Towards a New Model for Collaboration

Evaluation of the effectiveness and efficiency of the "Aronsohn contracting vision"

R.M.C. van Rijn BSc

rvanrijn@ziggo.nl

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Colophon

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Author:

R.M.C. van Rijn, BSc
rvanrijn@ziggo.nl
Student ID: 1170376

Graduation committee:

Prof. dr. ir. H.A.J. de Ridder
ir. F.A.M. Soons
Drs. M. Leijten
ir. P.J.F. van den Boom

Delft University of Technology
Faculty Civil Engineering and Geosciences
Stevinweg 1
2628 CN Delft
015-2785440
www.tudelft.nl

Aronsohn Management raadgevende ingenieurs bv
Lijnbaan 131
Postbus 2401
3000 CK Rotterdam
010-2808080
www.aronsohn.nl

Preface

This is it, my master thesis, the capstone on seven beautifull years studying in Delft. Seven years ago I started the study all enthusiastic about sleuces and bridges, dreaming of becoming an engineering and one day build those marvels myself. If someone would then have told me I would graduate a manager first and an engineer second, I would have laughed and told him I study in Delft, not in Twente. And yet here I am graduating for Construction Management Engineering.

Looking back I've had a great time studying in Delft and learning through experience both in and outside of the university. Finishing my masters thesis signifies the end and at the same time a new beginning, tomorrow will be my first day as a civilian. I'm eager to eplore that new venue and see where it leads me.

Now it is customary to thank a number of people here in your preface, but as my professor said I'm a bit stubborn sometimes so I won't do that. That does not mean they don't deserve my thanks, more that the people who I should thank know that already. I would like to invite the reader to no longer linger on my own words of thanks but proceed with the results of this thesis. I hope it will be an enjoyable read.

Renout van Rijn Delft, 15 November 2010

Executive summary

The research in this thesis is about the Aronsohn contracting vision, an innovative contract form developed by Aronsohn management. After successfully applying the method on a number of projects they were interested in a more formal evaluation of the method. This evaluation is presented in this report. The idea of Aronsohn is compared to the traditional contract, the bouwteam contract, the D&C contract and later also the Design Novate Construct (DNC) contract.

Research methodology

The formal research question concerned both the effectiveness and the efficiency of the researched method and was put as follows:

"What is the effectiveness and efficiency of the "Aronsohn contracting vision" in comparison to other forms of collaboration in the construction process and more specific in comparison with the design team, the design & build and traditional contracts?"

Effectiveness is a measure of whether the client derives any benefit from using this method, while efficiency concerns the ability of the executing parties to still realise a profit when working with the method. Later in the research a third contract was added to the comparison, namely the DNC contract. The research was broken down into three distinct research venues; a literature study, a case study and a set of interviews.

In the literature study a number of standard concepts of contracting, collaboration and the management of projects were researched to provide handholds for the comparison between the different methods. In addition the three other contracts were researched and per contract a list of pros and cons was derived from the literature. Lastly the Aronsohn contracting vision (see Figure 1) was described and on a number of criteria compared to the other contracts to give it a place among them.

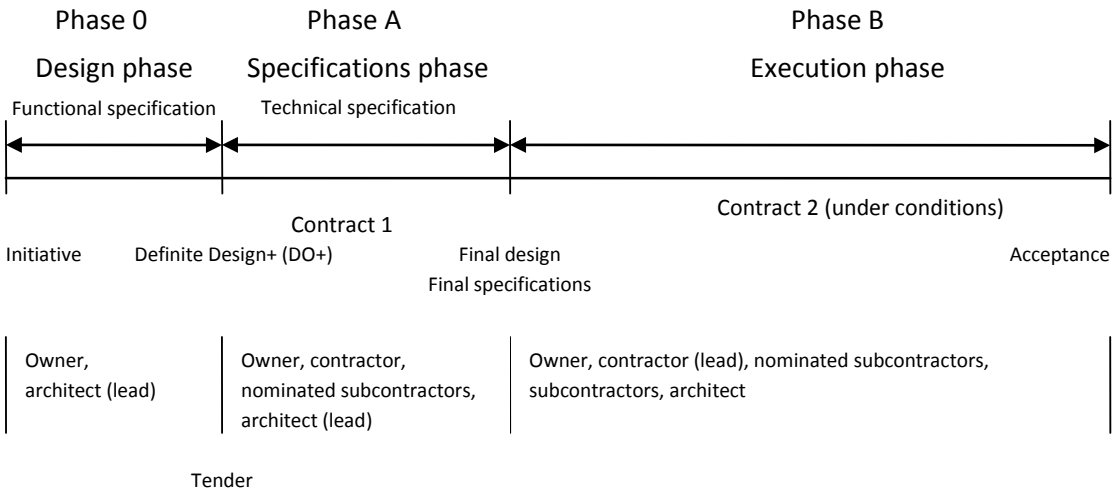

Figure 1 Overview Aronsohn contracting vision

the average traditional contract. For the average traditional contract, fifteen traditional projects were analysed on the delivery time and amount of added work and an average derived from the results. Three projects managed with the Aronsohn contracting vision were analysed on the same points and on the added quality during phase A. The resulting comparison proved that the

Aronsohn contracting vision delivers projects more on time, with lower costs and that there is a definite shift from unwanted added work to wanted scope change.

The interviews were conducted with the project manager, client, architect, main contractor and installations contractor. They served as a way to gauge how the parties felt about the method and to research a number of less tangible concepts, like trust and the use of information. To also go deeper into the perspective of the executing parties interviews were held just after a tender held with the Aronsohn contracting vision. The competing contractors were asked their opinion on the method and how and if the method affected their bids.

Conclusions

The Aronsohn contracting vision was evaluated on effectiveness for the client and on efficiency for the executing parties. Taking both measures individually and then presenting a general conclusion.

The Aronsohn contracting vision is clearly effective from a client point of view. Contracts using the method are delivered more on time, with less additional work claims and always realized a higher performance for the same budget. Comparing the contracting vision with the traditional contract there is a small direct financial benefit for the client, projects end up slightly (1-2%) cheaper. The biggest benefits are indirect there is less added work and more security for the client. Apart from that the additional preparation time for all parties in phase A leads to a better thought out design and a better execution. Overall for the contractor the Aronsohn contracting vision offers a benefit over the traditional contract but it is relatively safe for the client and leaves some opportunities untaken because of that.

For the executing parties the method has it’s benefits but those are harder to prove. Most of the benefits for the contractor are indirect. All contractors value the chance to participate in the design phase and offer their expert knowledge but they would actually like to be included earlier. The two phased approach offers the contractor more time to prepare for the execution, something that has been increasingly shorted upon by clients. Despite the benefits and the fact that most contractors see those the first impression of the method is difficult for them and makes it harder to accept it.

In general the Aronsohn contracting vision deserves a place in between the other contracts and can offer added benefits for all parties. The method is slightly client focussed but doesn’t negatively affect the executing parties. In a large and complex project with a client that has a lot of knowledge of his wishes the method can be a great addition for both the client and the contractors.

