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Design-Build and housing

Suitability analysis of Design-Build in housing projects

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Abstract

Summary of contents

DESIGN-BUILD AND HOUSING

The need for structural improvement in the construction industry has caused several new developments to emerge. This paper focuses on such a development: Design-Build.

Design-Build is an organization model that fights the separation of the design and construction disciplines by providing an integrated approach towards the construction process. Having already proven its use on infrastructural and utility projects, Design-Build has never been used in the Dutch housing sector. Therefore, this paper investigates the suitability of the Design-Build concept in housing projects.

DESIGN-BUILD VERSUS THE TRADITIONAL AND BUILDING TEAM MODEL

The two organization models that currently are of common use to housing associations, the traditional and the Building Team model, will be compared to Design-Build in order to examine their relative suitability in housing projects. This is done through the help of 18 different, project-affecting conditions. The suitability of the three models to handle the conditions may heavily influence project progress, and will therefore be investigated and subsequently be presented in a theoretical framework.

The empirical part encompasses the study of four housing projects. Two of them have been procured traditionally, whereas the other two have been realized through the Building Team approach. This part functions as verification of the framework, as well as a reference to compare the theoretical suitability of the Design-Build model with.

MAJOR FINDINGS

Housing associations show a tendency of choosing traditional procurement to realize their projects. Using this organization model, both the climate of the market and the attitude of the procured constructor turn out to be affecting project progress. Traditionally procured housing projects may even be affected more by these two variables than by any of the 18 conditions.

The Building Team approach is used merely to maintain a symbiotic relationship with the constructor, rather than an active choice with only the product in mind.

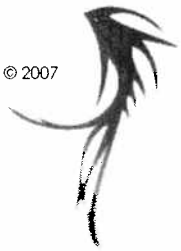
Design-Build -compared to both traditional procurement and the Building Team model- turns out to be little suitable for housing. Each studied case demonstrates to be better off using either the traditional or the Building Team model. The main cause for this result is that Design-Build shows inferior performance on those conditions that are of high relevance for housing projects. These are:

1. housing associations desire to have maximum influence on the final product;
2. housing projects are highly dependent on the market, government and environment;
3. Housing associations desire a high certainty of confirmation to expectations.

The three conditions indicate that housing associations need to be in full control of the process, because they are aware of their responsibility for the final result. Maximum involvement in the process provides a manner for associations to bend the project towards their consent, which may secure certainty of confirmation to expectations.

Design-Build however, requires a *handing over* of control and influence and therefore does not lend itself for the conditions mentioned above.

Currently, housing associations are better off using the traditional or the Building Team model for their new estate activities, as Design-Build does not appear to be a more advantageous approach.



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Introduction

Immediate cause and structure

IMMEDIATE CAUSE

The set-up of the organization that has been established to realize a construction project, may influence total construction costs up to 5% (van Delft, 2006; Dorée et al., 1999; Contractual, 1982). The temporary coalition determines the appearance of the contract and with that overall project success. Therefore, housing associations should consider thorough research in order to find the organization model that fits their project best.

This paper focuses on the application of a rather new and innovative organization model that has emerged to deal with existing issues in the construction sector: Design-Build. Having proven its use for infrastructural and utility projects, it has never been used for housing projects in the Netherlands yet. Instead, housing associations tend to apply the traditional or Building Team model. Therefore, this study examines whether Design-Build may be suitable for housing projects initiated by housing associations, with the traditional and the Building Team model functioning as references to compare performance with.

STRUCTURE AND OBJECTIVE

The paper first discusses the classical issues the construction sector in general has been struggling with for decades. Poorly established and inefficient project coalitions turn out to be the main cause.

The traditional organization model, which is being blamed by many for this reason, will be examined. Housing associations are keen on this approach, despite of its disadvantages.

The other organization model that is frequently used by associations is the Building Team, which will be discussed subsequently.

Next, Design-Build is introduced as a possible appropriate model for housing procurement. After having compared the -theoretical- impact the three organization models have in housing projects, a framework is presented that gives insight into their relative suitability to handle 18 different project-typifying conditions. These conditions determine the appearance of the project and the suitability of the organization model to handle them may heavily influence project success.

When the *theoretical* part of the paper is finished, the main objective is formulated:

"Determine the suitability of Design-Build –pertaining to the traditional and the Building Team model- in housing projects initiated by housing associations."

The *empirical* part of this paper encompasses the study of four housing cases: two traditionally procured and two Building Team projects.

The framework will be verified through the help of these cases, and it will then be used to obtain performance grades in order to compare the *actually used* organization models with *Design-Build*.

The cases will be individually examined, to find out to *what extent* and on the basis of *which conditions* Design-Build would have performed if it had been the used organization model in that case. The cases will also be collectively examined, to make a pronunciation upon Design-Build application on housing projects in general.

Clients may use the outcome to predict the suitability of Design-Build for future housing projects.

Please see appendix 1 for a visualized overview of the structure of this paper.

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Inefficiency in the construction industry

The need for improvement

3.1 Problems in the construction industry

For decades, there have been complaints about the construction industry. Many studies have shown this sector to be far from efficient. The two most representative issues will be discussed briefly:

SEPARATION BETWEEN DESIGN AND CONSTRUCTION

The first shortcoming was accurately illustrated by Emmerson (1962): *"In no other important industry is the responsibility for design so far removed from the responsibility for construction."* In continuation, Boes et al. (2004) state that the functional process of technical execution is more or less isolated from the remaining processes. Disadvantages of this situation are numerous. Because there is little cooperation (or none at all), there is a lack of knowledge of both the designer and the constructor concerning each others' specialism. This prevents design and construction skills to synchronize, which ultimately causes a lack of innovation and inefficient use of resources. Also, this situation increases the risk of a mismatch between estimated costs (by the architect or an external advisor) and actual proposed costs (by the constructor). (Hasselhof et al., 1988; Winch, 2001; Dorée, 1996; Boes et al,. 2004; Briscoe et al., 2003 and many others.)

STRONG FRAGMENTATION

The construction sector consists of many small enterprises that temporarily tie onto each other to form a project organization (Boes et al., 2004). Tommel (1995) stated that he would like to see a decrease in the fragmentation of the building process, because -as a client- it is preferable to work with multiple partners that act as one. Besides obtaining a huge administrative burden and an overall high project complexity, a disintegration of the supply chain prevents opportunities for innovation.

Fragmentation in the building sector causes discontinuity (Boes et al., 2004). The cooperation between actors that are involved in a project is generally strictly limited to the period the project takes place in. After completion, the coalition splits up. This temporary nature of the cooperation is seen as inefficient. Gained knowledge, about the appropriate mode of operation for a specific team for example, is wasted after each project. Constructors are uncertain about obtaining a continuous flow of work because their appointment is only project-bound (Boes et al., 2004).

3.2 Developments and solutions

DEMAND FOR RENEWAL: THE CLIENT AS NORMATIVE ACTOR

Throughout the world, there was an urgent demand for solving these issues. Many researches -originating from authorities, universities and individuals- revealed the *client* to be the normative factor that should initiate improvement and structural renewal (Latham, 1994; Egan, 1998; Winch, 2001; Caniels et al., 2005; Ketterings, 2006; OGC, 1999; SCF, 2004; King, 1998). The aforementioned issues are both situated at the organizational level, which is the level the client has most power.

Gradually, new methods of tendering and cooperation emerged. Building Team[1] is an example of an innovative organization model that fights fragmentation. Nowadays it has settled itself thoroughly in the construction sector and has been widely accepted and utilized.

DESIGN-BUILD AS REMEDY

Design-Build[2] is another rather 'new' organization model that has been developed in order to deal with the problems mentioned. Although the Design-Build procurement route has witnessed significant growth in the United Kingdom, (Anumba et al., 1996), the Netherlands have showed to be more reserved upon implementing the concept. After a short research (EIB, 2006; OTB, 2006; BNA, 2006; Aedes, 2006), it turned out that Design-Build has never been used in any Dutch housing project.

This paper examines the question whether Design-Build could theoretically be suitable for Dutch housing projects that are initiated by housing associations.

Goodchild (1998) mentions that there is no such thing as a better or superior organization model. Therefore, this study merely tries to recover the *conditions* that make Design-Build theoretically appropriate for a project, rather than attempting to unanimously designate the model as being superior to currently used ones. Under what circumstances can Design-Build be advantageous in terms of costs, time and quality compared to traditional contracting or Building Team?

[1] Please see paragraph 4.3 for a definition of the Building-Team concept.

[2] Please see paragraph 4.4 for a definition of the Design-Build concept.

4

Housing and organization models

Two commonly used models versus Design-Build

4.1 Introduction

HOUSING ASSOCIATIONS IN GENERAL

Initially, housing associations have been raised by the government in order to provide accommodation for lower class citizens. Their main function used to be the management of public dwellings and the care of housing in order to prevent deterioration.

Nowadays, housing associations have taken a (forced[3]) shift from pure public/social responsibility to a combination of public and commercial activities. Also, instead of just managing dwellings, *development* has become a task.

ORGANIZATION MODELS

A recent Dutch study (Keizer, 2006) showed that housing associations, especially large ones, don't have a standard organization model for developing. Roughly, models most used are the traditional approach, Building Team and Turn-Key.

This chapter first describes the traditional and the Building Team approach, followed by the proposed Design-Build concept[4].

Figure 1 shows an overview of how the three organization models (highlighted) are situated compared to other models in the construction industry. The figure is surrounded by four axes, which indicate that the organization models this paper studies relatively show dependency on the market or government (upper axis), a maximum separation of exploitation and development (right axis), a relatively high amount of client influence (lower axis) and virtually no integration of profits in the board out (left axis).

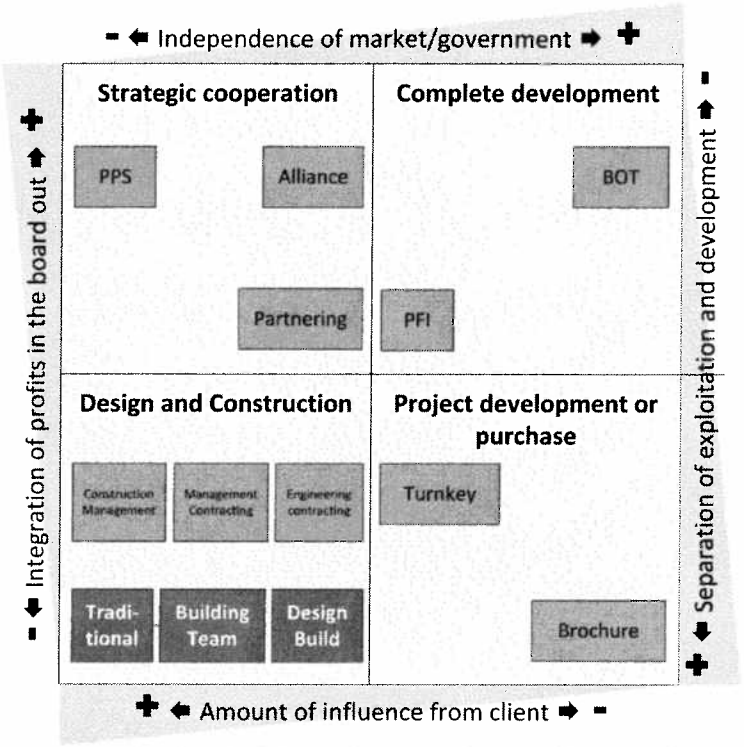


Figure 1: Overview of different organization models (de Koning et al., 2001)

The next paragraphs will show the main properties and differences of the discussed models.

4.2 Traditional Procurement

DESCRIPTION

Another name for the traditional approach of cooperating is *the classic triangle* (see figure 2).

In order to realize a project, a client creates a programme of requirements the project has to fulfil. He then brings in an architect who converts the programme into spatial dimensions and specifications. When finished, a constructor is procured on a competitive basis to execute the scheme and physically realize the project (RWS, 1997; de Koning et al., 2001; Goodchild, 1998).

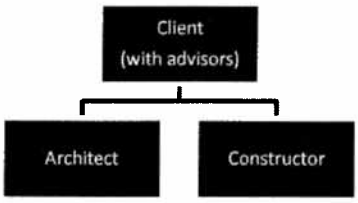


Figure 2: Traditional procurement

HOUSING APPLICATION

Approximately 37% of all housing procurements are being executed using the traditional, client-led way (Keizer, 2006). Housing associations that pro-

[3] For 1995, the Dutch Government stopped direct subsidizing of housing associations (Priemus, 1996).

[4] Turn-key contracting will not be considered in this paper due to the fact it is used only when associations purchase land and dwellings from a developing constructor. This is not a preferred situation due to the lack of input the client has.

cure this way are in fact developers (Audit Commission, 1996).
The traditional approach is best suitable for large and simple housing projects, for example projects that have a high amount of repetition.
This organization model is also highly suitable for projects that require a sophisticated plan before bringing in the market.

ADVANTAGES AND DISADVANTAGES

- May be inexpensive when the procurement is done at the right time, that is when there is little work in the construction sector going on and suppliers are eager for assignment (De Koning et al., 2001);
- The client gets full control of the process (De Koning et al., 2001);
- There is a maximum amount of survey because of the strictly separated responsibilities each actor has (De Koning et al., 2001);
- The role each actor has in the process is obvious and clear (De Koning et al., 2001).

- The aforementioned separation of design and construction is seen as inefficient (see paragraph 3.1, "Problems in the construction industry");
- It may be difficult to estimate exact costs of the project during the design phase, sometimes the proposals come as an unpleasant surprise (Benschop, 2006);
- There is the risk of forced cooperation with an unsuitable or non-cooperative constructor when assigning to the lowest price[5] (Benschop, 2006);
- May be slow compared to other organization models due to the fact that execution of the project has to wait for the finished specifications (De Koning et al., 2001);
- There is a huge burden for the client during the entire process and in addition there is a requisite of internal knowledge (De Koning et al., 2001).

4.3 Building Team

DESCRIPTION
When using the Building Team approach, the contractor steps into the process during one of the design phases or even before. Rather than handing over a finished scheme, the client allows the contractor to actively contribute to it. After completion of the design, the coalition drops back to the traditional mode. In most cases, the constructor who has been part of the Building Team gets to execute the work. In this case there is no competition, and the price of the building costs will be negotiated (Goodchild, 1998, van der Woude et al., 1997).

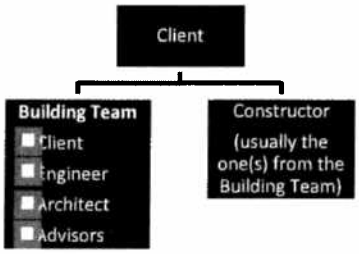


Figure 3: Building Team

HOUSING APPLICATION
Like the traditional approach, 37% of the projects originating from housing associations are procured using a Building Team (Keizer, 2006). Especially small associations tend to choose the Building Team for less internal knowledge is necessary because of its replacement by external knowledge of the constructor and advisors. This makes the Building Team highly suitable for technically complex housing projects.
Furthermore this model is used when the constructor owns the site the project is to be realized on. The constructor is then able to bring in the Building Team as a stipulation to sell his land.

ADVANTAGES AND DISADVANTAGES

- Unites design and construction, which opens ways for innovation, project speed[6] and better cooperation;
- Knowledge of the constructor can be implemented in the design at an early stage (De Koning et al., 2001);
- The constructor gets a better idea of the client's needs and is more able to fix issues during the execution phase autonomously, which prevents delays (Nahapiet, 1983);
- Compared to the traditional model, there is a better possibility of changing plans during construction (De Koning et al., 2001).

- Constructors are not used to designing, there is a risk the constructor reverts to the traditional role (Benschop, 2006);
- When procuring *at* or *before* the design phases, the contract can only be based on the proposed indirect costs[7] (De Koning et al., 2001);
- The total building costs may be high. Also, the *formation* of costs may be hard to control (De Koning et al., 2001).

4.4 Design-Build

DESCRIPTION
Design-Build, also known as Design and Construct, is seen as an organization

[5] The supplier that proposes the lowest price is automatically procured.

[6] Project speed is not as important for housing associations (public sector) as it is for pure commercial developers (Goodchild, 1998).

[7] Which consist of costs for risk and profit, general costs, additional costs, adopted tax rates, etc.

model that results in an innovative, performance based organization model that combines the advantages of Building Team and Turn Key contracting. It is an approach at which the supplying party takes care of both design and construction, which have become integrated disciplines (de Koning, 2001).
Design-Build is becoming more and more an attractive alternative for traditional contracting techniques, especially in the public sector (Molenaar et al., 1998). An important incentive to use Design-Build is to spur general innovation at the supplying side. This side isn't burdened with huge amounts of detailed specifications as seen in the traditional approach to cooperating, but is given freedom to be innovative and creative instead.[8]
Another characteristic of Design-Build would be the fact that responsibility and liability become highly assigned to the design-builder during the project. This causes the liability of the client to diminish.
Also, the client has only one party to communicate with and only one contract to manage, which is seen as an advantage because of its simplicity (Dorée, 1996).
Design-Build leans towards being contractor-led (Goodchild, 1998), which regularly results in a standardised or semi-standardised type buildings (Franks, 1993).

