made all the above mentioned choices, then he has to make the choice for the tender procedure. The tender procedure consists of 3 important levels:

- Tendering procedure
- Selection and awarding criteria
- Decision modelling (scoring, weighing)

3. Methodology

In order to achieve the goal that is set, the following research questions must be answered:

- Which factors influence the client’s decision making process for a functional composition?
- What are the distinctive features of the functional compositions DBB and DB?
- Which criteria determine the difference between the functional compositions DBB and DB?
- What are the distinctive differences between DBB and DB on these criteria?

The research is descriptive and explorative. On the one hand literature survey has taken place in order to find the answers on the first two research questions. On the other hand 12 interviews with experts have taken place to answer the third and fourth question. Information from these interviews has been analyzed. Based on this information a list of differences has been developed, which is the answer to the last research question.
The literature review can be found in paragraph 4. This survey has given a broad view on factors that influence the client’s choice for a functional composition. By means of a Cause-and-Effect Diagram these factors are gathered as shown in Figure 1. Furthermore this review has been used to get insight in distinctive features of both DBB and DB. Based on this literature survey a theoretical framework has been designed for the second part of the research: the interviews.

The theoretical framework has been converted to a research model that can be used for gathering and analyzing data from expert-interviews. By gathering and analyzing data it is examined which criteria determine the difference between DBB and DB. Based on these results a list is constructed to guide the client in his decision making process. This list helps clients choosing a more traditional or more integrated functional composition. The interview results can be found in paragraph 5. In paragraph 6 the results of both the literature review and interviews are combined.

4. Literature review

4.1 Factors that influence the choice for a functional composition

Factors that influence the choice for a functional composition are shown by the Cause-and-Effect Diagram in Figure 1. Mainly based on Kumaraswamy and Dissanayaka (1998) the factors in this diagram are divided in four categories: The functional composition, the procurement system, the specific project and process situation and project results. These features directly influence the choice for a functional composition.

The procurement system consists of four subsystems, work packaging, functional composition, contractual arrangement and team selection (Kumaraswamy and Dissanayaka, 1998; Luu et al., 2005). The functional composition is leading and once the choice for a certain functional composition has been made the choice of the other subsystems will become apparent (Luu et al., 2005).

Project and process features in specific project and process situations can be divided in four subcategories; external context, internal organization, project characteristics and client’s goals and priorities (PSIBouw, 2005; Luu et al., 2005).

The last category, project results can be described in terms of costs, time, quality, client’s satisfaction and a rest category (Chan, 2002).
4.2 Distinctive features of functional composition DBB and DB

The distinctive features of the functional composition can be divided into primary and secondary features. These primary and secondary features are shown in Figure 2.

The primary features are features of the functional composition. These are shown in Figure 1. Based on these subcategories five distinctive primary features have been formulated based on Dorée (1996), Kumaraswamy and Dissanayaka (1998) and Regieraad Bouw (2006). These five primary distinctive features are:

- Procurement method (Dorée, 1996; Kumaraswamy and Dissanayaka, 1998)
- Moment of transferring responsibilities (Dorée, 1996)
- Composition of the design team (Dorée, 1996)
The secondary features are features of the procurement system. As shown in Figure 2 the procurement method leads to the secondary features of the functional composition. These secondary features are: work packaging, contractual arrangements and team selection (Kumaraswamy and Dissanayaka 1998; Luu et al., 2005).

### 4.3 Criteria that determine the difference between DBB and DB

Based on Luu et al. (2005) and Ng et al. (2002) criteria are defined that determine the difference between functional compositions. Several interviews with experts in the Dutch Construction Industry completed this list of 16 criteria (see table 1). These criteria are divided into three categories: (1) project results, (2) process specific situation and (3) project specific situation.

### 5. Interviews

Based on the criteria from paragraph 4.3 twelve interviews with experts were held in order to determine differences between DBB and DB. Due to the amount of relations in the research model these interviews were semi-structured. One part was a survey in which experts had to give a value to relationships between criteria and functional compositions. The other part consisted of open questions in which experts were asked to declare these relationships. These
experts were experienced project managers from contractors (2), from consultants (3) and from public clients (7).

In table 1, differences between DBB and DB can be seen. The criteria and experts’ input are discussed in paragraphs 5.1.1 – 5.1.14.

5.1.1 Time certainty

11 experts state that time certainty is much higher in DB projects. The main reasons for this are the moment of contracting a contractor (which is earlier in a DB project) and close cooperation between design team and realization team.

5.1.2 Total time (preconstruction time and construction time)

10 experts state that the total time in a DB project is in most cases shorter. Better cooperation within a Design and Build firm and the contractor’s objective to spend as little time as possible are the main drivers for this. Looking at preconstruction time and construction time separately shows the same results.