Recommendations

There are a number of points the Aronsohn contracting vision could improve or evolve on. Most of these deal with the central question that rose during the research, namely: When and how far should a contractor be integrated in the design phase of a project. On the one hand the contractor can bring experience and worthwhile expertise, while on the other hand he can influence the quality and create opportunities for himself. Choosing a sweet spot for involvement is nearly impossible and is different in each new project. The Aronsohn contracting vision can shuffle with this question by including the installations contractor earlier or by opening up more design space for the contractor.

To better market the method the understanding should be improved, this can be done with some additions to the contractual documents and by offering more insight into the intention of the contract and the client.

Glossary

- Added work (meerwerk)
  Additional work in the project that originates from problems with the design or specifications.
- Agreement (overeenstemming)
  Reaching consensus on a certain issue.
- Backwards integration (achterwaartse integratie)
  Bringing the contractor more toward the start of the project, integrating him into the design.
- Bid-build contract
  See traditional contract
- Bifurcation of authority (splitsing van autoriteit)
  The problem when someone has two bosses to report to.
- Bill of quantities (hoeveelheden staat)
  Often used in British contracts to keep track of added works. Lists the used materials and extra hours.
- Brownfield (renovatie en restauratie)
  Construction in current buildings or the build environment.
- Client (Opdrachtgever)
  Party financing and ordering the project.
- Collaboration (samenwerking)
  Catch all term for parties who work together on a project.
- Conditions (algemene voorwaarden)
  General conditions that apply to the contract or project, often standardized for the different contract.
- Constructability (bouwbaarheid)
  How difficult or complex it is to construct (a detail of) the project.
- Contract (contract)
  The official and formal agreement between parties often incorporating clauses about rights and duties.
- Contractor (aannemer)
  A party that is contracted to construct the building.
- Contractual documents (contractstukken)
  Documents that encompass the entire agreement between client and contractor, including designs, conditions, etc.
- Design, novate & construct / DNC
  Contract form in which the design team is transferred from client to contractor (novation) and then proceeds with the final design and construction.
- Design & Build / D&B contract
  Contract that includes both the design and construct tasks for the contractor.
- Design team / bouwteam
  Dutch collaborative contract
- DNR 2005 (De nieuwe regeling)
  Dutch general conditions that apply to consultant contracts.
- Economically most advantageous tender (EMAT) (Economisch meest voordelige aanbieding (EMVI)
  Tender that is awarded on other criteria than just price.
- Effectiveness (effectiviteit)
  Measure of the benefit the contract has for the client.
- Efficiency (efficientie)
  Measure of the ability to generate a profit for the executing parties.
- European tender laws (Europese aanbestedings wet)
  European law dictating a number of specifics for tendering, most notable the fair competition clause.

- Execution (uitvoering)
  The phase in which the actual building is constructed.
- General conditions (algemene voorwaarden)
  List of conditions for a certain contract form that is assumed to be applicable in general.
- Greenfield (nieuwbouw)
  Construction of a new building or not in the build environment.
- Incentives (prikkels)
  Measures to stimulate or force a party to reach certain goals.
- Initial design (schets ontwerp (SO))
  First rough sketch design.
- Liability (aansprakelijkheid)
  To be responsible for an event and carry the (financial) consequences.
- Materialisation (detailafwerking)
  Detailed finishing and choice of materials in a building.
- Network theorem (netwerk theorie)
  Theory to describe the complex relations between multiple parties in the current society, applicable to a construction contract.
- Nominated subcontractors (aangewezen onderaannemers)
  Subcontractors that are chosen by the client but for whom the main contractor assumes responsibility.
- Opportunistic behaviour (opportunistisch gedrag)
  Event in which a party goes against the goals of a collaboration for his own gains.
- Partnering (samenwerking)
  Form of collaboration that can span one or multiple projects.
- Performance (prestatie)
  Total valuation of the delivered works.
- Performance measuring (prestatie gericht meten)
  Scheme in which a party gets remunerated based on the valuation of his delivered works.
- Preliminary design (voorlopig ontwerp (VO))
  First real design after initial design, shows the first real outlines of solutions and choices.
- Procurement (inkopen/aanbesteden)
  The act of soliciting services from another party for a certain price.
- Project control (project management)
  Controlling the critical indicators of a project, often time, money, scope and quality.
- Quality (kwaliteit)
  Delivering project objectives that are fit for purpose.
- Reasonableness and fairness (redelijkheid en billikheid)
  Clause in the Dutch law that contracts and acts should always be fair and within certain limits.
- Reimbursement (vergoeding)
  Compensation a party receives for a specific task rendered.
- Remuneration (betaling)
  Method of compensating a party for rendering services or expertise
- Requirement (eis)
  Specific demand the building needs to comply with.
- Responsibility (verantwoordelijkheid)
  To have the duty to perform a certain task.
- Risks (risico's)
  Negative uncertain events that threaten the project objectives.

- RVOI 2001
  General conditions applying to consultants agreements.
- Scope
  An initial high level description in which the purpose of the project will be described.
- Scope change (programmatische wijzigingen)
  Changes the client makes to the scope and designs after the project has been tendered.
- Specifications (specificities)
  List of points a building will have to comply with.
- SR 1997
  General conditions applying to consultants agreements.
- Tender (aanbesteding)
  The process of offering a project to market parties and asking them to submit a price.
- Terms of reference (programma van eisen)
  List of terms a design will have to comply with from a client's point of view. Used as a base for the design.
- Traditional contract (traditioneel contract)
  The traditional contract consisting of a design and specifications. The most basic form of a construction contract.
- True uncertainties (echte onzekerheden)
  Uncertainties that couldn't have been foreseen by any party.
- Trust (vertrouwen)
  To belief in some ones good faith and honesty.
- UAV 1989
  Set of general conditions used in a traditional contract.
- UAV-GC
  Set of general conditions used in an integrated contract.
- Wicked problems
  Problems that span the traditional boundaries between public and private institutions, that are inherently complex and most important that are hard to define.

Table of Contents

Chapter 1 Methodology

This chapter focuses on the scientific background of this qualitative research. The basic premises for the research are established and insight into the methodology provided. This chapter gives an overview of how the research is structured.

1.1 Motivation

The basis for this research originated from Aronsohn Management. For some years now they have employed their so called Aronsohn contracting vision on a number of projects they managed. From their perception this form of contracting has significant advantages for all parties involved; however this has never been objectively established.

With this research they hope to gather the proof that their method indeed works. This proof will be used to convince future clients to use the method for their complex construction project and to pitch the method to contractors and advisors. Apart from that possible improvements to the vision are researched with the hope of improving it further.

The vision was developed as an answer to the rise of the "claim culture" in the construction sector and the will to involve the contractor in the design phase of the project. The vision focuses on two key principles:

1. Early involvement of the contractor to improve the overall performance and constructability of the project.
2. Earlier financial security for all parties involved.

These principles are tested and evaluated in the research to see whether the vision indeed leads to higher performance and more financial security.