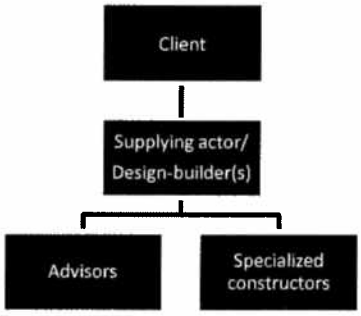


Figure 4: Design-Build

HOUSING APPLICATION
As mentioned before, there are no known housing projects that have been procured using the Design-Build concept.

ADVANTAGES AND DISADVANTAGES
- The client can save time, resources and general exertion because of the simple set-up Design-Build has to offer (Rougvie, 1988; Loulakis, 1987; Janssens, 1991; Akintoye, 1994).
- Design-B uild can be lower-priced than the traditional model (Veenvliet et al., 1991; Loulakis, 1987; Janssens, 1991; Akintoye, 1994).
- The client hands over risk and responsibility. This makes the constructor liable for possible errors in design or construction.
- There can be clearness of costs at an early stage of the process (Hughes, 1992; CIRIA, 1985).
- The client has little influence on the product. Only the main specifications and requirements are being taken into account by the constructor.
- There is little possibility for the client to change the project once it has started (Gunning et al., 1997; Chan, 1997).
- Being a performance based contract, requirements of the client are communicated only roughly. This could lead to misinterpretation.

4.5 Comparison

STEERING OF THE PROCESS
This paragraph gives a comparison of the three discussed organization models. The main difference is the origin of the steering of the process (which can also be seen in figure 1). Figure 5 gives a simplified overview.

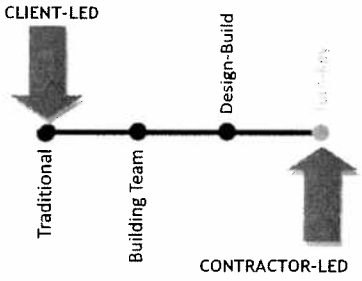


Figure 5: Steering of the process

Walentowicz (1992) has examined the implications of different angles of leadership in housing projects. He mentions that 'off the shelf-schemes' (which are in fact standardized designs that are used for projects that incline towards a contractor-led process) produce *lower quality* dwellings in general. A logical cause could be the fact that these types of schemes are not adapted to the specific needs of prospects/customers they have been built for. In addition, there are cases of off the shelf-schemes that have not been adjusted to changed building regulations and have therefore become unsafe or environment-polluting.
However, these issues can be mitigated when housing associations retain responsibility for certain aspects of design and don't leave the entire job to an external actor (Goodchild, 1998).
Moreover, standardization has a significant influence on value-for-money and can reduce overall costs to a large extent (Goodchild, 1998).
There are other reasons for contractor-led processes to result in lower costs. Also *on-costs* (including professional

[8] Innovation can lead to improved quality and more cost-effective solutions (Songer et al., 1994).

fees) are generally lower[9] because of the delegation of responsibilities to the contractor (Graham, 1996, Goodchild, 1998).
In favour of projects leaning towards a contractor-led approach can subsequently be put the more *negotiation* oriented establishment of the building costs, in contrast with the *competitive* oriented one that describes the traditional approach. Negotiated tenders can create cost-advantages for housing associations because they have to demonstrate good value for money to their funding agencies (Goodchild, 1998).

SEPARATION OF DESIGN AND CONSTRUCTION

Figure 6 gives a rough overview on the differences regarding the separation of design and construction.

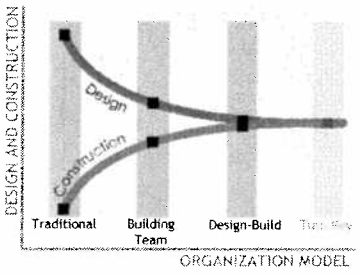


Figure 6: Separation of design and construction

The figure shows that the designing and the constructing disciplines get closer as the organization model is located more to the right. As mentioned before, there is a maximum separation using the traditional approach. Building Team conversely brings the two disciplines closer together because the constructor gets involved in the process during the design-phase. Next, Design-Build brings about nearly a full integration of design and construction, since they are performed by one actor (or better put: they *appear* as one actor to the client) (Dorée, 1996).

DISTRIBUTION OF EFFORT AROUND THE PROCUREMENT STAGE

When looking at the distribution of effort the client has to make around the procurement stage, there are several differences.

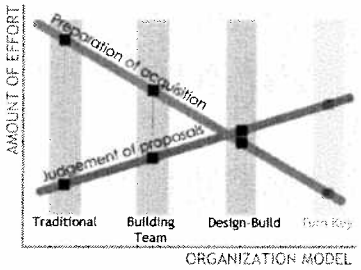


Figure 7: Distribution of effort for the client

As seen in figure 7, using the traditional approach the majority of the workload encompasses the preparation of the acquisition. Judging the proposals is a less comprising task due to the fact only prices have to be compared. The more a model is located towards the *right* side of the figure, the more the situation existing with the traditional approach gets reversed. An important cause is the difference of the *moment* of the procurement in the entire process. Design-Build (located at the right side of the figure) uses an early procurement, which results in little preparation of the acquisition because a design is still to be made. The judgement of the proposals however, is a more laborious job due to the fact there are many more factors to be taken into account compared to the traditional model (Rougvie, 1988; Veenvliet et al. 1991).

RISKS AND CERTAINTY

The next comparison to be made is the one of risks and certainty, as shown in figure 8.

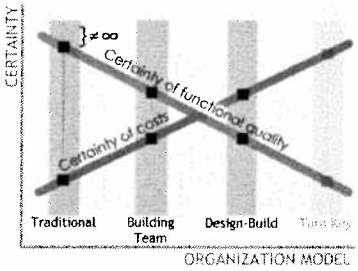


Figure 8: The client's certainty

Using traditional procurement, the client is involved closely in the designing process. Possible optimizations of the requirements can be discovered and effectuated immediately. This situation creates a high certainty of the functional quality of the final project[10]. Concurrently, certainty of costs is relatively low, due to the separation of design and construction. There is a fair chance of exceeding the budget.
Design-Build is located at the other side of the figure and switches the situation round. The contractual certainty of the functional quality of the housing project is lower compared to the traditional model. This can be assigned to a decreased possibility of adjusting and optimizing initial requirements once the project has started (Dorée, 1996). The total building costs however, can be estimated quite accurately in an early stage of the project, thus providing a relatively higher certainty for budgeting (Dorée, 1996).

[9] This is dependent on the certainty and consistency of project conditions.

[10] Though, as the symbols in the upper left corner indicate, there is *always* uncertainty which is in fact the risk of the investment (Dorée, 1996).

MOMENT OF PROCUREMENT

The last comparison concerns the moment of procurement, as illustrated by figure 9. The figure shows the phases of the building process in chronological order with the corresponding moments of procurement of each of the three organization models.

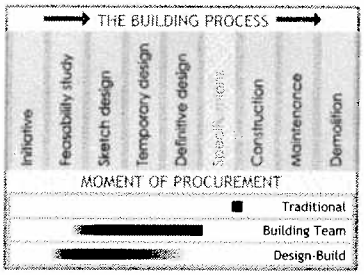


Figure 9: Moment of procurement

Traditional procurement always takes place after completion of the specifications[11]. The moment of procurement in the figure has therefore been reproduced as a *dot*: there is one fixed moment of procurement.

Building Team procurement on the other hand, has the shape of a line, which implies that the moment of procurement may take place at different phases of the building process. However, it will always be *before* the creation of the specifications, otherwise it would not be a Building Team anymore because the constructor did not have influence on the design.

The Design-Build moment of procurement line is situated more upstream in the building process compared to Building Team. The design-builder is procured to create the design autonomously, which means procurement should take place *before* commencement of the designing phases.

11 Note that "specifications" is not an actual phase of the building process, it has merely been placed in figure 9 to obtain a better survey.

5

Theoretical framework

Suitability of the three models examined

5.1 Introduction

Now that the three organization models have been discussed and compared, it has become clear that all three of them have both plus and minus points. From the client's point of view it may therefore be hard to know which type of coalition to form.
Presented is a theoretical framework that helps the client choose the organization model for his project that fits the required performance.
In order to develop the framework, variables that characterize the behaviour of the different organization models need to be inventoried. Molenaar et al. (1998) postulate that the progress of a project is heavily affected by a set of *conditions*, which is in fact a set of existing or required, project-specific circumstances.

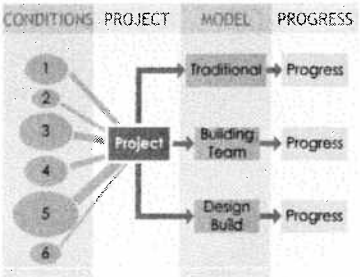


Figure 10: Relation between conditions and project progress

Figure 10 shows the relation of the conditions and project progress. The first column represents different conditions. They have been given different sizes, since their occurring intensity and importance to the project most likely differs. The second column represents the project, which is being affected by the conditions. Next, the client chooses an organization model (column 3) which will handle the project. The figure shows that the different models all have their own corresponding consequences for the progress of the project (column 4), which may differ in terms of performance.
The most significant conditions that generally apply for every project have been gathered by combining the works of Molenaar et al., (1998) and de Koning et al., (2001).
According to Molenaar, these conditions can be divided into four categories:

- Project based conditions;
- Client based condition;
- Market based conditions;
- Conditions based on relationship between client and supplier.

The framework presented shows the three models that have been discussed earlier (traditional, Building Team and Design-Build) and their corresponding -theoretical- effects on the conditions.
The suitability of each model to handle a condition will be valued with scores ranging from 1 to 5, using the following denotation:

1. Unsuitable;
2. Little suitable;
3. Moderately suitable;
4. Suitable;
5. Very suitable.

The values show how the organization models handle the conditions and how they -theoretically- affect the project process.
Since not all conditions will be of equal importance to a project, the client should rank the conditions and use the ones that characterize the project best in order to find the organization model with the highest total suitability score on average.
Note that it will appear that almost all arguments to judge a model for its suitability to handle a condition can be resolved to the main differences of the models as presented in paragraph 4.5 ("Comparison").

5.2 The conditions

Project based conditions
[Condition 1 - 6]

1 THE PROJECT IS SCHEDULE DRIVEN

The first condition concerns the situation where there is pressure to finish a project as soon as possible.

Traditional procurement
De Koning et al. (2001) state that due to the fact that design and construction are strictly separated when using the traditional model, projects can take relatively long. There is no knowledge of construction brought forward during the design phase which may result in error and delay.

Suitability score: 2

Building Team
The Building Team approach may be more efficient in terms of time compared to traditional procurement due to the integration of design and construction (De Koning et al., 2001).

Suitability score: 4

Design-Build
Molenaar et al., (1998) state that Design-Build is appropriate for schedule driven projects. *"Previous research indicates the primary reason owners choose Design-Build is to shorten project duration"* (Molenaar et al., 1998, according to Songer and Molenaar, 1996).
El Wardani et al. (2006) confirm this: *"design-build projects experienced less cost and schedule growth on average"* just like Thomas et al. (2002) who researched practical process speed of Design-Build projects: *"DB*

projects generally outperformed DBB[12] *projects in schedule-related metrics. In fact, DB project schedule growth and start-up schedule growth performance were significantly better than among DBB projects. DB projects also had significantly lower average start-up phase durations."* (Thomas et al., 2002). Moreover, their research shows that Design-Build provides a speedy handling of adjustments of the design: *"DB projects significantly outperformed DBB projects in both changes and rework"* (Thomas et al., 2002).

Like the Building Team approach, the speedier process compared to the traditional model may be ascribed to the integration of design and construction. Thomas et al. (2002) argue that another cause may be that Design-Build projects allow better for overlaps in the design-procurement-construction sequence.

However, Molenaar et al., (1998) put that thorough involvement of the client during the entire process is a stipulation to Design-Build being suitable for schedule driven projects: *"...owners must be heavily involved in the front end of the process to ensure success"* (Molenaar et al., 1998). Since the Design-Build concept is based on a contractor led process (see figure 5: "Steering of the process"), it is assumed that the involvement as mentioned by Molenaar et al. refers to *inspecting and verificating* rather than managing the process.

It can be concluded that Design-Build outperforms traditional procurement and Building Team in terms of speed, but only when the client is heavily involved during the process.

Suitability score: **5**

[12] DBB = Design Bid Build, which is in fact the traditional method of contracting.

THE PROJECT IS BUDGET DRIVEN

The second condition describes the situation where the project is to cost as little as possible and is not allowed to exceed estimated costs or the budget.

Traditional procurement

Implementing traditional procurement implies that offerors are competing with each other to obtain the work.

Comparing the proposals is relatively easy because all have been created for the same, finished design. This may result in obtaining the lowest price possible for a project (de Koning et al., 2001).

Note the situation where there is little competition or where the client has incorrectly estimated costs. In both cases the actual building costs may exceed the budget. Certainty of the costs arises only after procurement (de Koning et al., 2001).

Dorée (1996) warns clients to prevent architects from creating fancy designs that serve as advertisement for their companies. These designs tend to be more expensive than necessary.

Concluding: traditional procurement is suitable for budget driven projects, with the stipulations mentioned.

Suitability score: **4**

Building Team

The Building Team approach is based on competition to a minor extent. When procuring, the design has not been finished yet, which prevents the client from comparing equivalent offers. Suppliers can only be judged by their reported indirect costs (costs for profit, risk and general costs) (de Koning et al., 2001).

Building Team is not per definition a low cost type of cooperating. The final price of the project is realized through negotiation (Goodchild, 1998). Hendrickson et al., (2003) emphasize that the negotiation process can be a complex and laborious task, in which negotiation skills can determine a great deal of the ultimate construction price.

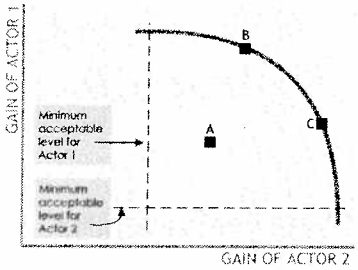


Figure 11: Pareto optimal agreement set

Figure 11 shows the current curve the actors are drawing on when negotiating. Point **A** represents the situation in which both actors have arrived at an inferior agreement. Still, the actors can improve the agreement to the benefit of both. Point **B** shows the situation in favour of actor 1, whereas **C** is more profitable for actor 2 (Hendrickson et al., 2003).

Concluding: the Building Team model is moderately suitable for budget driven projects, and the ultimate costs of the project are dependent on the negotiation skills of the involved actors.

Suitability score: **3**

Design-Build

The suitability of Design-Build for budget driven projects is controversial. De Koning et al. (2001) state that the buying off of risks makes Design-Build financially less attractive compared to the traditional model. Another counter-argument is that there is limited competition possible.

However, the convergence of design and construction that Design-Build provides may lead to a scheme that is better tailored to available production technology. This may result in a reduction of overall project costs (Dorée, 1996).

The client can strongly influence project costs by determining his contribution to the project. When the constructor is given sufficient freedom on designing the product, total project costs can be kept low. Conversely, too much input of the client in the design phase can be misplaced: *"If the owner provides more design, the unit cost is likely to be higher. (...) An explanation is that clients tend to reckon with their needs, rather than with project costs"* (Ling et al., 2004).
Note that Design-Build is also a negotiation-based model (see Building Team).

Suitability score: **3**

CERTAINTY OF COSTS AT AN EARLY STAGE NEEDED

The third condition describes the situation where total project costs should be fixed at an early stage of the process. Cost growth should be prevented.

Traditional procurement

As concluded earlier (see condition 2), using the traditional model the costs only become certain/fixed *after* procurement. Since the procurement takes place at a relatively late stage in the process (that is, after completion of the design), the traditional model is not suitable for obtaining certainty of costs at an early stage.
To strengthen this statement it should be noted that the *state of the market* may *change* during the initiative and design phases. As with traditional procurement, this will heavily influence the calculated costs arranged by the offerors, and with that final project costs (Benschop, 2006).

Suitability score: **2**

Building Team

See condition 2: the building team is procured by indirect costs only. This causes final project costs to be uncertain at the procurement stage.
However, there are two arguments that make Building-Team better suitable for the need of certainty of costs at an early stage compared to the traditional model. First, the procurement takes place at an earlier stage in the process (see figure 9, "Moment of procurement"). Second, construction costs will be clear within a relatively short period after procurement due to contribution of knowledge and experience of the constructor in the design-phases (de Koning et al., 2001).