5.1.3 Costs certainty

8 experts state that costs certainty in a DB project is higher than in a DBB project. As with time certainty, costs certainty is also better because of the moment of contracting a contractor (which is earlier in a DB project and therefore the amount of money that a client has to spend is known and fixed earlier). Next to that, close cooperation between design team and realization team will make sure that coordination between these two teams will go smoother and faster.

5.1.4 Construction costs

6 experts state that construction costs in a DBB contract are always lower. Three experts state that the construction costs in a DBB are only lower in the right economical phase and 3 state that the construction costs in a DB project are lower. The construction costs in a DBB project are lower because of the price oriented way of tendering. Opposite to that is the fact that total construction costs in a DB project might become lower because of the good cooperation between design and construction teams.

5.1.5 Maintain and operate costs

Experts’ opinions are miscellaneous. Most experts agree that the client’s influence on specifications in a DBB project is higher and can therefore lead to better specifications on the field of maintenance. On the other hand, a client can also do this in a DB project.
5.1.6 Quality guarantee

4 experts state that DBB can better guarantee quality. 4 experts state that DB can better guarantee quality and 2 state that both can guarantee quality on an equal level. The influence of a client in DBB can make sure the quality is better guaranteed. Opposite to that, the cooperation in a DB firm can optimize quality.

5.1.7 Price/quality ratio

5 experts state that DB can lead to a better price quality ratio. 2 state that DBB leads to a better price/quality ratio. 3 experts say there is no difference and one states that it depends on the extent in which the contractor is able to use an innovative solution; if that is possible, DB leads to a better price/quality ratio. The last expert states that it depends highly on the economic situation.

5.1.8 Risk for the client

10 experts state that risks for the client are better manageable in a DB project. One says that they are better manageable in a DBB project. One states that it depends on the extent in which partners are able to manage risks. Main reason for this difference is the fact that a client has the possibility to allocate more risks with the contractor.

5.1.9 Flexibility of the client

8 experts state that the flexibility for the client (to change parts of the design) is bigger in a DBB project than in a DB project. This is because the higher level of influence that a client has during the project.

5.1.10 Knowledge of the client

Experts’ opinions are miscellaneous. The knowledge that is needed from a client in a DB project is concentrated in a short period in which his contribution of high level knowledge is big. In a DBB project, knowledge is needed during the whole project.

5.1.11 Capacity of the client

The capacity that a client needs to deliver is closely related with the knowledge that is needed.

5.1.12 Client’s influence on the project

10 experts state that the client’s influence is bigger in a DBB project. This is because of his design-responsibility.
5.1.13 Product complexity

10 experts state that a DB contract is more suited for projects with high complexity. Main reason for this is that coordination between design team and construction team is easier in a DB contract. Next to that, risks in a complex project are high. These risks can easier be allocated with the contractor in DB contract.

5.1.14 Process complexity

All experts state that complexity related to coordination between the different stakeholders Can better be managed in a DB contract. Next to that, all experts also agree that complexity on the field of the project’s environment (e.g. licenses) can better be managed by the client.

6. Results and discussion

The results of this research are combined in table 1. Clients can use this as a first step or a guide in making a choice for a certain functional composition.

Compared to the model of Maas and Van Eekelen (2003), in this paper only two functional compositions have been compared. Therefore a client can only conclude that a more traditional or a more integrated functional composition suits a specific project and process situation.

The results from this research are not valid in all situations. This means that some factors not taken into account in this study can strongly influence the differences between DBB and DB. The results that are shown are only valid under ‘normal’ circumstances.

This guide for clients has been designed, based on literature and research in practice. The list itself has not been validated yet. Therefore this list must still be validated by experts or by means of a few case studies.

Clients still lack insight into the complexity of a construction process and are not able to choose the right functional composition. Research at this subject is still needed to give different insights into this complexity and thereby helping a client in making the right choice.
Table 1: Differences between Design-Bid-Build and Design-Build

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Variable</th>
<th>D-B-B</th>
<th>D-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Time Certainty</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>Total Time</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Preconstruction Time</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Construction Time</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Costs</td>
<td>Costs Certainty</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>Construction costs</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Maintain and Operate costs</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Quality</td>
<td>Quality guarantee</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Price/quality ratio</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>Risk</td>
<td>Risks for the client</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td>Process</td>
<td>Flexibility of the client</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Knowledge</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Capacity</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Influence</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Project</td>
<td>Product Complexity</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>Process complexity / Uncertainty</td>
<td>+/-</td>
<td>+/-</td>
</tr>
</tbody>
</table>

7. Conclusion

This research gives clients insight in factors that influence the decision for a certain functional composition. It helps clients in making the first steps in the decision making process.
Besides that, this research shows what factors influence the project results. Based on the criteria in this research insight is created in differences between more traditional and more integrated functional compositions. Thereby the first steps of the decision making process have been made transparent.

This list can be used in every type of project. However this research is limited to those situations where only the Design phase and Construction phase will be considered when choosing the most suitable functional composition.

8. References