From a scientific point of view the evaluation of this method is interesting to find out whether this method outperforms any of the standard contracts in use and thus has an added benefit for the construction sector as a whole. Furthermore a wide evaluation of the current contracting practice could bring up interesting discrepancies between the literature and the practice.

1.2 Goal

Aronsohn would like to employ the method more often but currently lacks the objective knowledge and proof that their vision is indeed working. To fill this lack of knowledge Aronsohn would like to formally evaluate the effectiveness of the "Aronsohn contracting vision" so it can assure clients of its benefits. With the results of this study they have a better insight into how and why the method works and might even use this knowledge to improve the method. The evaluation of the "Aronsohn contracting vision" in all its facets is the core of this graduation thesis.

From a more scientific point of view the goal of this research is to find out whether this method has any added value in comparison to methods already in use. To ascertain this, research is undertaken to compare the "Aronsohn contracting vision" with other comparable collaboration/contracting methods and with the traditional form of contracting.

1.3 Scope

This qualitative research focuses on exploring all the aspect of the Aronsohn contracting vision, logically the research is confined to projects that are realized using this method. The research mainly focuses on the aspects of collaboration and contracting. Aronsohn Management mostly works for (semi)public institutes; universities, schools and research institutes. They manage Green- and Brownfield construction projects and resettlements in current and new buildings. These are often large complex projects including high tech laboratories and other demanding facilities. This thesis research focuses on educational buildings in a large price range.

To give a true evaluation of the new contract form, no single viewpoint is considered. The opinion of all parties involved is gathered and represented in this research. The verdict on the method is therefore broken down into multiple parts, each representing a party and their opinion of the method. A general verdict is provided as well from the viewpoint as unbiased researcher.

1.4 Research questions

From the above motivation and goal the following research question has been drafted:

"What is the effectiveness and efficiency of the "Aronsohn contracting vision" in comparison to other forms of collaboration in the construction process and more specific in comparison with the design team, the design & build and traditional contracts?"

Effectiveness in this statement means whether the customer gains a tangible benefit from using the vision and efficiency means whether the companies working with this type of contract have any chance to make a profit. This last part is related to the main contractor and the installations subcontractor.

Before a clear verdict on the effectiveness of the "Aronsohn contracting vision" can be given, a formal definition and measurable baseline of effectiveness has to be defined. Therefore a frame of reference is sketched in which the vision is placed and compared to other methods. This frame of reference is used to facilitate a fair comparison between the researched vision and the other methods. Important aspects of effectiveness are collaboration, price and performance.

Efficiency is judged by the opinion of parties who have worked within this type of contract. Here with efficiency is not only meant the ability to make a profit but also how difficult it is to make a profit and how certain this profit will be. Things like collaboration, conflict resolution and risks all play into this criterion.

The main research is conducted in three blocks each focussing on another research technique. The blocks serve to further the understanding of the vision and to give handholds for the next step in the research. After each block of the research preliminary conclusions and hypotheses are developed that feed into the next block, either as assumptions or as hypotheses to be proved.

These three blocks all have a specific sub research question:

1. *"What are the differences between the "Aronsohn contracting vision" and other forms of collaboration in the construction process and more specific between the "Aronsohn contracting vision" and a design and construct contract, a design team contract and a traditional contract?"*

2. *"How did the "Aronsohn contracting vision" perform in previous applications on the criteria of financial benefit, the quality of the specifications, the quality of the delivered works and on planning benefits and speed of execution?"*

3. *"What are the experiences of owner, contractor, subcontractor, advisors, architects and Aronsohn self in working with the "Aronsohn contracting vision"?"*

In this report a verdict is given on both the effectiveness and the efficiency of the "Aronsohn contracting visions. To reach this verdict the research and sub research questions are answered and conclusions are drawn based on those answers. Different viewpoints are taken into account and a general conclusion about the Aronsohn contracting vision is presented. Also apart from a verdict about the vision, recommendations are given on how to improve the method, how to apply it more successful and whether its merits are also useful in other sectors of the construction industry.

1.5 Research methodology

To provide answers to the research questions presented above a qualitative exploratory research is undertaken into the Aronsohn contracting vision. By the nature of an exploratory research no set hypotheses are formed at the start of the research, but hypotheses are developed during the different stages of the research (Verschuren, P. & Doorewaard, H., 2007).

For this research a three pronged approach is implemented, using a different research method to tackle each of the research sub questions in turn. This three pronged approach consists of a literature study, a comparing case study and semi structured open interviews, followed by a validation with experts. An overview of the research methodology is presented in Figure 2.

Block 1: Literature research

The first block is a literature study to place the "Aronsohn contracting vision" in perspective with other methods for collaboration and to find important differences between the researched methods. These differences are used as guidelines for the following research blocks.

The main questions in this part are:

1. What is the position of the "Aronsohn contracting vision" compared to other forms of collaboration between owner and contractor?
2. What are the differences between the "Aronsohn contracting vision" and the design team method?
3. What are the differences between the "Aronsohn contracting vision" and the design construct method?
4. What are the differences between the "Aronsohn contracting vision" and the traditional method?