Suitability score: **3**

Design-Build

Since Design-Build is a performance-based approach, the design-builder is handed only guidelines and descriptions of the performance the final product has to fulfil, rather than detailed specifications. This situation may lead to different interpretations of the client and the design-builder, which can ultimately cause cost growth (de Koning et al., 2001). However, the early involvement of the design-builder in the process results in an early familiarity of the final costs. Dorée (1996) also confirms an early certainty of costs using Design-Build because of the intervention of construction knowledge in the designing phases.
Different researchers (Thomas et al., 2002; Sanvido et al., 1997 according to El Wardani et al., 2006) that compared cost growth between traditional procurement and Design-Build indicated the latter to be more inexpensive and cost-efficient. A possible cause is the integration of design and construction which creates better communications among project participants and reduces the need for additional work (Thomas et al., 2002).
However, Molenaar et al. (1998) postulate that the client must be prominently involved in the design-phase in order to keep cost growth to a minimum.
Ling et al. (2004) mention that *"...contractors with smaller financial capabilities are less able to control cost, as they may have to channel their limited funds to other activities."*, which emphasizes the importance of selecting a design-builder that has a large turnover rate when cost growth needs to be prevented.
Concluding: Design-Build gives certainty of the project costs at an early stage of the process. A lack of involvement of the client or the selection of a contractor with a low turnover rate may worsen this situation.

Suitability score: **4**

REQUIREMENTS HAVE NOT BEEN COMPLETELY INVENTORIED

The client may choose to bring in the market at a moment the requirements (for example: required aesthetics, identification of end-users, total capacity of the buildings, etc.) have not been completely inventoried. The supplier can subsequently assist the client in forming requirements.
This situation could be caused by a need for lowering risks (Olsen et al., 2005), input on decision-making, funding, sharing of risks, etc.

Traditional procurement

As with the traditional model, procurement takes place the moment the project is ready for construction. The requirements should be totally known by then (de Koning et al., 2001). This makes the traditional model unsuitable for a project of which the requirements are not entirely clear at the moment of contracting.

Suitability score: **1**

Building Team

Unlike the traditional model, the supplier is being procured *at* or even *before* the design-phase (see figure 9: "Moment of procurement"). If the

requirements of a project are not entirely clear, it could be a favourable moment to compose the building team.
However, literature is silent about Building Team being suitable for projects with unidentified requirements, and judging from the statements given for the Design-Build contract (read below), it can be assumed that Building Team is little suitable for projects with a low amount of known requirements, because a voluminous part of the power to form the project is given away to the supplier (de Koning et al., 2001).
A difference with the Design-Build approach is that when using Building Team, the client preserves more control on forming the requirements. This may reduce the risk of obtaining requirements that suit the supplier rather than the client.
Compared to Design-Build, Building Team lends itself better for projects with a low amount of known requirements.

Suitability score: **3**

Design-Build
The greater part of theory indicates that Design-Build requires a well defined scope[13] in order to effectuate success. *"..The client should develop a thorough project plan in which the scope of work is clearly defined, and the contractor's project manager should understand and commit to the achievement of project objectives because the contractor has the sole responsibility for the D&B project"* (Chan et al., 2001). Also mentioned is *"...the importance of establishing a set of clear project goals and directions at the outset. This is particularly true for D&B projects because any misunderstanding of what to achieve can be avoided, which is instrumental in completing a building project in a short time"* (Chan et al., 2001).
Molenaar et al. (1998) found that the first two of the top five important project characteristics were *well-defined scope* and *shared understanding of scope*. Mo et al. (1997) emphasized the importance of the *quality* of the client's brief. Chan et al. (2001) add to this statement that *"..significant changes made to the client's brief midway through a D&B project may lead to poor project performance in terms of time and cost."*
This situation makes Design-Build risky for mass customization. *"If the end-users' needs are uncertain or ambiguous, it is difficult to develop a comprehensive and clear client's brief for the contractor to propose a suitable design and construct the building. Disputes and claims may be expected if the details of the client's requirements are not adequately stated at the outset"* (Tam 1997).
Chan et al. (2001) conclude that *"..to improve the chance of project success, the client should perform the following activities: (...) develop a clear understanding of project scope"*.
This makes Design-Build little suitable for projects of which the functional requirements are unclear at the moment of procurement.

Suitability score: **2**

THE PROJECT IS COMPLEX

Project complexity can stem from the design, construction, technology, specialization requirements or compressed schedules (Molenaar et al., 1998). Complexity usually implies less control, which creates more risk.
It may be difficult to name a project *objectively* complex. For this condition, the client should use his own experience and determine whether the project is complex and to what extent.

Traditional procurement
Ustinovichius et al. (2006) state that one of the potential risk factors of complicated situations in construction projects is associated with improper channels of communication. As with the traditional approach, there is no channel of communication with construction ('hands-on') experts when the design is created. It can therefore be difficult to get a survey of all necessary building elements for example. This may lead to unintentional errors.
In addition, Hendrickson et al. (2003) state that *"the ability to deal with complex issues is often precluded in the competitive bidding which is usually required in the public sector"*.
Both arguments contribute to the conclusion that the traditional model is little suitable for complex projects.

Suitability score: **2**

Building Team
The Building Team makes use of a channel of communication between the design and construction experts. The constructor is involved in the design-phase and can give instructions about how to make the design executable and realistic, which is a better approach to complex projects. Investigation on Dutch housing associations originating from de Keizer (2006) shows that the Building Team model is usually applied on complex projects.

Suitability score: **3**

Design-Build
Research has shown that Design-Build is suitable for simple as well as complex projects (Molenaar et al., 1998 according to "Design-Build", 1992).
Design-Build can simplify projects that are complex at the organizational level because of the *single point responsibility*. The fact that the client has only one contact person leads to a clear separation of responsibilities (Dorée, 1996).

Suitability score: **4**

[13] It has been assumed that the term 'scope', as used in the mentioned quotes, indicates the amount of known/inventoried requirements.

THE PROJECT REQUIRES CUSTOMIZATION FOR THE END-USER

Housing associations tend to listen more and more to individual customers' needs. These customers (future occupants) obtain influence on the development of their dwelling-in-the-making by being involved in decisions concerning number of rooms, floor plans, appearance of facades, etcetera.

The amount of involvement of the customer may vary, but the principle of this approach implies that every dwelling has its own unique requirements and specifications. The fact that the information to develop these has to be obtained *externally* (that is, originating from future occupants), makes the developing function of the project relatively complex. It may be a burden to fit this function well with designing.

Traditional procurement

Traditional procurement may handle this condition well, since the developing and design function are handled by the same actor: the client. This creates flexibility, as both functions can be easily adjusted until they match (Dorée, 1996).

Suitability score: **4**

Building Team

As for the Building Team approach, the design function is partly boarded out to the constructor. This may cause less flexibility concerning the combined action between development and design compared to the traditional model.

Suitability score: **3**

Design-Build

Design-Build doesn't lend itself for individual customization, because of the separation of the developing (client) and the design (design-builder) functions. Optimization of the requirements may be difficult without proper feedback from the designing process (Dorée, 1996).

Note the quote stemming from Tam (1997) in the discussion of Design-Build's suitability on condition four, which also shows this organization model to be little suitable for customization for the end-user.

Dorée furthermore argues that Design-Build may be more suitable for creating advantages in terms of *scale*, rather than for projects that characterize themselves by means of *variety*.

Suitability score: **2**

Client based conditions
[Condition 7 - 10]

THE CLIENT HAS LITTLE EXPERIENCE

Condition seven describes the situation where the client has little or no experience with managing the construction process and developing (similar) projects.

Although this condition is different from condition five, they show slight overlap. This is because even a relatively simple project can seem to be complex for an inexperienced client.

Traditional procurement

Using traditional procurement, the client functions as a manager of the project. There are many parts susceptible to error and the client doesn't get full assistance of all involved actors during the process. If the client has little experience with (and thus little knowledge of) a project, it may be difficult to efficiently steer the process. Bringing in several external advisors may clarify aspects, but this measure comes with extra costs.

This makes the traditional model little suitable for inexperienced clients.

Suitability score: **2**

Building Team

The Building Team provides the client with more assistance and support, especially on the design function. This makes the Building Team suitable for inexperienced clients.

Suitability score: **4**

Design-Build

Competency stems from experience (Edum-Fotwe, 2000). So when Chan et al. (2001) conclude from their research that "*the client's competencies in managing the D&B project were found to be the second key factor contributing to overall project success*", they also claim that clients should be experienced in managing the project to secure success.

Furthermore, Molenaar et al., (1998) state that cost growth is lower with Design-Build projects when the project is similar to the client's past projects. This indicates that little experience may cause exceeding of estimated costs.

Both arguments make Design-Build little suitable for projects that are led by inexperienced clients.

Suitability score: **2**

THE CLIENT NEEDS TO HAND OVER RISK TO THE SUPPLIER

As with risky, inconstant or unpredictable projects, the client may choose to hand over risk to the supplying actor (Olsen et al., 2005).

The given arguments below are based on the correlation between risk and control: the more control an actor has on a project, the more risk this actor will carry (de Koning et al., 2001). The more influence the supplier gets on forming the project, the more responsibility will be allocated to this actor. Possible cost growth, delays or other unwanted events won't be borne by the client alone, but (partly) by the supplier as well (van der Meer, 1998).

The downside of this measure is the accompanied outline of extra costs

(Hendrickson et al., 2003; Olsen et al., 2005).

Traditional procurement
Traditional procurement is not suitable for handing over risk to the constructor, for the constructor can only be held liable for the execution of the project. This implies that merely defects stemming from execution will be allocated at this actor's expense. Issues stemming from other functions, such as incorrect estimations on building capacity, will be put on the client's account. Constructors are not likely to agree upon accepting more risk, because they have not had any input in the design, and therefore were not able to optimize it and lower risk according to their knowledge.

Suitability score: **1**

Building Team
Using Building Team, the constructor gets chances to actively contribute to the design and add own decisions. He will be responsible for these decisions and with that accept risk. The Building Team approach is suitable for handing over risk.

Suitability score: **3**

Design-Build
The tendency is continued further by providing even more room for the supplier for input compared to Building Team. The supplier -who in some cases forms requirements for a project (de Koning et al., 2001)- gets deeply involved in developing the project, which makes Design-Build even more suitable for clients that need to hand over risk.

Suitability score: **4**

POSSIBILITY FOR MINIMIZING ADMINISTRATIVE BURDEN AFTER PROCUREMENT

Condition nine implies the situation where the client needs to minimize the administrative burden after procurement. This may be due to financial or strategic motives, for example to reduce staff.
Note figure 9 ("Moment of procurement").

Traditional procurement
Intuition says that the traditional approach is unsuitable for this condition, due to the maximum effort the client has to put into the project compared to the other models.
However, Ling et al. (2004) mention that in order to obtain a low administrative burden, the client should procure a constructor with a high staffing level.
Concluding: traditional procurement might be little suitable for reducing administrative burden, but only when the procured constructor has a high staffing level.

Suitability score: **2**

Building Team
The suitability of Building Team for this condition is unknown, although theory does not insinuate a different fortitude of administrative burden than the one occurring with the traditional model. Moreover, de Koning et al. (2001) states that after completion of the specifications, the contractual relations amongst the project participants are similar to the traditional model. This leads to the same conclusion.

Suitability score: **2**

Design-Build
Although Design-Build seems to be a logical choice for clients that need to reduce their administrative burden after procurement, Molenaar et al., (1998) postulate that involvement of the client during the project process should not be underestimated. In other words: Design-Build is little suitable for clients that need to reduce staff.
There are some measures that could theoretically reduce the administrative burden. Ling et al. (2004) state that in order to reduce administrative burden, clients should *"engage contractors who have good quality performance in past projects"*. Also Molenaar et al. (1998) emphasize the need for prequalification of the design-builders, which is in fact research of the offerors' past performance. Furthermore, *qualifications-based selection* gives the design-builder more control over scope, cost and schedule and requires less administration from the client (Molenaar et al., 1998).
This makes Design-Build suitable for this condition, with the mentioned stipulations.

Suitability score: **3**

THE CLIENT NEEDS TO BE ABLE TO INFLUENCE THE PRODUCT

De Koning et al., (2001) postulate that the influence practised by the client on both the design and construction is a significant factor when choosing an organization model. The client should thoroughly consider to what extent he wishes to influence the ultimate appearance of the product and its realization by determining needs for certainty, controllability, effectuation of quality, social commitments, responsibility and liability (de Koning et al., 2001).
The three organization models differ in allocating influence to the client during the course of a project.

Traditional procurement
The traditional approach (compared to Building Team and Design-Build) gives the client maximum influence on both the design and the construction. The client has full leadership and takes all major decisions.

Ling et al. (2004) state that clients that need flexibility[14] during the construction phase, should not rely on experience of a constructor with many change orders during previous projects. *"This may be because these contractors would, after being awarded the DBB contracts, set out to identify minor deficiencies in the design and ask for change orders to be issued."* (Ling et al., 2004).
This makes traditional procurement very suitable for clients that need to maintain influence during the entire process in order to determine the final product, but choosing a constructor with experience in change orders does not contribute to extra influence during the construction phase.

Suitability score: **5**

Building Team
The Building Team approach diminishes the influence of the client during the designing phases. That is, the client still has leadership, but has to be open for input from the contractor (de Koning et al., 2001).

Suitability score: **4**

Design-Build
"Design-Build is at its best using a request for proposal written in performance criteria rather than prescriptive specifications." (Molenaar et al., 1998). As Design-Build utilizes a performance based contract, the client only sets out main requirements the product has to fulfil[15]. (de Koning et al., 2001). The design-builder subsequently gets room for own interpretation which gives him power to influence the final result. Using Design-Build, The client is still able to influence the design of the product (which distinguishes the model from the turn-key approach for example), but to a little extent.
Changes during the process that are initiated by the client are difficult to effectuate, unless agreements have been made on this subject in advance (de Koning et al., 2001).
Chan et al. (2001) recommend limiting change of client's requirements during construction.
Concluding: Of the three models, Design-Build is the least suitable for this condition.

Suitability score: **2**

Market based conditions
[Condition 11 - 13]

INPUT FROM THE SUPPLYING ACTOR IS REQUIRED
This condition implies the situation where input from the supplier in terms of knowledge (obtained through experience) is required. There are several motives for this condition. Examples are: little knowledge of the client, high complexity of the project, new/innovative production or the need for fast construction.

Traditional procurement
"The contractor's design management expertise is more critical in D&B projects than in the traditional projects." (Chan et al., 2001). This is because the traditional approach creates less room for input from the constructor.

Suitability score: **1**

Building Team
Compared to the traditional model, the Building Team approach provides more room for input. The constructor is procured at an earlier stage of the entire process, which enlarges his contribution.

Suitability score: **4**

Design-Build
"The contractor's capability and experience in managing D&B projects is critical to project success." (Chan et al., 2001). El Wardani et al. (2006) confirm this statement and give an explanation: *"..The impact of an ill-qualified design-build team can be particularly acute to project performance because the team can cause serious problems to both the design and construction of a facility as the team for both is being procured together rather than separately"* (El Wardani et al, 2006).
Chan et al. (2001) subsequently add that *"..apart from applying appropriate technical capabilities, the contractor, who is not trained to be a designer, should gain a thorough understanding of the design process and how the design work integrates with other activities. As an experienced contractor commented, "any contractor that does not have that knowledge and ability should avoid Design & Build like the plague, because your designers are likely not to produce what you want when you want it and you won't know until it's too late""* (in: Chan et al., 2001)
Ling et al. (2004) postulate that the client's satisfaction is accounted for by -amongst others- the contractors' technical expertise and their ability to complete past projects to acceptable quality.
These arguments suggest that Design-Build is not only *suitable* for projects that need input from the supplier, but that it is also a stipulation for success.
Chan et al. (2001) also mention that the contractor's expertise in using appropriate building technology and input of building knowledge on design development can speed up project delivery time, which is also confirmed by Ling et al. (2004).

Suitability score: **5**

[14] Influence of the client during the construction phase requires flexibility of the constructor, since all specifications have been fixed earlier in the process.
[15] Note that these requirements need to be well-considered, clear and complete (de Koning et al., 2001; Chan et al., 2001)

THE CLIENT WISHES TO LET A LARGE NUMBER OF OFFERORS COMPETE TO OBTAIN LOWER COSTS

The client may wish to have a large number of offerors compete for obtaining the assignment in order to benefit from competition of the market. Competition may lead to financial advantages or it may meet the need for input of variants of the design (which could ultimately lead to financial advantages as well).

Traditional procurement

The traditional model is highly suitable for competition based procurement. All offerors hand in proposals on the same final design, which results in easy comparison. Quality has been fixed through the plans and specifications the proposals have been based on (Gransberg et al., 2004). Because of this situation, the *cost* of construction is the factor in which the client seeks competition (Gransberg et al., 2004; de Koning et al., 2001, Dorée (1996).

Suitability score: **5**

Building Team

Literature is silent about the effects of letting a large number of offerors compete with costs using the Building Team approach.

Suitability score: **?**

Design-Build

Competition may be achieved using Design-Build, although not at the level of costs. In most Design-Build projects, the client requires the design-builder to establish a firm-fixed price on a project that has not yet been designed. Usually, the owner also fixes the project delivery period, which makes the *scope* and hence the *level of quality* the main element of competition, rather than costs. (Gransberg et al., 2004).