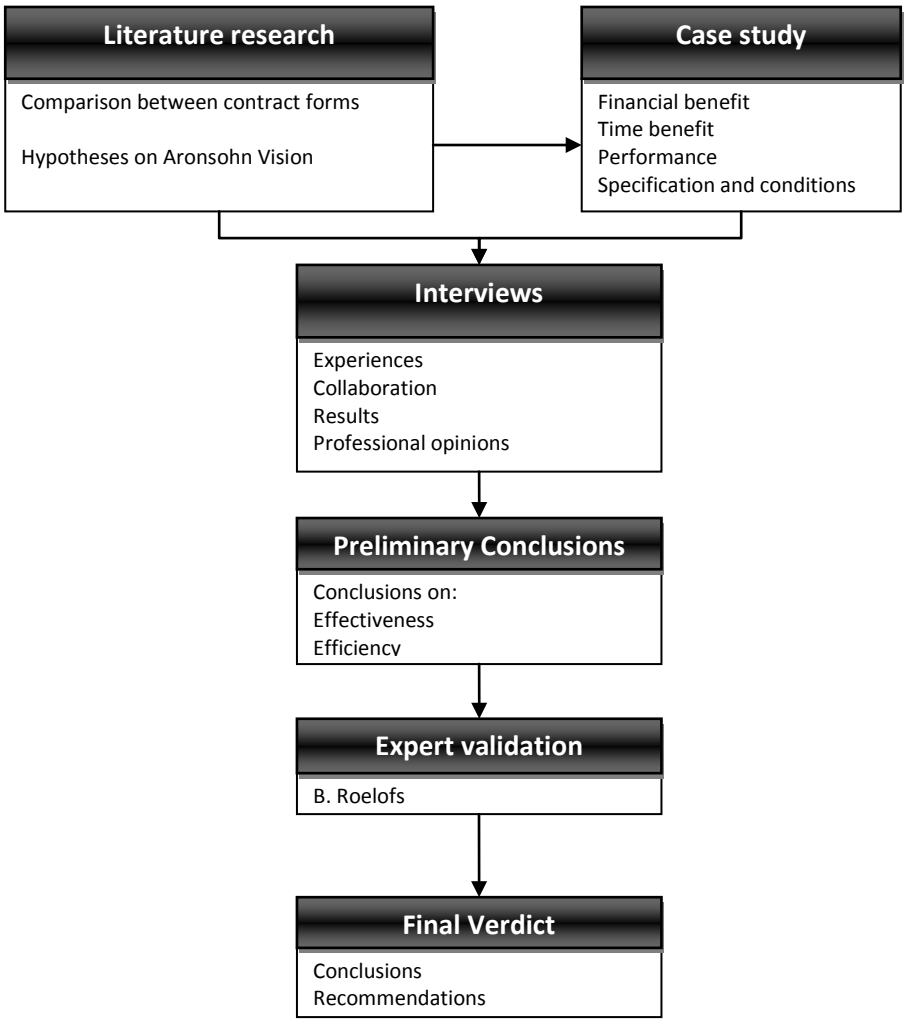

Figure 2 Research Model

To answer the first sub question a literature research is conducted into the material of collaboration in the construction process. An overview of the possible forms of collaboration is given and the "Aronsohn contracting vision" is placed in this overview. The "Aronsohn contracting vision" is loosely based on the design team approach but also shares similarities with the design & build approach. These two other methods are taken as a reference since they are the two extremes in between which the "Aronsohn contracting vision" falls. Since the traditional contract is still used often this contract form is used as a baseline for the comparison, both in the literature study and in the case study.

During the case study another comparable contract surfaced, the not often used Design, Novate & Construct. Since it shares a number of important aspects with the Aronsohn vision this contract form is added to the literature study and to the comparison. This introduced another research question:

5. What are the differences between the "Aronsohn contracting vision" and the Design, Novate & Construct contract?

Block 2: case study

Block two is a quantitative multiple case study dealing with a number of measurable aspects of the Aronsohn contracting vision. In this block the existence of financial benefits, time benefits and performance benefits are researched. This is done by analyzing three projects executed with the Aronsohn contracting vision and comparing them to a number of baseline projects, which have been executed with a traditional contract. A verdict is reached, based solely on the literature research and on the case studies, on the added value of the Aronsohn contracting vision, mainly from the viewpoint of the client/manager.

The key questions in the case studies relate to time, money and quality. Since there is a lot of ambiguity about quality a definition is derived from the literature before the case study. All the cases are analysed with the following questions in mind:

1. Whether the "Aronsohn contracting vision" has a financial benefit compared to traditional projects?
2. Whether the collaboration led to better planning and quicker execution?
3. Whether the collaboration led to more uniform and unambiguous specifications?
4. Whether the collaboration led to a higher quality of the delivered work?

Financial benefit

For the financial benefit an analysis is made of the total cost of the case study projects. These costs include both the cost for phase A and for phase B. Since the Aronsohn contracting vision abolishes only part of the work outside the design a definition has to be derived, distinguishing these terms. Added work claims can be broken down in two parts; extra work due to added work as the result of errors in the specifications or as a result of interface problems between other designers and extra work due to scope change initiated by the client.

For the nine baseline projects an average percentage of added work is derived and compared to the cost of phase A. This assumes that the project base cost (phase B or just the cost of execution) are the same. A case can be made that the Aronsohn contracting vision leads to a lower total price for the work which pollutes this figure. It is assumed that this has a small influence on the total costs, and even if the influence is large the proposed calculation method yields pessimistic values for the Aronsohn vision. This comparison gives insight into whether a tangible financial benefit exists in using the Aronsohn contracting vision. Less tangible financial benefit is off course found in the increased certainty of the project costs and in the possibility to steer more on budget in phase A. This is difficult to prove using a case study but is researched in the interviews.

Planning benefit

The benefits of planning and lowered execution time are hard to assess. Since each building is a unique object with its own typical problems and difficulties. However from the nine baseline projects a general idea of planning time at the end of execution phase related to the planning time after the specifications phase. The case study projects are checked against that figure. This gives a rough measure of benefits in completion time. The time taken for phase A is disregarded here since normal contract negotiations also take an amount of time and in a traditional contract the specifications are drafted by the client, losing this time as well. The general idea is that the contractors planning for the execution phase can improve by better building techniques, more integration and benefits related to an increase in scheduling opportunities.

Quality of specifications

To gauge whether the Aronsohn contracting vision indeed improves the quality of the specifications a careful study into drafting those is done. For all the case study projects it's identified whether any serious changes were instated during to the collaboration in phase A and whether the specifications were indeed unambiguous. Here no parallel is drawn to the nine traditional projects since this comparison is not useful. Part of this research is also done in the interviews of the next step; the ideas from the case study are used to support questions in the interviews.

Quality of the delivered work

Here the quality of the final work is meant, not how well the building is constructed but how well the building suits the purpose of the client. This is evaluated by checking whether major changes in design were made during phase A and to see if those indeed led to a better quality design. This is done by analyzing the documents of phase A and identify major changes dealing with the building itself, not with the specifications. Also here no parallel is drawn with the baseline projects since that provides no further insight. Part of this research is also done in the interviews in the next step; the ideas from the case study here are used to support questions in the interviews.

Casus selection

Since the amount of projects to be studied is closely related to the amount of interviews to be held, the number of projects to study is determined by the time reserved for interviews, further in the research. As a general rule of thumb conducting an interview takes 1,5 day including travel, preparation and working out of the results. Per project five important roles are interviewed, one of them the project manager from Aronsohn. The project manager can be interviewed on multiple projects at once. So per project at least 4 interviews will have to be conducted. In the planning five weeks are reserved for interviews, in total 25 days. With the additional five interviewees from the current tender of the AUC this leaves a total of three case study projects.

The case study focuses on 3 (number derived based on the amount of interviews needed, see above) projects that have been tendered using the Aronsohn contracting vision. This are finished projects or projects that are in the final stage of execution. This is necessary to give a proper review of the project and the effects the Aronsohn contracting vision has. As a reference figure 9 (traditionally tendered) projects of Aronsohn management are evaluated and used to benchmark the three case study projects. These projects are tendered in the traditional way and provide the baseline for the evaluation of the Aronsohn contracting vision.

For the case study the following projects have been chosen:

- Springplank Vught
- Renovatie vliegtuighal L&R TU Delft
- FNWI Amsterdam

Aronsohn has been construction manager on all these projects. These projects have a broad range in the price and complexity spectrum but can be analysed together rather well. All projects are executed for semi-public institutions and all were tendered and managed using the Aronsohn contracting vision. The broad range in price can give an indication whether the size of the project

has any influence on how well the vision works. The other reason these specific projects have been chosen is the parties (client, (sub)contractors and advisors) that are involved are different for each project, thus giving the case study and the related interviews more statistical value.

For the reference pool nine traditional contracted contracts are selected which Aronsohn has managed in the past. Some of these projects were more successful than other but they give a good mean, in size, complexity and success. The following nine were picked:

- Construction of a research institute with offices and research facilities in Amsterdam
- Construction of a university building with labs and offices in Eindhoven
- Construction of a university building with labs, clean rooms and offices in Eindhoven
- Construction of an educational building with offices and a new restaurant in Delft
- Construction of an office building in Utrecht
- Redesign and rehousing of a research institute, mainly offices and a small library in Delft
- Redesign of an educational building into a student facility and offices in Delft
- Renovation and construction of a educational building with labs, ateliers, offices and educational rooms in Eindhoven
- Renovation of a high tech data centre in Amsterdam

Next to these projects an overview of the current European tender process for the Amsterdam University College (AUC) is given. This tender, using the Aronsohn vision, ran in parallel with the graduation research and is closely followed. After this tender is concluded and the contract awarded parties are asked to answer a number of questions regarding the tender and the Aronsohn contracting vision. The AUC project does not feature in the case study comparison, but receives a write up and an evaluation.

Block 3: Interviews

The third block consists of a number of interviews dealing with the less measurable aspects of the Aronsohn method. The differences found in block one and the benefits found in block 2 are used to draft interviews and are validated in those interviews. These interviews are also used to gather input from all the different parties involved in the contract and get their opinion on the method. This block is concluded with a discussion of the interview results and a small conclusion based on those.

Two different sets of interviews are planned. The first set corresponds to the projects used in the case study and serves to round out the research in those. The goal is to get information on the less tangible aspects of the Aronsohn vision. For these interviews five important roles are interviewed per project to get input from all angles. The second set deals with the contractors who submitted a bid on the tender of the AUC. These interviews focus on how the contractors see the contract and how they deal with the financial aspects in a tender.

For the first set of interviews at least the following people should be interviewed to get a good grasp on the project and to get all the important angles involved:

1. Client (focused on the owner since he participated)
2. Contractor (optional with his calculator)
3. Architect
4. Nominated subcontractor
5. Project manager from Aronsohn

The main goal of these interviews is:

> *To find out how the different parties experienced the collaboration with the Aronsohn contracting vision?*

This question is supplemented with the insights gained from the literature study and the case study. The important differences and hypotheses found in the literature study are questioned and checked whether they are also perceived by the other parties. The benefits found in the case study are validated. Specific attention is given to the following aspects:

- Trust building
- Problem solving during execution
- Use of information
- General idea about the collaboration
- Reduction of failure costs
- Possible time benefits
- Controlling of risks in the contract
- Quality of the specifications
- Quality of the delivered works

All these aspects are questioned and related to experiences in previous (traditional) works. All the interviews are drafted as open semi structured interviews (Baarda D.B., et al, 1996). A set number of questions is used but the interviewees are encouraged to elaborate and wander off. This approach is taken to balance between the scientific comparability of the results and the hope that an open and personal approach would yield more information from the interviewees. This type of interview demands more from an interviewer and is more dependent on the skills of the interviewer but should also yield better and more specific results. The subjects above are the basis of the interview coupled with the insights and hypotheses developed earlier in the research.

For the current tender interviews the focus lies more on the financial benefits and on the quality of the specifications part. Contractors are asked to give their opinion on the method and to point out where they possibly could have claimed additional work. Since the tender is completed they should have lesser benefit from lying about these facts. These interviews should provide some good insights into the contractor's side of things. These interviews are also drafted based on the open semi structured approach for the same reasons mentioned above. Some of the information in these interviews might be harder to come by and the interviewees might be prone to misinformation. The interviewer should be wary of this and try to gain truthful answers.

Main questions are:

- How did they create their prices?
- How was this different from a more traditional tender?
- Did they see any holes in the design or specifications?
- What is their opinion of the contract form?

All the interviews are recorded (with permission) and after the interview worked out into a detailed overview. This overview is send back to the interviewee to check. From the results off the interviews preliminary conclusions are drawn and presented.

The last part of the research is the syntheses of the previous three blocks. All the information gathered and all the preliminary conclusions are combined to form a general verdict on the method and to provide recommendations on the possible improvement. These general conclusions will be validated with two experts to round out the research. The results and recommendations will be presented and discussed with both experts, soliciting their opinion on the vision as well. Their opinions are taken into account when discussing the results and recommending further research.

To allow for a smooth supervision the research is broken down into distinct parts which feed into each other and allow for different free standing parts to be delivered. These parts correspond to the three research blocks described above and all are accompanied with preliminary conclusions, assumptions and hypotheses for the next block. The flow diagram in Figure 3 gives an over view of the steps.

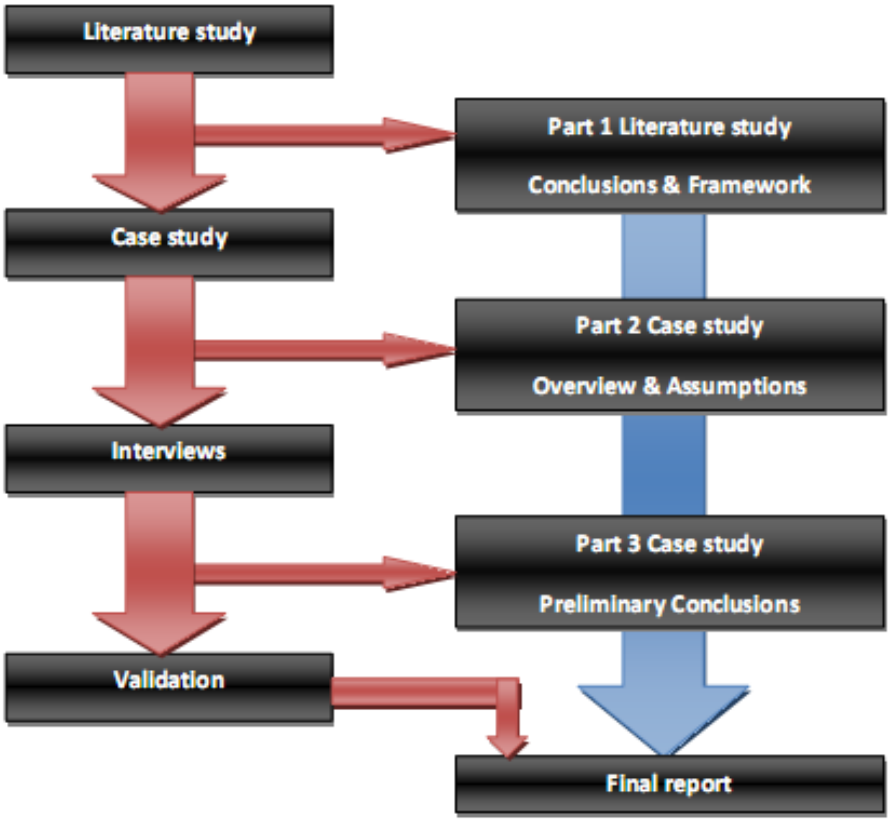

Figure 3 Product Delivery Flow Diagram

1.6 Organisation

This graduation research is sponsored by Aronsohn Management raadgevende ingenieurs from Rotterdam. They offered an internship position to conduct this research. The graduation committee governing this thesis consists of the following persons:

Professor (chairman):	Prof. dr. ir. H.A.J. de Ridder
1st supervisor TU Delft:	ir. F.A.M. Soons
2nd supervisor TU Delft:	drs. M. Leijten
Supervisor Aronsohn:	ir. P.J.F. van den Boom

The day to day supervision is done by: ir. J.G. van der Panne form Aronsohn, he is not a member of the graduation committee though.