Allowing an open field of design-builders only increases the number of offerors and not necessarily costs. Design builders may be more competitive in terms of price tags when a low number (e.g. 4) of suppliers is proposing, rather than a large number (e.g. 14) (Molenaar et al., 1998).

Concluding: although Design-Build benefits from competition, it is not a costs-related kind and reducing costs cannot be obtained by letting a large number of offerors compete. This makes Design-Build not suitable for this condition.

Suitability score: **1**

THE PROJECT IS HIGHLY DEPENDENT ON MARKET/GOVERNMENT/ENVIRONMENT

The residential housing market is heavily affected by general economic conditions, tax laws, and general regulation and legislation (Hendrickson et al., 2003). Furthermore it may be difficult to assess potential resistance of neighbourings, ecology groups or (local) authorities. Therefore, a project that is highly dependent on the market, government and/or environment, usually holds more unidentified risk (de Koning et al., 2001).

De Koning et al. (2001) suggest that clients should keep their influence on risky projects as long as possible, and the arguments given below are based on this suggestion.

Traditional procurement

Traditional procurement is very suitable for this condition, as clients keep their influence on the project for a maximum amount of time.

There is one situation that diminishes the suitability of the traditional model though. This occurs when suppliers have a strong market position, or possess the site the project has been planned to be developed on. This situation makes the client dependent on the supplier (de Koning et al., 2001). The supplier may make demands on aspects of the project or process, which results in a loss of influence of the client, which may be an unwanted situation.

Concluding: traditional procurement is very suitable for this condition, as long as the market is favourable for the client, and this actor also owns the land.

Suitability score: **5**

Building Team

Building Team may be suitable for this condition, but suppliers should be procured as late as possible in the entire process, for example after having completed the definitive design. This way the client can keep his influence as long as possible (de Koning et al., 2001)..

Suitability score: **4**

Design-Build

Design-Build is not likely to be suitable for projects that are dependent on the market/government/environment, because of the give away of influence at an early stage of the process (de Koning et al., 2001).

Suitability score: **2**

Relation based conditions (client - supplier) *[Condition 14 - 18]*

DURATION OF PROCUREMENT COURSE MUST BE AS SHORT AS POSSIBLE

This condition is multi-layered, as a number of factors influence the duration of the procurement. Here, the factors counted will be limited to four. These four factors will first be introduced briefly. Next, the suitability of the three organization models on these four factors will be discussed. Finally, the suitability scores will be given in a separate conclusion.

The factors are:

1. the time the supplier(s) may allocate to create the proposal;
2. the selection criteria at which to tender offerors;
3. The necessity for prequalification of the applicants;
4. Market approach.

Factor 1 may influence duration of procurement because the process will be on hold until the proposals have been established.
Factor 2 may influence the duration because this (partly) determines the nature of the proposals and thus complexity or simplicity of comparison.
According to El Wardani et al. (2006), there are three types of selection criteria.

	SELECTION CRITERIA		
Types	**Price based procurement**	**Best value procurement**	**Subjective/ qualitative procurement**
Selection factors	Quantitative cost factors	Subjective, qualitative, quantitative cost factors	Subjective and qualitative cost factors
Examples	■Low-bid ■2-Step sealed bidding	■Competitive negotiaton ■Weighted criteria ■Fixed budget	■Sole source ■Qualification-based

Figure 12: Selection criteria

Price based procurement can be seen as the most simple selection criteria to judge proposals on, since only prices have to be compared (El Wardani et al., 2006; Dorée, 1996). Identifying the best offer takes up relatively little time.
The *best value* and *subjective* selection are more flexible but also complex approaches since the client has to compare different criteria simultaneously (Gransberg et al., 1999; Palaneeswaran et al., 2000). These approaches may take up more time and require more effort from the client.

Factor 3 may extend the duration when prequalification is necessary. Prequalification is in fact identifying competent suppliers by making demands on the offerors' technical and management capabilities, financial capacity, equipment/human resources and researching their past performance (Palaneeswaran et al., 2000). Furthermore the client may erect exclusion grounds at which to refuse admittance to applicants (Gribnau et al, 2007).
Factor 4 concerns the material the clients hand to the market on which the proposals will be based.

Traditional procurement

Factor 1: Dutch law prescribes that the minimum time the client has to allow the applicants for creating their proposals is 36 days. During this period, the applicants convert the obtained specifications into a quotation (Gribnau, 2005). This duration can be used as a standard to compare the other two organization models with.
Factor 2: The traditional approach is suitable for *price based procurement*, since quality has been fixed earlier in the specifications (de Koning et al., 2001; Dorée 1996).
Factor 3: Prequalification can be minimized using the traditional model. If the procured constructor proves to be ill-qualified, the client has a strong legal position. The strict division of responsibilities that typify traditional procurement, results in a clear legal situation (de Koning et al., 2001). Constructors should rather figure out whether they are qualified *themselves*.
Factor 4: Traditional procurement implies a maximum amount of effort for creating the information the suppliers will be founding their proposals on. The design has to be drawn up into detailed specifications before the announcement of the procurement can be dispatched.

Building Team

Factor 1: The constructor that applies for functioning in the Building Team is selected by the client through the provided *specifications of indirect-costs* (de Koning et al., 2001). This means the 'proposal' requires a minimum amount of effort for the constructor to set up and may even be a standard list.
Factor 2: The constructors' proposal may be judged on either *best value* or *subjective and qualitative criteria*, which both require more time to judge than price based criteria.
Factor 3: Prequalification may be a huge factor for determining project success. Especially past-performance and experience should be taken into account. Constructors with no experience with functioning in a Building Team tend to fall back to their common role: the one of executing construction (Benschop, 2006).
Factor 4: Figure 9 ("moment of procurement") indicates that the moment of procurement of the Building Team may vary from the *sketch design phase* to the *commencement of the specifications*. The request for proposal will be less defined in the first situation than in the second. Either way, compared to the traditional model, the materials required for approaching the market demand less effort from the client.

Design-Build

Factor 1: The following quotes: *"Experienced design-builders yield better performance when given adequate time to respond to a performance-based request for proposal"* and *"Results show that providing more preparation time to experienced design-builders produces greater overall owner-satisfaction."* (Molenaar et al., 1998) show that factor 1 may take relatively long.
Concerning factor 2, Molenaar et al (1998) state that Design-Build performs

at its best when selecting the supplier through the *best value procurement*. Price based procurement is not reliable since the design hasn't been established yet at the moment of procurement.

Factor 3: *"Since design-build relies on contracting with a single entity to deliver the project, the procurement method used to select this entity should be comprehensive as much as possible to ensure successful performance"*. (El-Wardani et al., 2006). The authors add that a multi criteria approach for contractor selection is more effective at increasing the probability of overall project success.

Several other authors (Ling et al., 2004; Chan et al., 2001; Molenaar et al., 1998) confirm that thorough prequalification is required for Design-Build projects.

Factor 4: *"Design-Build is at its best using a request for proposal written in performance criteria rather than prescriptive specifications."* (Molenaar et al., 1998). Although performance criteria should be well-considered, they require less time to set up than detailed specifications.

Conclusion

The bars in Figure 13 represent the relative durations of the procurement for all three organization models, per factor. Note that these are rough estimations and that other factors may influence the duration.

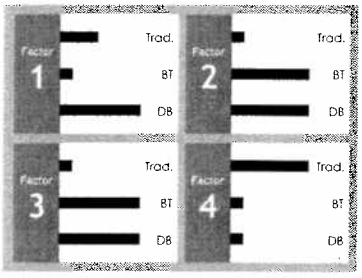


Figure 13: Relative durations of procurement

Judging on the findings that have been discussed here, traditional procurement showed to have the fastest procurement course.

Suitability score: **4**

The Building Team approach follows closely but takes up more time judging the proposals and pre-qualifying applicants (factors 2 and 3).

Suitability score: **3**

Finally, Design-Build has the longest procurement course. Its only accelerator is the market approach (factor 4). Other than that it performs slowly at the factors 1, 2 and 3.

Suitability score: **2**

OUTSOURCING OF OTHER FUNCTIONS THAN CONSTRUCTION IS REQUIRED

This condition concerns the amount of contribution of the supplier. A client could decide to hand over certain aspects of the project to the market, for example when his own funding is insufficient. Hendrickson et al. (2003) state that this measure can be used to reduce overall project risk.

The client should determine at an early stage of the process which parts of the project should be sourced out (or 'boarded out') and which shouldn't. Figure 14 gives a quick overview of the two extreme situations that are possible (according to de Koning et al., 2001):

Situation 1 "Autonomous project"		Situation 2 "Outsourced project"	
Own	Outsource	Own	Outsource
Finance	Finance	Finance	Finance
Development	Development	Development	Development
Design	Design	Design	Design
Maintenance	Maintenance	Maintenance	Maintenance
Exploitation	Exploitation	Exploitation	Exploitation

Figure 14: Autonomous versus outsourcing

The variables are called *functions*. 'Own' indicates an autonomous accomplishing of functions (if necessary with the assistance of professional advisors), whereas 'outsource' indicates the boarding out of functions to a supplier.

In situation 1 the client handles all the functions but construction autonomously. In situation 2, the other extreme, the supplier takes care of all functions. Note that there are several intermediate forms between situation 1 and 2. Also should be mentioned that outsourcing can be done partly.

The discussions below focus on how the three organization models handle the condition in which the client needs to source out all functions (situation 2).

Note that the funding of the construction is traditionally sourced out by means of a loan provided by a bank (Hendrickson et al., 2003), which means that the 'supplier' is in this case a financial institute.

Traditional procurement

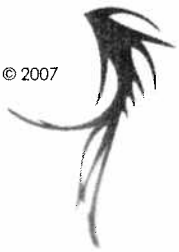
If the market is attracted to fulfil all of the functions (situation 2), the principle of the traditional approach makes itself unsuitable. Since using the traditional approach implies procuring a constructor *after* completion of the design, he has had no influence or input on the functions prior to that one.

Suitability score: **1**

Building Team

The Building Team procurement brings in the market at an earlier stage of the process. The supplier gets to actively participate in the designing process and is able to adapt the project in such a way funding and/or exploiting it will be advantageous for him. Note that Building team will only be suitable when the supplier is procured as early as possible.

Suitability score: **3**



Design-Build
The explanation given for the Building Team can be applied to Design-Build as well. The principle of Design-build implies an early procurement of the supplier. This actor will get involved in all the functions and Design-Build is therefore suitable for outsourcing all functions.

Suitability score: 4

NUMBER OF CONTRACTUAL RELATIONSHIPS WANTED IS LOW
The client may choose for maximum simplicity concerning cooperation during the building process by lowering the contractual relationships he has as much as possible.

Traditional procurement
Traditional procurement results in a high number of contractual relationships, compared to Design-Build. De Koning et al. (2001) note that different contracts concluded with the members of the coalition may not fit in properly with each other. This requires effort from the client to identify boundaries.
The traditional approach is not the organization model of choice for this condition.

Suitability score: 2

Building Team
Although the Building Team coalition results in a different lay-out than the traditional one, the number of contractual relationship remains the same (de Koning et al., 2001).

Suitability score: 2

Design-Build
Using the Design-Build, the client has only one contractual relationship to manage (see figure 4, "Design-Build"), which makes this method extremely suitable for this condition (de Koning et al., 2001; Dorée, 1996; Palaneeswaran et al., 2000 and many others).

Suitability score: 5

HIGH CERTAINTY OF CONFIRMATION TO EXPECTATIONS IS NEEDED
Conformation to expectations is always desirable, but a client may emphasize this. This condition occurs when a client has a specific idea he wishes to execute exactly as it is. Expectations have been conceived in detail and should be accurately met.
The possibility of *misinterpreting contractual agreements* needs to be low in order to achieve this condition, whereas the certainty the supplier *effectuates these agreements* needs to be high. Furthermore the project shouldn't incline towards the supplier's conceptions. Note that this condition refers to both the product (the end result) and the process.

Traditional procurement
A traditional approached project is client led, which means the client has maximum power on controlling decision-making (also see paragraph 4.5). He has the authority to make sure that the project will confirm his expectations.
The constructor has been procured through detailed specifications, which lowers the probability of misinterpreting contractual agreements. Moreover, responsibilities and liabilities are clear amongst the members of the coalition using the traditional model, whereby the client has a strong legal position (de Koning et al., 2001). This will effectuate complying with contractual agreements. Consequently, traditional procurement provides a high certainty of confirmation to expectations.

Suitability score: 4

Building Team
Using Building Team, the project will be subject to the constructor's conceptions. The initial expectations of the client may be met to a lesser extent compared to the traditional approach. This stems from influence of the constructor during the design phases.

Suitability score: 3

Design-Build
The Design-Build model further extents influence of the supplier, which may result in deviation of confirmation to the client's expectations. Moreover, Design-Build is performance based, which makes it impossible for the client to specify *exact* needs to the supplier. This situation may also result in misinterpretation of intentions (de Koning et al., 2001).
However, thorough involvement of the client during the process may improve confirmation to expectations and prevent misinterpretation of agreements (Molenaar et al., 1998).
Concluding: Design-Build is little suitable for handling this condition. Thorough involvement of the client may improve this.

Suitability score: 2

INTEGRATION OF BENEFITS IN THE BOARDING OUT IS REQUIRED
This condition concerns the sharing of (potential) profit of the project with the constructor. Bell et al. (1993) state in general that *"profit sharing plans clearly introduce a component of performance related pay (...)"*. This indicates that this measure serves as an incentive for the constructor to produce maximum performance: the better the final result, the higher the profit will be (Olsen et al., 2005).

Traditional procurement
Using traditional procurement, the constructor gets influence neither on development nor on design. The constructor probably will not agree to sharing profits of a project he isn't familiar with. This makes traditional contracting unsuitable for this condition.

Suitability score: 1

Building Team

De Koning et al. (2001) state that in order to let suppliers have a share in the profit, it is important that they have had influence on both design and construction. This way they have been able to steer the project in a way that they can obtain optimization of the returns.

The Building Team approach may be suitable for this condition when the supplying actor has been procured in an early stage of the process.

Suitability score: **3**

Design-Build

The explanation given for the Building Team can be applied to Design-Build as well, where the latter takes this situation to a higher level because the design-builder gets even more influence on the project. Also the design-builder gets to steer the process in a way estimated profits will be advantageous to him.

Suitability score: **4**

5.3 Overview

Figure 15 gives an overview of the suitability scores.

Overview of the suitability scores

This table gives an overview of the suitability of the three organization models to handle the conditions.

Conditions by which to typify the project		Suitability per organization model		
Category	Condition	Traditional	Building Team	Design-Build
Project based conditions	1. The project is schedule driven	Little suitable	Suitable	Very suitable
	2. The project is budget driven	Suitable	Little suitable	Mod. suitable
	3. Certainty of costs at an early stage needed	Little suitable	Mod. suitable	Suitable
	4. Requirements have not been completely inventoried at the moment of procurement	Unsuitable	Mod. suitable	Little suitable
	5. The project is complex	Little suitable	Mod. suitable	Suitable
	6. The project requires customization from the end-user	Suitable	Mod. suitable	Little suitable
Client based conditions	7. The client has little experience	Little suitable	Suitable	Little suitable
	8. The client needs to hand over risk to the supplier	Unsuitable	Mod. suitable	Suitable
	9. Possibility for minimizing administrative burden after procurement	Little suitable	Little suitable	Mod. Suitable
	10. The client needs to be able to influence the product	Very suitable	Suitable	Little suitable
Market based conditions	11. Input from the supplying actor is required	Unsuitable	Suitable	Very suitable
	12. The client wishes to have a large number of offerors compete to obtain lower costs	Very suitable	Unknown	Unsuitable
	13. The project is highly dependent on the market/government/environment	Very suitable	Suitable	Little suitable
Conditions based on relationship between client and supplier	14. Duration of the procurement course must be as short as possible	Suitable	Mod. suitable	Little suitable
	15. Outsourcing of other functions than construction is required	Unsuitable	Mod. suitable	Suitable
	16. Number of contractual relationships wanted is low	Little suitable	Little suitable	Very suitable
	17. High certainty of confirmation to expectations is needed	Suitable	Mod. suitable	Little suitable
	18. Integration of benefits in the board out is required	Unsuitable	Mod. suitable	Suitable

Figure 15: Overview of the suitability scores

6

Analysis of empirical results

Verification of the framework

6.1 Introduction

FOUR CASES

The empirical research encompasses the study of four housing projects, which have been procured with the two most common organization models: traditional and Building Team (see paragraphs 4.2 and 4.3).

The objective has been to examine per case:

- which project conditions characterized the project and to what extent (absolute as well as relative);
- which project conditions influenced the choice of the organization model and to what extent;
- how the chosen organization model suited the conditions in retrospect.

The data collection method used is a retrospective case study questionnaire/interview. Four project managers were asked to fill in the objective Evaluation Form (see appendix 2), accompanied by additional, subjective information.

The empirical part of the study serves two purposes.

The first is the *verification of the framework*, as discussed in this chapter. The obtained information from the four cases will be held against the values of the theoretical framework. Possible deviations become exposed and give information about the practicability and validity of the framework.