Part 1 Literature study

Chapter 2 Overview of contracting and collaboration in construction

This chapter deals with the basic ideas behind project control, contracts and collaboration in construction. The focus lies on the different aspects of a construction contract and on the influence these aspect have later in the project. A short introduction about the theory of managing and controlling projects is given, followed by the legal aspects of contracting. Since the contract is a tool used to establish the basic premises for collaboration the last part of this chapter deals with different models for collaboration and some important factors of collaboration.

2.1 The Control of Projects

There are multiple theories for project control available in the current market. This paragraph describes two of the more common ones and their relation. These theories of project control are used to serve as a backdrop to a number of different contracts used in the construction sector. Part of the control mechanisms are based on the decision for a specific contract. The theorem described below will be used to evaluate multiple contract forms later in this thesis.

The iron triangle

At the heart of project management lays the theory about controlling projects. The first real forays into project management by NASA and the USAF tried to find a way in which they could better control and monitor their projects and ensure the project finished on time and within budget. Over the years many authors added to this notion of control but one of the dominant ideas is that of the Iron triangle or triple constraint (Dobson & Feickert, 2007, p. 4-6). They argue that in its essence project management is about the following three questions:

1. How long do I have?
2. How much can I spend (money, resources)?
3. What exactly does this puppy have to do, anyway?

The answers to these questions boil down to the three constraints, namely time, cost and quality. For two of these a clear definition is apparent; time relates to the amount of time (days, weeks, months) the delivery of the project will take, cost determines the usage of goods, either expressed in money or in other resources like man hours, needed to finish the project. They are scarce goods since you only have a limited amount of time, and devoting it to this project precludes you from using it on another project, the so called opportunity cost. The same goes for goods like money and man power. This scarcity dictates that choices have to be made on how to use those goods, putting a constraint on projects. Quality is harder to pin down since a lot of definitions for quality exist; an often used definition is that quality represents that which must be achieved to satisfy the

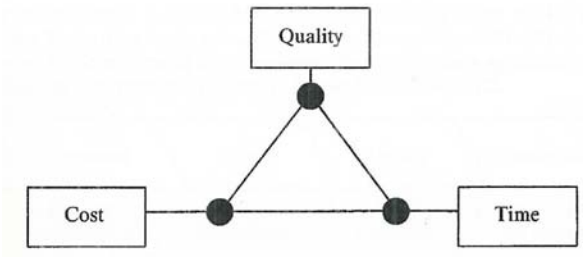

Figure 4 Iron triangle

customer's needs and wants. Quality is also used to denote a certain minimal level of requirements the work has to comply with. These two definitions are used interchanged and this often leads to confusion. Later in this chapter a definition of quality is given.

In a project these three aspects are linked together in such a way that you can never affect one without affecting the other, hence the idea of an iron triangle. Controlling a project therefore is all about managing these three aspects and keeping them all within the bounds specified by the client. Dobson and Feickert argue further that in each project the three constraints are ordered. One of them is the driver, one of them the middle constraint and one the weak constraint. (Dobson & Feickert, 2007, Ch. 5) This doesn't mean one constraint is more important in the project than other constraints but it is a measure of how much "wiggle" room each constraint has. The driver is the key constraint in the project, which can be the budget, the turnover deadline or the very specific requirements of the client. There is limited to no room to change this constraint, on the other hand the weak constraint has the most leeway for changing.

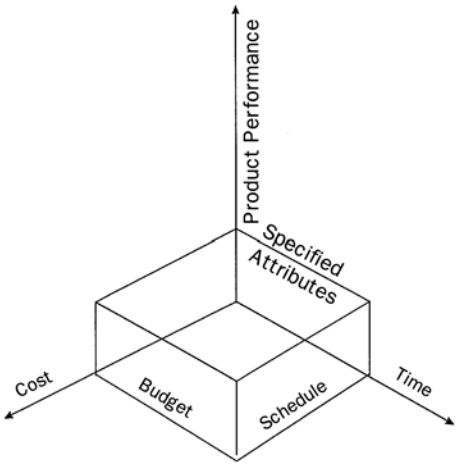

Figure 5 Triple constraint

Another way to represent the iron triangle is by using the constraints Dobson and Feickert write about as axis of a grid. The project then can be seen as a 3d representation of cost, time and performance. Figure 5 is a representation of this. If the project constraints are mapped on the axis the entirety of the project takes on the form of a cube. The cost constrain is then formed by the budget, the time constrain by the schedule and the performance constrain by the specifications. For time and cost these constraints form a maximum below which the project should stay, for performance often a minimum is laid down in the specifications. The main theorem however remains the same; changing one of the constraints will have an influence on the other two.

The theory of Turner

Most modern project management literature incorporates the theorem of the three communicating aspects in their general descriptions, but don't acknowledge is as the iron triangle anymore. The basic ideas about project control remain though; some methods adopt more aspects that are important (PMBOK 2000, p. 4-8), while others keep three aspects but use different ones (Cooke & Williams, 2009, Ch. 15). Turner (1999, p. 8) however takes on a wider approach, instead of just using time, cost and quality he adds scope and organization. He creates a sort of pyramid with the old three on the bottom, scope at the tip and organization enclosed by the others inside the pyramid.

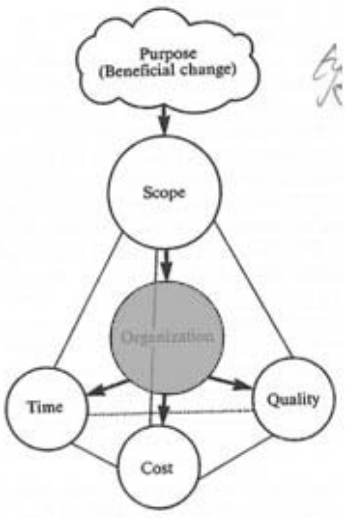

Figure 6 Model of Turner

Scope, Turner (1999, Ch. 5) argues follows from project purpose (see also Figure 6). The purpose of a project is: "a statement of the business need to be achieved by the project".

Closely linked to this is his definition of scope: “an initial, high-level description of the way in which the purpose will be satisfied.” He breaks this description down into three separate things:

- The work that needs to be done within the project
- The work which falls outside the project
- Interfaces with other projects

The scope of a project should define these three things. The first is very obvious but can be quite difficult to define as discussed below. The second shouldn’t be an exhaustive list but a definition of the projects “borders”. The last can be very important when multiple projects need to be completed at the same time and location, clear demarcations are needed to prevent problems and grasp certain opportunities.

Since Turners definition of scope intrudes in the domain originally encompassed by quality, his definition for quality also changes. Turner starts by acknowledging the difficulty in defining quality since it is widely used with different meanings. He distinguishes four definitions:

- Meets the specifications; the project is in accordance with the requirements that were laid down at the start. This can be objectively measured by checking off on the requirements. Problem is that part of the requirements can also refer to other constraints like time and cost so this is a difficult definition to implement.
- Is fit for purpose; the project works for the purpose that was intended. This can be objectively measured and is a solid definition.
- Meets the customer’s requirements; here the projects meets the requirements the customer had of it. This means the requirements the customer thought up, not the customer’s translation of those requirements into a specification. It can easily be seen that this is a very subjective definition that can lead to huge differences of opinion.
- Satisfy the customer: this means the customer is happy with the end result. Once again a subjective definition and very hard to account for or even measure.

It should be clear from the above that these four definitions of quality all mean very different things, some can even contradict each other. For instance delivering the project entirely according to specification may not satisfy the customer and/or meet his requirements since what the customer thinks he needs, can be widely different from what he laid down in the specifications. Same goes for that which is laid down in the specifications may not be what is fit for the purpose of the original project.

After this rundown of the different possible meanings Turner states “the widely accepted definition of good quality is now taken as delivering project objectives that are fit for purpose”, an objective measureable definition. This definition will also be used for the remainder of this thesis.

The theorem of Turner is widely referenced and used, often in a slightly adapted form, even Turner himself expanded his theory. In the Gower Handbook of Project Management (Turner & Simister, 2000, Ch. 4) he defines eight project functions that need managing. These eight are an expansion from his original five, namely scope can be expanded into functionality, configuration and work while quality can be split into quality (finish) and safety and health. Later he once again lowered the number of project functions and brought it back to three in total; cost, time and performance. He used performance to differentiate from the aspect of quality, which is a vague

definition and hard to grasp. Important here is, that he is back to three aspects that are critical while scope is somewhat overarching. (Turner, 2007)

Project control

In this thesis the theory of Turner will be used in a slightly adapted form. Since the goal is to measure the effectiveness and efficiency of a certain contractual form, organization is the independent variable. It is assumed that all contracts are based on a variant of the principal-agent relation which will be discussed in paragraph 2.3. The other four aspects will be dependent and vary based on the contract used. So for every contract form that is evaluated the following aspects from Turner will be explained:

1. Time
2. Cost
3. Quality
4. Scope

Time and costs are obvious and won't need extra definition; quality and scope need some commentary on how to apply them.

Here quality is defined as: *How fit for the initial purpose the client had in mind the building is.*

Scope is defined as: The whole of functionality of the building as laid down in either the program of requirements or in the specifications. In which document and how scope is defined, depends on the phase of the construction process in which the tender is held.

2.2 Contracting

Contracts are the backbone of all collaborations in the construction sector. Contracts are used to detail any and all agreements between the different parties in a construction project. For different forms of collaboration different contracts exist. This chapter discuses the basic premise of a contract as it exists in the Dutch (building) law, the general idea about the connection between form of contract, form of collaboration, liability and method of remuneration. This discussion is not about specific contracts in the construction sector but about contracting in general, the principles presented here apply equally to construction contracts as to a buyer's agreement.

Contract law

Before we can even discuss the intricacies of contracting it is wise to first establish the definition of a contract. The Dutch law (Bruggeman, et al., 2008) has the following definition for a contract:

> *"An agreement in the sense of this title is a multilateral juristic act, in the context of which one or more parties take up an obligation towards one or more other parties."*

The words contract and agreement are often used to denominate the same principle. In this thesis the word contract is used when referring to the official papers, while agreement is used in the more liberal sense of reaching consensus about something. The above definition of a contract gives a number of important notions about contracts in general. The two most important aspects of the definition are underlined.

The first is that a contract can only be established as a multilateral juristic act. This signifies that a contract is an agreement between multiple, at least two, parties, who both are willing that the agreement carries legal consequences and legal effects. These consequences and effects lead to the second important part of this definition, the obligation. An obligation is a relationship between parties that can be expressed in monetary terms. In the most basic form when A has an obligation to B, A has a claim on something from B and B is required to provide that which A claims for which B often receives compensation from A. The simplest example is a purchase agreement, or more formal a purchase contract, A must pay B a specified amount of money to which B is entitled and in return B transfers ownership of the purchased good to A.

Contracting doesn't apply solely to the construction industry, contracting is a part of everyday life. Making a purchase is done through an (implicit) contract, asking a plumber to fix your drain involves a contract and there are numerous other examples possible. Dutch contracting law is based around three (Bruggeman, et al., 2008) key principles:

1. Freedom of contract
2. Binding effect of the agreement
3. No prescribed form required

Freedom of contract

In principle there are no regulations regarding contracting, everyone is allowed to enter into whatsoever agreement with anyone else. There are some provisions though; all contracts should not be a violation of good morals, public order and mandatory statutory provisions. If the contract doesn't comply with these provisions the contract is null and void, it is not enforceable. It does however takes a judge to void the contract.

Binding effect of the agreement

Once again in principle that which is put in a contract is legally binding for those parties engaging in the contract. A seller cannot suddenly sell his wares to someone else who happens to bid more for the product if the seller has already made the obligation to sell at a certain price to someone else. There are however specific clauses when this binding effect doesn't apply. The Dutch law has a reasonableness and fairness clause referring to contracts (Dutch Civil code, Article 6:248) which stipulates that in very specific circumstances a judge can void a rule in a contract, which is not considered reasonable or fair for one of the parties. For this to happen there must be something very seriously wrong, otherwise the binding nature of contracts will be worth almost nothing. This is called the derogatory effect of reasonableness and fairness. On the other hand of this stipulation is also the supplementary effect of reasonableness and fairness, this clause deals with things that aren't described in detail in the contract but can be assumed as self-evident. Despite their non existence in the contract they can be assumed to be in their since everybody expect they should be included, parties therefore cannot claim that they are not present in the contract.

No prescribed form required

Lastly there is no prescribed form of contract, when parties reach consensus an agreement has been made and this agreement counts in all aspects as a legal contract. For certain special cases a contract has to be notarized or otherwise formally approved, for instance when buying a house, before it is valid. It is sensible however to draft a contract for any long term agreements, so that if a dispute arises it can be dealt with by looking at what was agreed upon in the contract before the conflict arose.

Contracting in the construction industry

Contracting in the construction industry is more elaborate than the laws that govern general contracting. Due to the influence of the European tender laws it is no longer possible to just ask a few known contractors to offer a bid and award the contract to whoever you as a client deem fit. Nowadays before awarding the contract for a project above a certain threshold value, a tender has to be drafted to everyone in the European Union on the basis of fair competition. But that is not all that changed, there exists a multitude of new and innovative possibilities, both for awarding a contract and for the specific form of contract.