The second purpose of the empirical study is the *obtaining of references at which to compare the theoretical suitability of Design-Build with.* This information will be utilized to create chapter 7: "Analyzing Design-Build application". Appendix 4 clarifies the implementation of the empirical results.

In the next paragraphs, each case -grouped by the utilized organization model- will be introduced briefly. More extensive information on the cases can be found in appendix 3. Next, the empirical results will be compared with the theoretical framework. Accompanying data can be viewed in appendix 5. This comparison will be followed up by explanations of striking deviations between theory and practice. Finally, the validity of the framework will be discussed in the conclusion.

6.2 Case 1: Wiedenbroek

(Traditional procurement)

INTRODUCTION

Wiedenbroek is a relatively small housing project, located in Haaksbergen. It consists of one volume, which holds 18 ground-bound apartments. Typifying is the fact the building accommodates disabled people, which created demand for domotics. Also the presence of a combined heat and power system (CHP) makes Wiedenbroek a technically complex project.

Acceptance took place in 2004.

COMPARISON WITH THE FRAMEWORK

When taking a look at the results of the study of Wiedenbroek, it becomes clear that not all values match those that had been obtained through the theoretical study.

The most striking dissimilarities are associated with the following five conditions:

- The project is schedule driven;
- Certainty of costs at an early stage is needed;
- The project is complex;
- Possibility for minimizing administrative burden after procurement;
- Number of contractual relationships wanted is low.

For all five conditions applies that suitability scores as assigned by the interviewee are *higher* than one would suspect judging from theory. In fact, the interviewee has given the maximum score to almost all options for determining the appropriateness of the model.

EXPLANATION

How to explain these deviations?

The interviewee stated that the success of the traditional approach is highly sensitive to two variables.

The first one is the *market*, which is constantly searching for balance. At certain moments suppliers are offering themselves by dozens at low prices (sometimes below cost prices) because they suffer from a lack of work. A few months later the situation could be reversed completely; then clients experience difficulty in finding a constructor. The first situation is preferable for clients when procuring the traditional way; they can financially benefit from the high amount of competition. The market is a variable the client can anticipate to by knowledge and experience.

The other variable that influences the success of the traditional model is the *attitude of the supplier.* The attitude of the supplier, in terms of cooperation, contribution, effort, performance, etc., influences the success of a project to a high extent. The traditional model is extraordinarily sensitive to this variable because of the separation of design and construction. The client procures a stranger and can only hope the cooperation will be a successful one. Therefore, the attitude of the supplier is a variable that can be hard to anticipate to[16].

Both variables have been optimal and advantageous when procuring and executing Wiedenbroek. This explains the much higher scores obtained with

16 Clients can procure partners they are familiar with, but this method of working loses some of the advantages of traditional contracting. The competition factor for example will be diminished this way.

the empirical study compared with the theoretical ones.
It appears that these two variables *overrule* the 18 conditions.

6.3 Case 2: **Talma**

[Traditional procurement]

INTRODUCTION
A firework storage depot had exploded in 2000, destroying an entire district called Roombeek, Enschede. Talma is part of the redevelopment programme that had been erected and encompasses the construction of 96 new dwellings. These are all rentals, and the client had decided to give the tenants influence on both the floor plan and the appearance of the façade of their new house: *mass customization*. This makes the project a varied one because no two buildings ended up being the same.
Acceptance took place in 2003.

COMPARISON WITH THE FRAMEWORK
Judging from appendix 5, Talma shows similarity to theory. There is only one condition of which the suitability score deviates from what one would suspect:
- Number of contractual relationships wanted is low.

EXPLANATION
The interviewee claimed that the need for a low number of contractual relationships for the housing association to conclude and maintain stemmed from inexperience towards mass customization. A low number of contracts was thought to be reducing overall project complexity. Although theory claims the traditional model to be little suitable for this situation, it applied well to Talma. According to the interviewee it had been possible to reduce the amount of contractual relationships by sourcing out subcontracts. An example is letting the general contractor take care of procuring subcontractors.

6.4 Case 3: **Deppenbroek**

[Building Team]

INTRODUCTION
Deppenbroek, located in Enschede, is still under construction at the moment of writing. Its planned acceptance takes place in 2008 and encompasses a total of 323 dwellings. Part of it will be new housing estate and this case study focuses on that part only. The immediate cause is the restructuring of the district because of ageing of the existing accommodation stock. An exceptionality has been the extreme hindrance coming from the neighbourhood during demolition.

COMPARISON WITH THE FRAMEWORK
When viewing the comparison table (appendix 5), one can see the "*influence on choice of organization model*" column shows that there has been merely one condition that had influenced the choice of the organization model:
- The project is highly dependent on market/government/environment.

This has to do with the following:
The choice of the Building Team approach seemed to be based only on *handing a service in return*. In the past, the constructor had sold ground to the client more than once for 'friendly prices'. On the other hand, the client had provided labor for the constructor several times by procuring him. Some sort of symbiotic cooperation emerged through the years, with the result that even for this specific case, where the initial ground position belonged to the client, the Building Team approach had been chosen to provide benefit for both actors. Both the client and the constructor confirmed this and also mentioned that this method of working is of common use.

The Building Team approach handles the conditions that characterize Deppenbroek fairly as expected. In fact there are no significant differences with theory.

6.5 Case 4: **Plan de Nassau**

[Building Team]

INTRODUCTION
The fourth and last case that has been studied is Plan de Nassau, which is located in Enschede as well. Plan de Nassau is a restructuring project that comprises a mixture of 113 dwellings to let and to sale, a commercial part and accommodation for a religious community.
There is a high amount of variety of the facades in terms of colour and material. Furthermore the interiors have been set up using flexible building components, which creates possibilities for changing the functions of the buildings when necessary.
Acceptance took place in 2004.

COMPARISON WITH THE FRAMEWORK
Like Deppenbroek, the main reason for choosing the Building Team approach is to maintain the relationship with the supplying party. Some characterizing conditions also played part, but were inferior in influencing the decision of which organization model to select.

The most characterizing conditions have been handled as expected using the Building Team approach. There are three exceptions though:
- The project is complex;
- Possibility for minimizing administrative burden after procurement;
- High certainty of confirmation to expectations is needed.

EXPLANATION
The interviewee stated that due to the experience of the constructor, the complexity could be handled fairly

easily. This explains the higher suitability score granted to this condition.
Concerning condition nine, the Building Team approach has been indicated as being little suitable for clients that need to minimize administrative burden after procurement, because of the necessity of thorough involvement during the entire process. However, the interviewee stated that by means of a distinct division of tasks, it had been possible to delegate a great deal of the administrative burden to the constructor. Compared to the traditional model, the administrative burden had been strongly reduced.
The third deviation, condition seventeen, can be explained by the existence of clear agreements between client and supplier. Moreover, these two actors are familiar with each other and will exert to keep their symbiotic relationship. This secured the certainty of confirmation to expectations.

6.6 Conclusion

TRADITIONAL PROCUREMENT
The main conclusion concerning traditional procurement is that its success is highly dependent on the *market* and *the attitude of the constructor*. These variables could even overrule the conditions within the framework, as proven by both Wiedenbroek and Talma.
Wiedenbroek can be described as a successful project, at which almost all suitability scores were higher than theory indicates. The main cause is that both the market and the attitude of the constructor had been extremely favourable to this project.
The suitability scores of Talma did stick more to theory. It is assumed that Talma was less of a 'lucky project' where every aspect sailed with the wind astern. Although the market had been favourable, the constructor turned out to be inexperienced and inclining towards opportunistic behaviour. This affected the project in a negative way and explains the lower suitability scores compared to Wiedenbroek.

BUILDING TEAM
Judging from Deppenbroek and Plan de Nassau, the Building Team cooperation appears to be based on relationships between client and supplier, rather than several of the conditions.
This strongly decreases the freedom of a client to choose an organization model, as that decision has already been fixed in the very beginning of the process.
Roughly it can be put that the empirical results obtained from the Building Team projects match theory. Several disadvantages of the Building Team approach (which result in low suitability scores) appear to be skirtable by a combination of a *good relationship* and *clear agreements*.

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7

Analyzing Design-Build application

What conditions plead for Design-Build application?

7.1 Introduction

Now that the framework has been compared to the empirical research, the main objective comes back into focus.

"Determine the suitability of Design-Build –pertaining to the traditional and the Building Team model- in housing projects initiated by housing associations."

The objective will be approached by applying the framework. It will be used to retrieve how the Design-Build approach theoretically would have performed in the four cases. This will give an answer to the question whether Design-Build would have been a more advantageous option than the actually utilized organization models. Furthermore it will reveal which conditions caused these results. Appendix 4 further explicates the work flow.
In order to achieve the objective, two steps will be taken. The next two paragraphs will describe these steps.

7.2 Comparison of grades

SCHEME
Step 1 will provide information on the performance of Design-Build pertaining to the actually used organization models. It encompasses the comparison of two groups of grades[17], determined separately per case.
The first group stems from the suitability scores of the actually used organization models to handle the conditions. The information to create this group of scores is derived from the empirical study.

The second group of grades will be obtained by pretending as if Design-Build had been the used organization model. The suitability scores used to create this group stem from theory.
These two groups of grades can be analytically compared and will provide clarity which of the two models handles the individual as well as the combined conditions more advantageously.
▶ Step one gathers information on the project-level. This means the viewer can conclude *per project* whether Design-Build would have been a more advantageous approach than the actually used model.

FINDINGS (GENERAL)
The results of the comparison of grades can be viewed in appendix 6. They appear to be unambiguous: for each project, Design-Build turns out to perform less than the actually used organization model.
Design-Build performs the worst concerning Wiedenbroek (a total grade of -56%, see appendix 6). This is fairly as expected, since the corresponding interviewee had granted only high suitability scores to the traditional model for handling the conditions. The more moderate suitability scores theory provided for Design-Build can not compete with them.
Concerning the remaining projects, Design-Build on average also performs worse than the actually used organization models, but to a smaller extent.
The next section examines what conditions cause the differences in performance between Design-Build and the other two models.
These differences will be discussed on the basis of *deviations*[18].

FINDINGS (NEGATIVE DEVIATIONS)
The following conditions (that affect the projects to a large extent) show the largest negative deviations. They are the main cause for the overall inferior performance of Design-Build:

The client needs to be able to influence the product.
All interviewees stated that this condition had been of very high relevance to their projects. One of the reasons is the increasing demand for uniqueness by tenants as well as buyers. Design-Build, a more contractor-led approach, is not suitable for realizing unique, individualized dwellings (see paragraph 4.5 "Comparison", and in particular figure 5 "Steering of the process"). Therefore, conform expectations, the grades ascribed to Design-Build concerning this condition are lower than those of the actually used organization models.

The client wishes to have a large number of offerors compete to obtain lower costs.
The second negative deviation only concerns the traditionally procured cases. The traditional approach lends itself excellently for this condition, as it leans heavily on competition to reduce project costs (see paragraph 4.2, "Traditional procurement"). Indeed, the interviewees stated that financial benefit had been gained because of the available competition. Design-Build projects however, do not join in financially from letting a large number of offerors compete.

The project is highly dependent on market/government/environment.
All interviewees indicated this condition to be of high relevance for their projects. Research originating from de Keizer (2006) confirms this for housing projects in general. Both the traditional and the Building Team approach

[17] A [grade] is the [suitability score] of an organization model to handle a condition, multiplied with this condition's absolute [weight] on the project.

[18] A deviation is the extent to which the Design-Build grades differ from those of the used organization models, As can be seen in Appendix 6, a negative deviation signifies that Design-Build performs inferior to the competing models, whereas a positive one is in favour of Design-Build.

had been able to handle this condition well. This may be explained by the management function the client retains using either model. Pertaining to Design-Build, where the client hands over this function to the supplier, the client has more control of the process and is more able to fine-tune project aspects like conditioning in order to meet external demands.

Duration of procurement course must be as short as possible
This condition only concerns the traditionally procured projects, as those of the Building Team did not have a procurement phase (see paragraphs 6.4 "Deppenbroek" and 6.5 "Plan de Nassau"). Both traditional projects succeeded in obtaining a short procurement course, just like theory indicates. As can be seen in appendix 3, the procurement course of Talma had even been too short.
Design-Build has a longer course due to extensive prequalification necessity and therefore is less suitable to handle this condition.

High certainty of confirmation to expectations is needed.
The last condition that shows a collective negative deviation on the studied cases concerns confirmation of expectations. Again, all interviewees indicated this condition to be of importance to their projects. Compared to Design-Build, the more structural and thorough involvement of the client that both the traditional and the Building Team model provide, may be indicated as one of the main drivers for obtaining a high confirmation of expectations.

FINDINGS (POSITIVE DEVIATIONS)
There is only one condition that shows a value in favour of Design-Build:

The project is schedule driven.
Mainly for Talma, Design-Build could have yielded advantage on this condition. This can be explained as follows: The cooperation with the constructor that had been procured to realize Talma went rather laboriously, as the actor appeared to be inexperienced and inclining towards opportunistic behaviour. This resulted in project delay. Design-Build however could have skirted these issues because of:

1. the more thorough prequalification that is required for Design-Build (see condition 14 as discussed in chapter 5) which would have resulted in a more experienced supplier;
2. the earlier involvement of the design-builder, which would have resulted in a more efficient and speedier process (de Koning et al., 2001).

7.3 Order of conditions

SCHEME
The second step will provide information to do a pronouncement on the suitability of Design-Build on housing in general. In order to establish this step, the *orders of ranking* the interviewees have assigned to the conditions of their projects will be added up. This creates a total relative ranking order, which will be conceived as an identification of the most important conditions that apply to housing projects in general[19]. The suitability of Design-Build on the first three of these conditions may be decisive on the issue whether Design-Build can be suitable for housing projects.

▶ Step two gathers information at a project-exceeding level, as the combined information gained from the cases serves to provide a collective overview.

FINDINGS
The results are presented in appendix 7. The top 3 of the most important and characterizing conditions are:

1. The client needs to influence the product;

As a result of increasing prosperity, buyers as well as tenants tend to get more articulate concerning their accommodation. Instead of being content with standardized, mainstream dwellings as realized in typical Dutch VINEX-locations[20], they demand more individualized, customized ones (Derksen, 2005). As concluded earlier (see paragraph 4.5, "Comparison"), Design-Build tends to be more suitable for standardized dwellings, which is the kind the consumer seems to relinquish. In order to realize more specific and unique projects, the client should retain maximum influence during the entire construction process.
Another argument that might explain why this condition is relevant for housing projects may be that housing associations will be responsible for their project's performance. As one of the interviewees stated, especially rentals should be built well, since the association will be held financially responsible for possible flaws during their life span.

2. The project is highly dependent on market/government/environment;

Housing associations fulfill a social role. This means they will be constantly monitored by the government. Recently, associations have made agreements with the local authorities concerning performance (de Keizer, 2006, Zandstra et al., 2002).

19 Note that this information stems from only four cases and results may therefore be inaccurate.

20 "VINEX" is the abbreviation of 'Vierde Nota Ruimtelijke Ordening Extra', which represents Dutch spatial regulation as established in 1993.

Next to dependence on the government, housing associations usually realize their projects in dense, urban settings. The probability of hindrance stemming from individual residents, the local neighbourhood association or environmentalists is heavily present.
At length, housing associations are dependent on the market, for this actor may have the ground position.

3. High certainty of confirmation to expectations is needed;
Theory does not explain why housing associations -compared to other sectors in the construction industry- need a high certainty of confirmation to expectations. It may be that the final appearance of the dwellings as well as their exploitation and maintenance[21] are responsibilities assigned to the association, rather than the supplier, to whom these factors are of no avail. This might explain why housing associations won't allow deviation from their initial plans.

Design-Build appears to be a weak performer on the three conditions listed above: each of them has been handled better by the traditional or Building Team approach. Since these conditions represent the top three of the most important circumstances to typify housing projects, it can be concluded that Design-Build does not lend itself for housing projects in general.

7.4 Conclusion

Based on the four cases, it can be put that Design-Build performs in an inferior way on housing projects compared to the traditional model and Building Team.

The first analysis, where the organization models compete with each other in the field of their suitability to handle the given conditions, proves that both traditional procurement and the Building Team approach outperform Design-Build in each case.
The main conditions to cause this result concern influence of the client to form the product, obtaining financial advantage by letting a large number of offerors compete, dependence of the project on the market/government/environment, duration of the procurement course and certainty of confirmation to the client's expectations.
Design-Build may offer advantage towards schedule driven projects, but its inferior performance on other conditions that affect the project nullifies this advantage on balance.

The second analysis, in which the project conditions are arranged by their relative order of importance, shows that Design-Build is little suitable for the most relevant conditions which typify the studied housing projects. These concern:

1. influence of the client to form the product;
2. dependence of the project on the market, government, and environment;
3. certainty of confirmation to the client's expectations.

Judging from these three conditions, it can be concluded that housing associations require a high amount of involvement in the project, as they will be responsible for the final result. Only by means of maximum participation during the construction process, the association is able to actively secure an outcome of consent.
Design-Build however, requires the housing association to disassociate itself from the project. Handing over the power to form the project creates an unwanted situation.

Therefore, the Design-Build approach - compared to the traditional model and the Building Team, is little suitable for housing projects, because it fails on handling the relevant conditions.

[21] In case of rentals.

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8

Conclusion & discussion

General findings and suggestions for further research

8.1 Conclusion

Construction projects in general are affected by a set of 18 conditions. The suitability of the used organization model to handle these conditions heavily influences project progress. Figure 15 ("overview of the suitability scores") represents a theoretical framework which shows the suitability of the traditional model, Building Team and Design-Build to handle these conditions. By judging the relevance of each condition in combination with its suitability score, a client can determine which organization model may provide the best performance to his project.

Based on this study it can be said that housing associations show a tendency of choosing traditional procurement in order to realize their projects. Using this organization model, both the climate of the market and the attitude of the procured constructor turn out to be affecting project progress. This affection may even overrule the conditions, and should therefore be taken into account when using the framework.
The Building Team approach is used merely to maintain a symbiotic relationship with the constructor, rather than an active choice with only the product in mind.
The Design-Build concept at last has never been used by any Dutch housing association.

Design-Build -compared to both traditional procurement and the Building Team model- is little suitable for housing projects. Each studied case demonstrates to be better off using either the traditional or the Building Team model. When examining housing projects in general, Design-Build appears to be little suitable to handle the conditions that are of high relevance. This study points out that:

1. housing associations desire to have maximum influence on the final product;
2. housing projects are highly dependent on the market, government and environment;
3. housing associations desire a high certainty of confirmation to expectations.

These three conditions indicate that housing associations require to be thoroughly involved in the process, for they will be held responsible for the final result. Nevertheless, Design-Build shows inferior performance on these three conditions, as this model requires handing over of influence. This situation is contrastive to the desired one. Therefore, Design-Build appears to be little suitable for housing projects in general.
It has been stated that the client is thought to be the normative factor to make improvement in the construction sector. Currently, housing associations are better off continuing to use the traditional or the Building Team model for their new estate activities, as Design-Build does not appear to be a more advantageous approach.

8.2 Suggestions for further research

The next sections provide suggestions for further research and investigation regarding this paper's subject.

RESEARCH OF MORE CASES
Although this study concludes that Design-Build is a weak performer on housing projects, one should keep in mind that these results have been based on only four housing projects. It is thinkable that certain types of housing projects -theoretically- may benefit from the Design-Build approach. This would mean for a project that it is affected most by conditions that show high suitability scores. It may be supposable for example that a client needs to get a small housing project realized as fast as possible, and simultaneously is not able to put lots of resources in it, partly because of the pressure of other running projects.
This imaginary housing project is heavily affected by the following conditions:

- The project is schedule driven;
- Input from the supplying actor is required;
- Number of contractual relationships wanted is low.

All of these conditions show a relatively high suitability score for Design-Build to handle them (see figure 15, "overview of the suitability scores"). In this example, Design-Build could be more advantageous for the client than the traditional or the Building Team model.
This demonstrates that the current research could be further explored in order to come up with more funded conclusions, for example by demonstrating the existence of the above-mentioned type of housing project.

INVESTIGATION OF THE CONSTRUCTOR'S MOTIVES
It has been concluded that housing associations in some cases choose the Building Team approach merely to maintain a relationship with the constructor. In other words: they are meeting the constructor's needs. Moreover, research originating from de Keizer (2006) shows that constructors who own land may put the Building Team cooperation as a stipulation for selling it to a housing association. These two findings prove that constructors in some cases exert pressure in order to join themselves in the project coalition at an early stage. Therefore, the motives that constructors have to demand the Building Team approach could be inventoried. This

would elucidate whether Design-Build could be of even more advantage for both actors.

RESEARCH OF PREPARATION NECESSITIES

If -after having carried out further research- the Design-Build concept turns out to be an advantageous choice to certain kinds of housing projects[22], housing associations should know how to be prepared for implementing the Design-Build model within their work flow. Judging from the findings obtained with this research, three aspects turn out to be of high importance.

Drawing up pre-qualification criteria the supplier has to meet;

Housing associations should know what competencies to demand from the design-builder. As stated earlier experience of the supplying actor is one of the key stipulations for project success (for example when discussing condition 9, "Possibility for minimizing administrative burden after procurement", or 11, "input from the supplying actor is required"). As there are currently no suppliers with experience regarding Design-Build in housing projects, it may be examined whether applicants have had management functions or responsibilities regarding conditioning in past projects.

Formulation of performance criteria the product has to fulfill;

As housing associations are used to formulating their demands through detailed specifications[23], it may be worth examining how to set up performance criteria. As these are less detailed and more open to different interpretations (see for example condition 17, "High certainty of confirmation to expectations is needed"), it is important to formulate them correctly in order to obtain conformation to the client's initial expectations as much as possible.

Determining the role and function of the client during the process.

Several findings within this paper indicate that project success depends heavily on the involvement of the client (for example condition 1: "The project is schedule driven"). Research should be done to comprehend the meaning of this involvement: how should the client be included in the project and how can his effort be minimized and still be efficient?

8.3 Final words

In this paper it has been attempted to uncover the possibilities of Design-Build application in the housing sector. Hopefully the findings may assist housing associations in their decision which organization model to choose. Plunging into this matter was rather revealing, as it exposed many interesting facts. Paragraph 8.2 shows that there is still more to explore on this subject, and it is therefore recommended to subsequent researchers to continue studying the possibilities of Design-Build application in housing projects.

[22] Despite of the findings obtained through this study.

[23] As is customary when using the traditional or the Building Team model.

9

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APPENDICES

Design-Build and housing

Suitability analysis of Design-Build in housing projects

WOON GROEP twente

Universiteit Twente
de ondernemende universiteit

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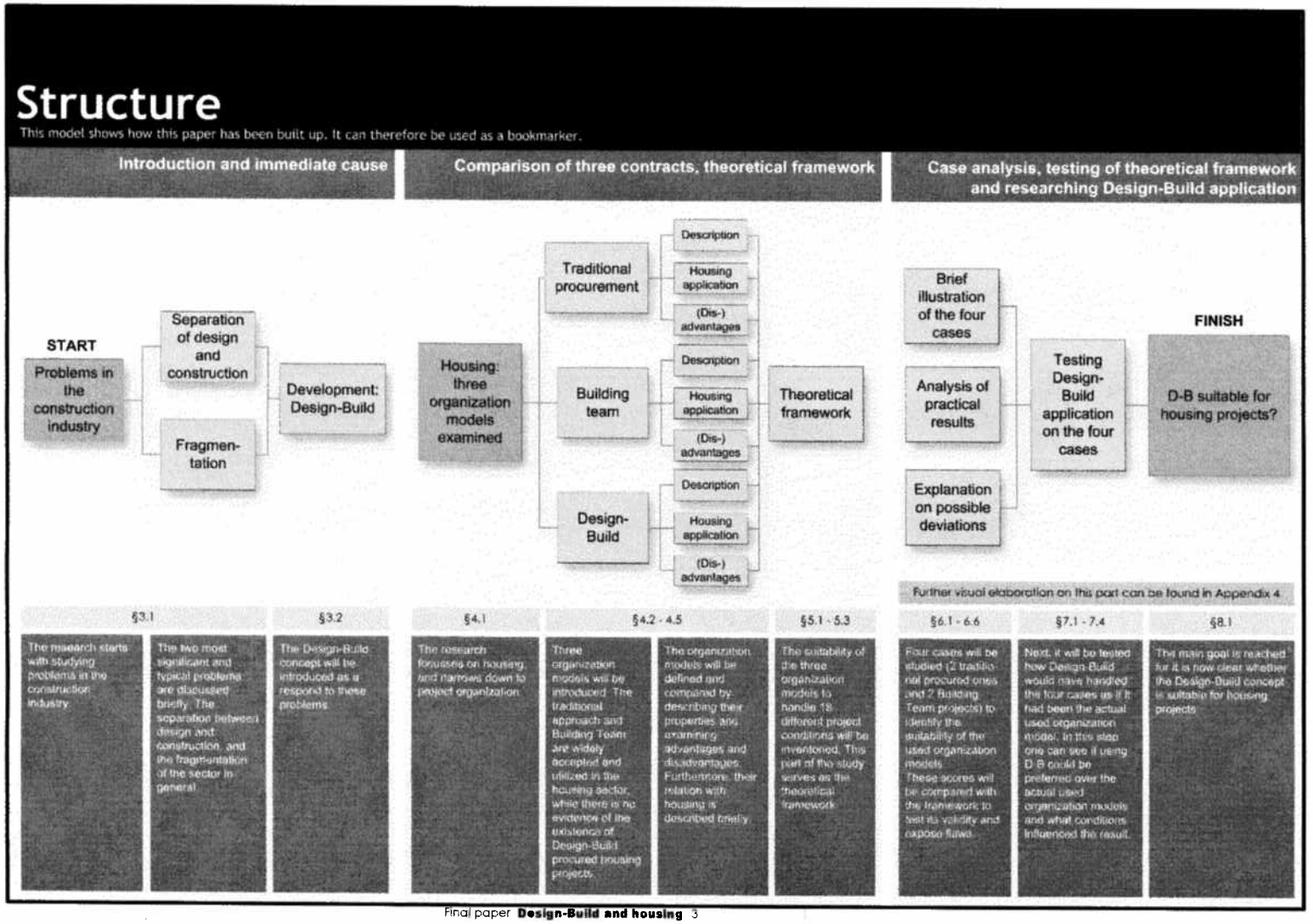
Appendix one - *Structure*



2

Appendix two

Evaluation Form

Evaluation of the organization model [Case X]

Category[A]	Required or existing project condition[B]	Applies to project?[C]						Influence on org. model[D]						Suitability score[E]						Order[F]
		Not at all				Very much	Unknown	Not at all				Very much	Unknown	Not at all				Very much	Unknown	
Project based conditions	1. The project is schedule driven	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	2. The project is budget driven	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	3. Certainty of costs at an early stage needed	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	4. Requirements have not been inventoried at the moment of procurement	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	5. The project is complex	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	6. The project requires customization from the end-user	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
Client based conditions	7. The client has little experience	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	8. The client needs to hand over risk to the supplier	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	9. Possibility for minimizing administrative burden after procurement	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	10. The client needs to be able to influence the product	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
Market based conditions	11. Input from the supplying actor is required	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	12. (..) have a large number of offerors compete to obtain lower costs	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	13.. The project is highly dependent on the market/government/environment	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
Conditions based on relationship between client and supplier	14. Duration of the procurement course must be as short as possible	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	15. Outsourcing of other functions than construction is required	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	16. Number of contractual relationships wanted is low	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	17. High certainty of confirmation to expectations is needed	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	
	18. Integration of benefits in the board out is required	o	o	o	o	o	□	o	o	o	o	o	□	o	o	o	o	o	□	

A) **Category**: The group under which the conditions can be ranged.

B) **Project condition**: circumstance that identifies the nature of the project.

C) **Applies to project?**: the extent to which the condition/statement typified the project. → Situation before procurement

D) **Influence on choice of organization model**: to what extent did the condition influence the choice of the organization model? → Situation after completion of the project

E) **Suitability**: In retrospect, how did the chosen organization model handle the condition? → Situation after completion of the project

F) **Order**: Please rank the conditions in the order they affected the project, using a top 10.

1) "Complex": Related to housing, please score according to your own opinion and/or experience, using option 1 to indicate a very simple project, and 5 to indicate a very complex one.

2) For example building regulations, procurement laws, or expected hindrance of environment groupings.

3

Appendix three

Practical results

Case 1: Wiedenbroek

Evaluation of the organization model [Wiedenbroek]

Category		Requirement or existing project condition	Applies to project?	Fit on org. model	Suitability score	Order
Project based conditions	1.	The project is schedule driven	○ ○ ○ ○ ● □	● ○ ○ ○ ○ □	○ ○ ○ ○ ● □	2
	2.	The project is budget driven	○ ○ ○ ○ ● □	○ ○ ○ ○ ● □	○ ○ ○ ○ ● □	1
	3.	Certainty of costs at an early stage needed	○ ○ ● ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ● □	9
	4.	Requirements have not been inventoried at the moment of procurement	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	5.	The project is complex	○ ○ ● ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ● □	10
	6.	The project requires customization from the end-user	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
Client based conditions	7.	The client has little experience	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	8.	The client needs to hand over risk to the supplier	○ ○ ● ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ● □	
	9.	Possibility for minimizing administrative burden after procurement	○ ○ ○ ● ○ □	● ○ ○ ○ ○ □	○ ○ ○ ● ○ □	6
	10.	The client needs to be able to influence the product	○ ○ ○ ○ ● □	○ ○ ● ○ ○ □	○ ○ ○ ○ ● □	1
Market based conditions	11.	Input from the supplying actor is required	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	12.	(...) have a large number of offerors compete to obtain lower costs	○ ○ ○ ○ ● □	○ ○ ○ ○ ● □	○ ○ ○ ○ ● □	4
	13.	The project is highly dependent on the market/government/environment	○ ○ ○ ● ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ● □	7
Conditions based on relationship between client and supplier	14.	Duration of the procurement course must be as short as possible	○ ○ ● ○ ○ □	○ ● ○ ○ ○ □	○ ○ ○ ● ○ □	8
	15.	Outsourcing of other functions than construction is required	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	16.	Number of contractual relationships wanted is low	○ ○ ○ ○ ● □	● ○ ○ ○ ○ □	○ ○ ○ ● ○ □	
	17.	High certainty of conformation to expectations is needed	○ ○ ○ ● ○ □	○ ● ○ ○ ○ □	○ ○ ○ ○ ● □	5
	18.	Integration of benefits in the board out is required	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	

Remarks on the conditions

2. The traditional approach can be the cheapest, that is when the market is favourable. Project success using the traditional model is dependant on the moment of procurement and the type of constructor.
9. A client shouldn't attract more work than necessary. This condition is extremely linked to the experience of the client (condition 7).
10. The quality of the dwellings is very important when it concerns rentals. This is because the client will be responsible for maintenance. Influence on the project is extra important in this situation in order to obtain a high quality result.
11. Only during construction, of course.
12. Wiedenbroek had been procured at the 'right' time. Ultimately, five applicants competed with each other.
14. After the announcement, there is a certain period in which the applicants may make remarks and identify inefficiencies. Constructors should take their time to create the proposals. It is absurd to take up to four years time to develop a project, and then expect a constructor to create a flawless offer in two weeks.
16. It is possible to reduce the number of contractual relationships by ranging subcontracts under the main contracts. Only the main contracts will be bounded to the client.

Case analysis: Wiedenbroek, Haaksbergen

Overview of the main properties

Name	
(Title of the project)	"Wiedenbroek"
Location	
(Locatie: streetname, city)	Situated in Haaksbergen.
Start building process	
(Date of the first, initiating phase)	2000, start of the actual construction: 2004.
Date of delivery	
	2005
Immediate cause/motive	
(What initiated the project?)	Individualizing: instead of 4 individuals on one appartment, 1 on 1 had become the preferred division.
Type	
(For example a flat with dwellings to let)	One closed shape with the appartments enclosed.
Contracting method	
(Traditional or Building Team)	Traditional contracting.
Involved Actors	
(Client, architect, constructor, etc.)	Client: Lucht & Licht; Constructor: Kormelink (coordinating); Installations: Alferink.
Size	
(Number of dwellings, overall costs)	Number of dwellings: 18. Overall costs: unknown.
Type of construction	
■ Supporting construction (for example stacking or pouring)	Stacked sand-limed bricks, bridge deck slap floors
■ Facade (for example supporting facade)	None supportive laid brick
Materialisation	
■ Construction (for example steel or wood)	Sand-limed bricks;
■ Facade (for example sandwich panels or bricks)	Laid bricks, plastic roof covering;
■ Interior (for example wooden framework with plasterboard)	Sand-limed bricks.
Special circumstances	
(Unusual conditions or other specific properties)	Heat exchange unit, large amount of domotics. This makes the project quite complex at the fitting technique level. Furthermore there have been more rejected designs than usual.

Case 2: Talma

Evaluation of the organization model [Talma]

Category	Required or existing project condition	Applies to project?	Fits on org. model	Suitability to use	Order
Project based conditions	1. The project is schedule driven	□	□	□	5
	2. The project is budget driven	□	□	□	
	3. Certainty of costs at an early stage needed	□	□	□	
	4. Requirements have not been inventorised at the moment of procurement	□	□	□	
	5. The project is complex	□	□	□	7
	6. The project requires customisation from the end-user	□	□	□	1
Client based conditions	7. The client has little experience	□	□	□	10
	8. The client needs to hand over risk to the supplier	□	□	□	
	9. Possibility for minimizing administrative burden after procurement	□	□	□	
	10. The client needs to be able to influence the product	□	□	□	2
Market based conditions	11. Input from the supplying actor is required	□	□	□	
	12. (...) have a large number of offerors compete to obtain lower costs	□	□	□	3
	13. The project is highly dependent on the market/government/environment	□	□	□	4
Conditions based on relationship between client and supplier	14. Duration of the procurement course must be as short as possible	□	□	□	6
	15. Outsourcing of other functions than construction is required	□	□	□	
	16. Number of contractual relationships wanted is low	□	□	□	8
	17. High certainty of confirmation to expectations is needed	□	□	□	9
	18. Integration of benefits in the board out is required	□	□	□	

Remarks on the conditions

2. There has been a lot of struggling and discussion with the constructor about additional work. The mass customization approach partly caused this, as both the client and suppher were inexperienced on this matter.
4. All requirements were known, though the final specifications weren't entirely finished at the moment of procurement. This caused major discussion with the constructor.
6. See the remark on condition 4. The fact that the specifications weren't finished had to do with communication with the end-users, as some information was still missing.
8. Because of the unexpected additional work, it would have been more sensible to hand over more risk to the supplier.
9. The importance of supervision/checking during construction shouldn't be underestimated.
11. Only when retrospecting, it turned out that the project could have benefited from input from an (experienced) supplier, though this is only a guess.
12. There have been five applicants competing. The market was favourable.
13. The management needed to be transparent towards the public, as the whole project had a sensitive charge to it because of the disaster that had initiated the need for this project.
14. Duration of the procurement phase was short, as was intended. Perhaps it should have been longer by giving more attention to pre-selection. This could have resulted in a more capable constructor.
18. As in this case concerns only rentals, integration of benefits would be difficult.

Case analysis: Talma, Enschede

Overview of the main properties

Name	
(Title of the project)	'Talma'
Location	
(Locatie: streetname, city)	Situated in Enschede, Roombeek-West.
Start building process	
(Date of the first, initiating phase)	2000
Date of delivery	
	2003
Immediate cause/motive	
(What initiated the project?)	A fireworks-accident destroyed the entire district. Part of the remnants could be renovated, another part became new housing development.
Type	
(For example a flat with dwellings to let)	Only rentals: appartments, single family-dwellings, commuter dwellings and senior accomodations.
Contracting method	
(Traditional or Building Team)	Traditional
Involved Actors	
(Client, architect, constructor, etc.)	Client: Domijn Constructors: TenTije, Vastbouw, Trebbe Bouw, Nijhuis and others. Architects: Beltman Architecten & ing., IAA Architecten, de Boer, de Witte van der Heijden.
Size	
(Number of dwellings, overall costs)	A total of 96 dwellings. The total costs are hard to estimate because of insurance intervention. Resulting total building costs are approximately €14 million.
Type of construction	
■ Supporting construction (for example stacking or pouring)	Unknown
■ Facade (for example supporting facade)	Non supportive facade.
Materialisation	
■ Construction (for example steel or wood)	Supporting construction: Sand-limed bricks
■ Facade (for example sandwich panels or bricks)	Facade: Laid bricks, tiles and flagstones.
■ Interior (for example wooden framework with plasterboard)	Interior: Unknown.
Special circumstances	
(Unusual conditions or other specific properties)	The project has been based on mass customization. The tenants were able to choose from variations of floor plans and facades. This resulted in a high diversity. The client had set out several solid demands, the first dwellings had to be surrendered within one year.

Case 3: Deppenbroek

Evaluation of the organization model [Deppenbroek]

Category	Required in existing project condition	Applies to project?	Fit, on ing. model	Suitability score	Order
Project based conditions	1. The project is schedule driven	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	2. The project is budget driven	○ ○ ● ○ ○ □	● ○ ○ ○ ○ □	○ ● ○ ○ ○ □	5
	3. Certainty of costs at an early stage needed	○ ● ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ● ○ □	6
	4. Requirements have not been inventoried at the moment of procurement	○ ○ ○ ○ ■	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	5. The project is complex	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	6. The project requires customization from the end-user	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
Client based conditions	7. The client has little experience	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	8. The client needs to hand over risk to the supplier	○ ● ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ● ○ □	7
	9. Possibility for minimizing administrative burden after procurement	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	10. The client needs to be able to influence the product	○ ○ ○ ○ ● □	● ○ ○ ○ ○ □	○ ○ ○ ● ○ □	2
Market based conditions	11. Input from the supplying actor is required	○ ○ ○ ● ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ● □	4
	12. (...) have a large number of offerors compete to obtain lower costs	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	13. The project is highly dependent on the market/government/environment	○ ○ ○ ○ ● □	○ ○ ○ ○ ● □	○ ○ ● ○ ○ □	1
Conditions based on relationship between client and supplier	14. Duration of the procurement course must be as short as possible	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	15. Outsourcing of other functions than construction is required	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	16. Number of contractual relationships wanted is low	○ ○ ○ ○ ○ ■	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	
	17. High certainty of confirmation to expectations is needed	○ ○ ○ ○ ● □	● ○ ○ ○ ○ □	○ ○ ○ ● ○ □	3
	18. Integration of benefits in the board out is required	● ○ ○ ○ ○ □	● ○ ○ ○ ○ □	○ ○ ○ ○ ○ ■	

Remarks on the conditions

1. The traditional approach would not have been speedier.
2. This condition is dependent on the market, traditional contracting would probably have been cheaper.
3. Because the price can be negotiated at an early stage, it will be known at an early stage.
9. Although minimizing the administrative burden wasn't a goal, it always comes in handy when work can be handed over.
10. The amount of influence the client has on the project using Building Team is more or less similar to that using the traditional model.
13. There was a lot of hindrance from neighbouring inhabitants. Also the acquiring of licenses was more difficult than expected.
14. The interviewee stated that 'according to his experience' the procurement course of the Building Team model did not differ in length from that of the traditional model.
18. This never happens in housing projects. There is always a fixed price, the constructor will be held responsible for additional work

Case analysis: Deppenbroek, Enschede

Overview of the main properties

Name	
(Title of the project)	Deppenbroek
Location	
(Locatie: streetname, city)	Situated in Enschede. Enclosed by the Vanekerstraat, Mekkelholt, Geuitraat and Skelderstraat.
Start building process	
(Date of the first, initiating phase)	2000
Date of delivery	
	2001 and 2002: renovation, 2005 start construction. Expected delivery: early 2008
Immediate cause/motive	
(What initiated the project?)	One goal was to differentiate the area. In addition, it had to be adapted to new requirements and regulations.
Type	
(For example a flat with dwellings to let)	Mixture of dwellings for purchase and to let. Single family-dwellings, appartments (flats), senior-appartments.
Contracting method	
(Traditional or Building Team)	Building Team
Involved Actors	
(Client, architect, constructor, etc.)	Client: Domijn Constructor: Trebbe Bouw Architect: KAW Groningen (ook het stedebouwkundig plan) Engineer: Bartels.
Size	
(Number of dwellings, overall costs)	A total of 342 dwellings. Overall costs: approximately 27 milion euro.
Type of construction	
■ supporting construction (for example stacking or pouring)	Different types of supporting constructions have been used: The appartments/flats have been built up using tunneling and poured concrete.
■ facade (for example supporting facade)	The single family-dwellings consist of pre-fabricated, stacked sand-limed bricks. Almost all facades have been brick-layed.
Materialisation	
■ Construction (for example steel or wood) ■ Facade (for example sandwich panels or bricks) ■ Interior (for example wooden framework with plasterboard)	The construction exists out of sand-limed bricks (single family-dwellings) and concrete (appartments). Facades are made out of bricks, and wooden frameworks have been used for the facade-closing elements. Interior: Iton system walls
Special circumstances	
(Unusual conditions or other specific properties)	There have been a strong resistance from neighbouring inhabitants during the demolition. Acquiring licences went slow

Case 4: Plan de Nassau

Evaluation of the organization model [Plan de Nassau]

Category	Required or existing project condition	Applies to project?	Fit on criteria of costs	Suitability score	Order
Project based conditions	1. The project is schedule driven	○ ○ ● ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ● ○	□	10
	2. The project is budget driven	○ ○ ○ ● ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ●	□	7
	3. Certainty of costs at an early stage needed	○ ○ ○ ● ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ●	□	6
	4. Requirements have not been inventoried at the moment of procurement	● ○ ○ ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ○	■	
	5. The project is complex	○ ○ ○ ○ ●	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ●	□	1
	6. The project requires customization from the end-user	● ○ ○ ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ○	■	
Client based conditions	7. The client has little experience	● ○ ○ ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ● ○	□	
	8. The client needs to hand over risk to the supplier	○ ○ ● ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ● ○	□	9
	9. Possibility for minimizing administrative burden after procurement	○ ○ ○ ● ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ●	□	8
	10. The client needs to be able to influence the product	○ ○ ○ ○ ●	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ●	□	2
Market based conditions	11. Input from the supplying actor is required	○ ○ ○ ○ ●	□	● ○ ○ ○ ○	□	○ ○ ○ ● ○	□	4
	12. (..) have a large number of offerors compete to obtain lower costs	● ○ ○ ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ○	■	
	13. The project is highly dependent on the market/government/environment	○ ○ ○ ○ ●	□	○ ○ ○ ○ ○	●	□	○ ○ ● ○ ○	□	5
Conditions based on relationship between client and supplier	14. Duration of the procurement course must be as short as possible	● ○ ○ ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ○	■	
	15. Outsourcing of other functions than construction is required	● ○ ○ ○ ○	□	○ ○ ○ ○ ○	□	○ ○ ○ ○ ○	■	
	16. Number of contractual relationships wanted is low	● ○ ○ ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ○	■	
	17. High certainty of confirmation to expectations is needed	○ ○ ○ ○ ●	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ●	□	3
	18. Integration of benefits in the board out is required	● ○ ○ ○ ○	□	● ○ ○ ○ ○	□	○ ○ ○ ○ ○	■	

Remarks on the conditions

2. The goal had been to make a minimum of 5% profit
3. The Building Team approach implies more responsibility for the constructor. He will put more effort in establishing costs at an early stage. Unforeseen costs will be diminished.
5. The high variety of dwellings caused this project to be extremely complex. As the constructor was experienced, the Building Team was able to handle this complexity with ease.
8. "Whoever determines, pays" is the motto that has been applied to this project regarding distribution of risk.
9. A clear division of tasks has been established, which resulted in clear responsibilities for each actor. The constructor took away a part of the burden, for example by taking minutes during each meeting.
10. Agreements have been made about the division and corresponding levels of influence.
11. The supplier constantly sophisticated the design/project, which turned out to be very helpful.
17. During the design phases, extremely concrete agreements have been made.
18. The interviewee does not believe in an reward/penalty system. If for example an constructor finishes earlier than planned, he already has an advantage and shouldn't get an extra reward for this.

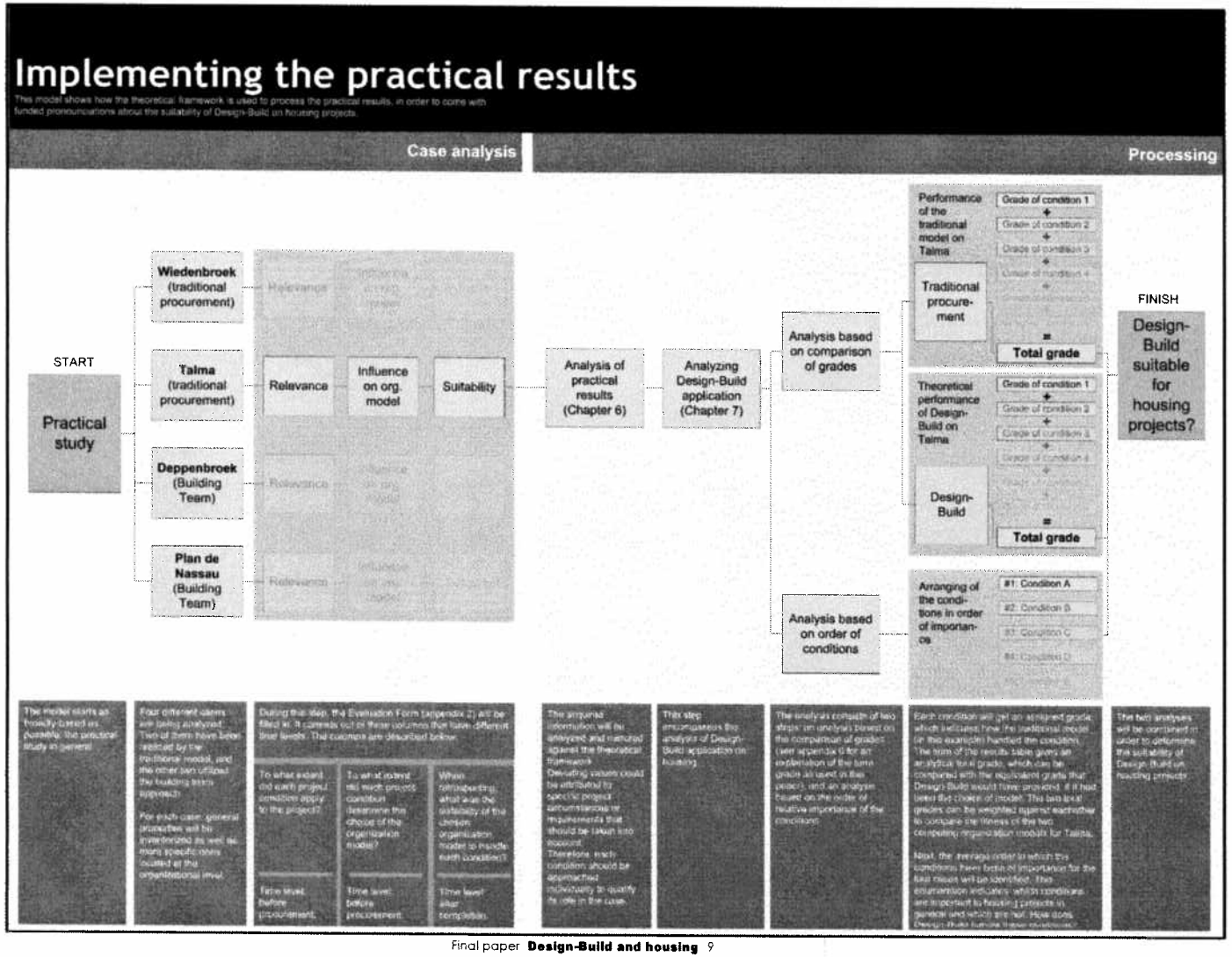
Case analysis: Plan de Nassau, Enschede

Overview of the main properties

Name	
(Title of the project)	"Plan de Nassau"
Location	
(Locatie: streetname, city)	Situated in Enschede, Horstlanden-Veldkamp. Enclosed by the Blekerstraat, Waldeck-straat, Nassaustraat, Emmastraat and Pyrmontstraat.
Start building process	
(Date of the first, initiating phase)	2000
Date of delivery	
	2004
Immediate cause/motive	
(What initiated the project?)	General improvement of the district, redevelopment.
Type	
(For example a flat with dwellings to let)	Mixture of dwellings for purchase and to let. Also a commercial part (medical centre) and accomodation for a religious community.
Contracting method	
(Traditional or Building Team)	Building Team
Involved Actors	
(Client, architect, constructor, etc.)	Client: Domijn and AM Wonen (DnA) Constructor: Koninklijke BAM Groep NV Architect: IAA Architecten (five different architects have been used) Engineer: AVS Customer of the medical centre: Stichting Gezondheidszorg Enschede
Size	
(Number of dwellings, overall costs)	Number of dwellings: 113. Size of dwellings: 85 to 105 m² (appartments), 130-150 m² (single family-dwellings) Overall costs: approximately 18 million euro.
Type of construction	
■ Supporting construction (for example stacking or pouring)	Construction has been made out of stacked concrete prefabricated elements.
■ facade (for example supporting facade)	Almost all facades have been brick-layed.
Materialisation	
■ Construction (for example steel or wood)	The construction exists of a concrete, prefab casco (both single family-dwellings
■ facade (for example sandwich panels or bricks)	and appartments).
■ interior (for example wooden framework with plasterboard)	Facades have been mainly made out of bricks Interior: Iton system walls
Special circumstances	
(Unusual conditions or other specific properties)	Eye-catching charisma, a lot of variety in the structure and colours of the facades has been used. Flexible arrangement of the interior: the commercial part of the project can easily be converted into housing for example. The ground/soil turned out to be polluted. The government took care of cleaning.

4

Appendix four - *Work scheme for implementing the practical results*



5

Appendix five

Analyzing practical results

Analyzing practical results/verificating the framework

This table shows how the values from the practical research are in ratio of the theoretic ones.

Conditions: Existing or required project condition. Comparison of practical results with theoretical values per project.

Condition	Wiedenbroek (traditional proc.) A Relevance	B Influence on org. model	C Weight (relevance and infl.)	D Order of importance	E Suitability (practice)	F Suitability (theory)	G Deviation (Practice-Theory)	Taluna (traditional proc.) A Relevance	B Influence on org. model	C Weight (relevance and infl.)	D Order of importance	D Suitability (practice)	E Suitability (theory)	F Deviation (Practice-Theory)
1. The project is schedule driven	5	1	3	#2	5	2	60%	5	2	3,5	#5	3	2	20%
2. The project is budget driven	5	5	5	#1	5	4	20%	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
3. Certainty of costs at an early stage needed	3	1	2	#9	5	2	60%	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
4. Requirements have not been completely inventoried (...)	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
5. The project is complex	3	1	2	#10	5	2	60%	1	2	2,5	#7	2	2	0%
6. The project requires customization from the end-user	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	5	1	3	#1	3	4	20%
7. The client has little experience	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	4	1	2,5	#10	1	2	20%
8. The client needs to hand over risk to the supplier	3	1	2		5	1	80%	3	2	2,5		3	[illegible]	40%
9. Possibility for minimizing administrative burden after proc.	4	1	2,5	#6	4	2	40%	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
10. The client needs to be able to influence the product	5	3	4	#3	5	5	0%	5	5	5	#2	5	5	0%
11. Input from the supplying actor is required	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
12. (...) a large number of offerors compete to obtain lower costs	5	5	5	#4	5	5	0%	5	5	5	#3	5	5	0%
13. (...) highly dependent on market/government/environment	4	1	2,5	#7	5	5	0%	5	5	5	#4	5	5	0%
14. (...) Procurement course must be as short as possible	3	2	2,5	#8	4	4	0%	5	2	3,5	#6	5	4	20%
15. Outsourcing of other functions than construction is required	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
16. Number of contractual relationships wanted is low	5	1	3		4	2	40%	5	5	5	#8	5	2	60%
17. High certainty of confirmation to expectations is needed	4	2	3	#5	5	4	20%	5	5	5	#9	4	4	0%
18. Integration of benefits in the board out is required	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

Condition	Deppenbroek (Building Team) A Relevance	B Influence on org. model	C Weight (relevance and infl.)	D Order of importance	E Suitability (practice)	F Suitability (theory)	G Deviation (Practice-Theory)	Plan de Nassau (Building Team) A Relevance	B Influence on org. model	C Weight (relevance and infl.)	D Order of importance	E Suitability (practice)	F Suitability (theory)	G Deviation (Practice-Theory)
1. The project is schedule driven	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	#10	4	4	0%
2. The project is budget driven	3	1	2	#9	2	3	20%	4	1	2,5	#7	5	3	40%
3. Certainty of costs at an early stage needed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	1	2,5	#6	5	3	40%
4. Requirements have not been completely inventoried (...)	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		X	[illegible]	X
5. The project is complex	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	5	1	3	#1	5	3	40%
6. The project requires customization from the end-user	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
7. The client has little experience	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
8. The client needs to hand over risk to the supplier	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3	1	2	#9	4	3	20%
9. Possibility for minimizing administrative burden after proc.	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	4	1	2,5	#8	5	2	60%
10. The client needs to be able to influence the product	5	1	3	#2	4	4	0%	5	1	3	#2	5	4	20%
11. Input from the supplying actor is required	4	1	2,5	#4	5	4	20%	5	1	3	#4	4	4	0%
12. (...) a large number of offerors compete to obtain lower costs	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
13. (...) highly dependent on market/government/environment	5	5	5	#1	3	4	20%	5	5	5	#5	3	4	20%
14. (...) Procurement course must be as short as possible	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
15. Outsourcing of other functions than construction is required	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
16. Number of contractual relationships wanted is low	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		X	[illegible]	X
17. High certainty of confirmation to expectations is needed	5	1	3	#3	4	3	20%	5	1	3	#3	5	3	40%
18. Integration of benefits in the board out is required	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

Clarification

Explanation of the columns

A	The A column represents the relative importance of the condition to the project.
B	The B column represents the extent to which the condition influenced the choice of the organization model.
C	The C column is the calculated average of column A and B.
D	Column D indicates the order of ranking of the conditions, as assigned by the interviewee.
E	Column E indicates the suitability of the organization model per condition, obtained via the *practical* study.
F	Column F indicates the suitability of the organization model per condition, obtained via the *theoretical* study.
G	Column G shows the deviation of column E and F. The following formula is used: G=|(F-E)*20|.

Interpretation

1	Four different project managers have been asked to assign scores to given conditions (see figure 15) that may have affected a past project they have been managing.
2	The interviewees indicated to which (absolute) extent the conditions played part in their project (Column A), how the existence of a condition influenced their choice of the organization model (Column B), and -in retrospective- the suitability of the chosen organization model to handle the conditions (Column E). Furthermore, they have given a ranking to the conditions, which indicates which conditions *relatively* affected the project the most and in what order (column D).
3	The suitability scores assigned by the interviewees (column E) are being compared with the respective theoretical obtained values (Column F), in order to identify deviations (column G).
4	The most important conditions (to which the interviewees have assigned a 5), are in bold print, whereas conditions that have been assigned a 1 are printed grey for they are of no importance.
5	An X indicates that a score cannot be assigned. This may be because it is not known, or the condition did not apply to the project.
6	The highlighted conditions (for example condition 5 - Wiedenbroek) indicate a relatively high deviation of practise-theory, in combination with a high weight score. The condition where A*G>100 applies have been highlighted.

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Appendix six - *Analysis 1: Comparison of grades*

Comparison of grades

This table compares the grades of these actual used organization models with Design-Build.

Conditions	Comparison of practical results with theoretical suitability values of Design-Build																													
Existing or required project condition	Wiedenbroek (traditional proc.)								Talma (traditional proc.)								Deppenbroek (DT)								P. d. Nassau (b.-ing. Team)							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
	Relevance	Influence on org. model	Weight (relevance and infl.)	Suitability (practice)	Grade (practice)	Suitability (Design-Build)	Grade (Design-Build)	Deviation	Relevance	Influence on org. model	Weight (relevance and infl.)	Suitability (practice)	Grade (practice)	Suitability (Design-Build)	Grade (Design-Build)	Deviation	Relevance	Influence on org. model	Weight (relevance and infl.)	Suitability (practice)	Grade (practice)	Suitability (Design-Build)	Grade (Design-Build)	Deviation	Relevance	Influence on org. model	Weight (relevance and infl.)	Suitability (practice)	Grade (practice)	Suitability (Design-Build)	Grade (Design-Build)	Deviation
1. The project is schedule driven	5	1	3	5	5,0	5	3,0	0%	5	2	4	3	2,5	5	3,5	28%																
2. The project is budget driven	5	5	5	5	5,0	3	3,0	-40%																	4	1	2,5	5	2,5	3	1,5	-20%
3. Certainty of costs at an early stage needed	2	1	2	5	2,0	4	1,6	-5%																	4	1	2,5	5	2,5	4	2,0	-10%
4. Requirements have not been completely inventoried (...)																																
5. The project is complex	3	1	2	5	2,5	4	1,6	-5%	3	2	2,5	2	1,5	4	2,5	25%									5	1	3	5	3,0	4	2,4	-12%
6. The project requires customization from the end-user									5	1	3	3	1,8	2	1,2	-12%																
7. The client has little experience									4	1	2,5	1	0,5	2	1,0	10%																
8. The client needs to hand over risk to the supplier	3	1	2	5	2,5	4	1,6	-5%	3	2	2,5	3	1,5	4	2,5	25%									3	1	2	4	2,5	4	2,0	0%
9. Possibility for minimizing administrative burden after proc.	4	1	2,5	4	4,0	3	1,5	-50%																	4	1	2,5	5	2,5	3	1,5	-20%
10. The client needs to be able to influence the product	5	3	4	5	5,0	2	1,6	-68%	5	5	5	5	5,0	2	2,0	-60%	5	1	3	4	2,4	2	1,2	-24%	5	3	3	5	3,0	2	1,2	-36%
11. Input from the supplying actor is required																	4	1	2,5	5	2,5	5	2,5	0%	5	1	3	4	2,4	5	3,0	12%
12. (...) a large number of offerors compete to obtain lower costs	5	5	5	5	5,0	1	1,0	-80%	5	5	5	5	5,0	1	1,0	-80%																
13. (...) highly dependent on market/government/environment	4	1	2,5	5	5,0	2	1,0	-80%	5	5	5	5	5,0	2	2,0	-60%	5	5	5	3	3,0	2	2,0	-20%	5	5	5	3	3,0	2	2,0	-20%
14. (...) procurement course must be as short as possible	3	2	2,5	4	3,0	2	1,0	-60%	5	2	4	5	3,5	2	1,4	-42%																
15. Outsourcing of other functions than construction is required																																
16. Number of contractual relationships wanted is low	5	1	3	4	4,0	5	3,0	-20%	5	5	5	5	5,0	5	5,0	0%																
17. High certainty of confirmation to expectations is needed	4	2	3	5	5,0	2	1,2	-76%	5	5	5	4	4,0	2	2,0	-40%	5	1	3	4	2,4	2	1,2	-24%	5	1	3	3	3,0	2	1,2	-36%
18. Integration of benefits in the board out is required																																
Totals:					53		23	-56%					37		27	-27%					14		11	-22%					25		18	-27%

Clarification

Denotation of the columns

A	The A column represents the relative importance of the condition to the project.
B	The B column represents the extent to which the condition influenced the choice of the organization model.
C	The C column is the calculated average of column A and B.
D	Column D indicates the suitability of the organization model per condition, obtained via the practical study.
E	Column E indicates the grade the actual utilized organization model gained with handling the condition, and its importance for the project. The following formula is used: E=C(D/5), which means the suitability scores have been multiplied with the weight of the condition.
F	Column D indicates the theoretical suitability of the Design-Build per condition.
G	Column G indicates the grade Design-Build gained with handling the condition. The following formula is used: G=C(F/5).
H	Column H shows the deviation of column E and G. The following formula is used: H=(G-E)/20%.

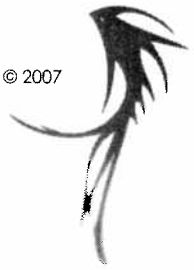
Interpretation

1	This table compares the grades of *the actual used organization model* and the matching theoretical ones that *Design-Build* would have provided, if it had been the organization model of choice. The values in columns E and G represent these grades, which are multiplications of the suitability scores (column D) and the assigned weights (Column C)..
2	Column H indicates the most suitable organization model. A positive value shows Design-Build to be more suitable to the condition, while a negative value is in favour of the actual used organization model. The higher this value, the larger the deviation. Striking positive values that yield for all cases have been highlighted, while negative values have been darkened.
3	The most important conditions (to which the interviewees have assigned a 5), are printed bold, while conditions that have been assigned a 1 are printed grey for they are of no importance.
4	The bottom line of the table shows the totals. These contain the added values of respectively column E, G and H. The added total of the H column shows the viewer at a single glance whether Design-Build would have been more suitable for the case or not. Again, a positive value shows Design to be more suitable, while a negative value shows the actual used organization model to be more suitable.

ENLIGHTENMENT: Denotation and relationship of A, B, C, D and E.

Because the above listed values might come through as being rather abstract, this text may clarify how to interpret one thing or another.
First let's take a look of the relation between A and D. A stands for the extent to which the condition typifies the project. How relevant was the condition for the case? *Example: The project suffered from a lack of time, condition 1 "The project is schedule driven" was very characterizing and therefore gains a value 5.*
D stands for the suitability of the chosen organization model to handle a condition (when retrospecting). *Example: the chosen organization model Building Team could handle condition 1 very well because the combined knowledge of the team resulted in easy and fast processing. Therefore D gains a value 5.*
For short: D shows the suitability in practice, and A describes the *significance* of this suitability. Therefore, A and D are related by means of a multiplier.
The next step is to clarify how B is involved. B indicates to what extent the condition influenced the choice for the organization model. *Example: Better project speed was one of the main reasons to choose the Building Team approach, so B gains a value 5.* A and B are related very closely. When A obtains a high value, B is likely to get one as well. When these two values deviate strongly[1], this could either mean that 1) other conditions had a stronger influence on the choice of organization model; or 2) there are other (strategic) considerations not to let this condition dominate the choice. Because both A and B describe the importance of a condition, their values can be combined by calculating their average (which is C). *Example: When A = 5 and B = 1, this means that a condition characterized the case very well, but wasn't important enough to base the choice of contracting on. Its average score (C) is 3. When A = 5 and B = 5, it means that a condition characterized the case very well and was also relevant to base the choice of contracting on. A higher average score is expected and given: C=5.*
Ultimately, E can be interpreted as a tool to combine the values of C and D, for $E = \frac{A+B}{2} * \frac{D}{5} = C * \frac{D}{5}$ The values of E are called 'grades' and serve to compare the different organization models on their ability to handle the conditions.

1. This can only occur when A > B. Otherwise, this would mean that an irrelevant project condition has had many influence on the choice of the organization model, which is highly illogical.



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Appendix seven

Analysis 2: Order of the conditions

Order of the conditions

This table shows the order of ranking the interviewees have assigned to the conditions by judging their relevance for the projects.

Conditions, sorted by relevance	Ranking of the conditions per case																				Totals	
Existing or required project condition	Wiedenbroek (trad. proc.)					Talma (traditional proc.)					Deppenbroek (BT)					Nasseu (Building Teams)					Totals	
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	F	G
	Order of importance	Score	Suitability (practice)	Suitability (theory)	Suitability (Design-Build)	Order of importance	Score	Suitability (practice)	Suitability (theory)	Suitability (Design-Build)	Order of importance	Score	Suitability (practice)	Suitability (theory)	Suitability (Design-Build)	Order of importance	Score	Suitability (practice)	Suitability (theory)	Suitability (Design-Build)	Total score	Percentage of total
10. The client needs to be able to influence the product	#3	8	5	5	2	#2	9	5	5	2	#2	9	4	4	2	#2	9	5	4	2	35	16%
13. (...) highly dependent on market/government/environment	#7	4	5	5	2	#4	7	5	5	2	#1	10	3	4	2	#5	6	3	4	2	27	13%
17. High certainty of confirmation to expectations is needed	#5	6	5	4	2	#9	2	4	4	2	#3	8	4	3	2	#3	8	5	3	2	24	11%
2. The project is budget driven	#1	10	5	4	3			1	4	3	#5	6	2	3	3	#7	4	5	3	3	20	9%
1. The project is schedule driven	#2	9	5	2	5	#5	6	3	2	5			X	4	5	#10	1	4	4	5	16	7%
5. The project is complex	#10	1	5	2	4	#7	4	2	2	4			X	3	4	#1	10	5	3	4	15	7%
12. (...) a large number of offerors compete to obtain lower costs	#4	7	5	5	1	#3	8	5	5	1			X	?	1			X	?	1	15	7%
11. Input from the supplying actor is required			4	1	5			X	1	5	#4	7	5	4	5	#4	7	4	4	5	14	7%
3. Certainty of costs at an early stage needed	#9	2	5	2	4			4	2	4	#6	5	4	3	4	#6	5	5	3	4	12	6%
6. The project requires customization from the end-user			X	4	2	#1	10	3	4	2			X	3	2			X	3	2	10	5%
9. Possibility for minimizing administrative burden after proc.	#6	5	4	2	3			3	2	3			X	2	3	#8	3	5	2	3	8	4%
14. (...) procurement course must be as short as possible	#8	3	4	4	2	#6	5	5	4	2			X	3	2			X	3	2	8	4%
8. The client needs to hand over risk to the supplier			5	1	4			3	1	4	#7	4	4	3	4	#9	2	4	3	4	6	3%
16. Number of contractual relationships wanted is low			4	2	5	#8	3	5	2	5			X	2	5			X	2	5	3	1%
7. The client has little experience			X	2	2	#10	1	1	2	2			X	4	2			X	4	2	1	0%
4. Requirements have not been completely inventoried (...)			X	?	2			X	?	2			X	?	2			X	?	2	0	0%
15. Outsourcing of other functions than construction is required			X	?	4			X	?	4			X	?	4			X	?	4	0	0%
18. Integration of benefits in the board out is required			X	?	X			X	?	X			X	?	X			X	?	X	0	0%

Clarification

Denotation of the columns

A	Column A shows the order of ranking as the interviewees have assigned to the conditions. #1 indicates the most important condition for the project, #10 the tenth most important one.
B	In column B the order of ranking has been converted to a score, where #1 obtains ten points, #2 nine, #3 eight, and so on.
C	The C column shows the suitability scores as obtained from the practical study. These are the scores the interviewees have assigned to the conditions.
D	The D column shows the suitability scores as obtained from the theoretical study. These are the scores of the actually used organization model.
E	Column E shows the suitability scores of Design-Build, obtained from the theoretical study.
F	Column F shows the added up scores of the B columns, and therefore indicates the relative importance of the conditions for the four projects.
G	Column G shows the relative importance of the conditions as a percentage.

Interpretation

1	The table gives an overview of the conditions sorted by relevance, rather than category.
2	Column F and G provide information of the overall relative importance of the conditions on average.
3	The top three of this table (conditions 10, 13 and 17) has been highlighted, as they appear to be the three most important conditions to the four cases.
4	The last three conditions (4, 15 and 18) are printed grey, as they appear to be of no relevance to the four cases.