While previously the bidder with the lowest price would receive the contract, nowadays almost all contracts are awarded based on Economically Most Advantageous Tender (EMAT) principle. When using the EMAT principle as an award mechanism the client specifies at the start of the tendering procedure how he is going to evaluate the bids of the contractors. Often price is still an important factor but other factors like sustainability, planned approach of the work and possible optimizations also play a role (Masterman, 2002, p. 74-75) (Bower, 2003, p. 21-23). The goal of using EMAT is to get more value for money by not focussing only on the lowest price but also on the total performance of the works.

Most important however is the form of contract chosen for a specific work. Over the past few years a multitude of contract forms has appeared which range from traditional design-bid-build contracts to long-term alliance contracts. Most of the newer contracts aim at increasing collaboration between the client and the contractor and/or at bringing the contractor into the design earlier (werkgroep LAvGC, 2006). These contracts hope to realize a better performance by using the specific contractor expertise on building in the design phase and/or by better aligning the goals of the client and the contractor.

The choice of contract form carries large and important ramifications for the remainder of the construction process. Apart from the legal definition of a contract given above, the main purpose of a building contract is to specify three key aspects (Rowlinson & McDermot, 1999):

1. Collaboration
2. Responsibility / risk
3. Reimbursement

These aspects are related as follows. Collaboration details the relation between client, contractor and the works. Important part of this collaboration is the division of responsibilities and risks between contractor and client. To take on these risks and responsibilities the contractor will demand a specific sum of money which should be paid using a specific remuneration method. As

shown these three aspects are closely interlinked in all of the common construction contracts. A short overview per aspect is given below, but they should always be considered as a whole when used in a contract. Further in this chapter is described how these aspects interconnect; in 0 an overview is given of the more common building contracts.

Collaboration details how the parties will be working together in the construction project. (Rowlinson & McDermot, 1999, p. 36-45). Collaboration can be in a formal client-contractor relation, in which the client is the dominant partner, or in a more liberal partnering arrangement in which client and contractor are more equal partners, both having a stake in and influence on the project. The means of collaborating also extend to how much of the project is decided upon by the client and how much is decided upon by the contractor. There are numerous ways of collaborating in a project, and even over multiple projects. The contract often concerns the hard side of the collaboration; describing the roles and defining the obligations and rights of the parties. The soft side of collaboration; issues as trust and conflict resolution are described in more detail in paragraph 2.3.

In the contract the contractor is appointed a number of tasks he needs to do. To complete these tasks he receives a number of authorizations and takes on the obligation to finish the task. This obligation makes him responsible which in turn leads to a possible liability. Liability is only an issue when the task doesn't go as planned. A construction contract is filled with tasks both for the contractor and for the client. These tasks and the accompanying responsibility also come with risks and the power to decide. In this way the contract defines which party has executive authorization and thus the final decision on which tasks, and flowing from that often bears the risk. This operates under the common assumption of: *"he who gets to decide is liable for the consequences of that decision."* This goes for both the contractor and the client, so if for some reason the client overrules the contractor he will bear the risk, be liable, for any consequences of that decision.

This is contrary to another often used rule of thumb in risk management: *"To minimize the impact of the risk the party best suited to deal with it should be in charge of that risk."* A lot of authors (Turner, 1997) (Cooke & Williams 2009)(Best & de Valence, 2002) have argued either case but it remains an often disputed part of contract negotiations. Either side of the medal has it's charms; it is unnatural that someone bears the risk without having the final say on a subject, this could easily lead to abuse, but on the other hand putting all the risks with the person who is best able to manage them might be a very unfair division of risks.

Risks are closely related to uncertain events, anything that has a chance of happening is an uncertainty. Uncertainties with negative effects on the project are often called risks, while uncertainties with a positive effect are called opportunities. Most modern project management handbooks devote an entire chapter to management of uncertainties, often called risks in the literature. Over the past years multiple methods have been developed to identify and deal with risks in projects, Rijkswaterstaat uses RISMAN, NASA uses ATOM, while the California Department of Transportation has written their own guidelines based on the general principles of the PMBOK.

These methods often have the same principles in dealing with these risks. The risks and sometimes opportunities are identified, estimated, ordered and then mitigated. By giving special and extra interest to the largest risks their potential effects are limited or taken out of the project.

There is however one thing all these methods don't incorporate, despite extensive brainstorming it is impossible to identify and assess all risks that threaten a project. There always are so called true uncertainties, events no one could have foreseen; for instance the state of the outer walls between two contiguous houses or the failure to waterproof a diaphragm wall due to a technical problem.

Recent study has shown that these true uncertainties are often the basis for failures, delays and cost overruns. While the risks for a number of true uncertainties are divided in the general conditions, the most are not mentioned and thus when they occur, lead to heavy debates which party will has to deal with the (financial) consequences. Apart from the direct damage of the event this will have repercussions on the collaboration and the further dealings in the project.

Lately more research is being conducted in how to deal with the division of risks, this research is being extended to not only deal with the known risks but also with future uncertainties. This division has to be lead down in the contract and agreed upon by both the contractor and the client.

Reimbursement is the third pillar of contracting (Walker & Hampson, 2003). In the contract the method for reimbursement and if possible the total price for the client will be laid down. All common forms of remuneration in the construction sector can be placed in an easy graph distinguishing them based on contractor's and client's risk. This risk is the total financial risk of the project, not the individual risks inherent in the project which can lead to financial risks. This graph is shown in Figure 7.

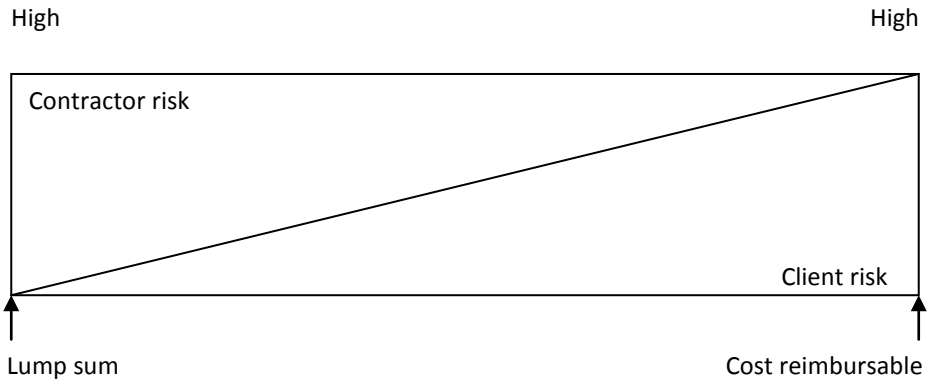

Figure 7 Cost risk continuum in construction contracts

On the far right side contractor's risk is low and owner's risk is high, on the far right this is exactly opposite. One of the extremes is the lump sum contract. In this contract the owner pays a fixed amount of money, the lump sum, to the contractor who agrees to deliver a total package to the client based on his wishes. Any problems or uncertainties fall to the contractor to solve, the client knows exactly how much the project is going to cost him and bears no financial risks at all.

The other extreme is the cost reimbursable under this type of contract all the costs the contractor incurs are paid for by the owner. This means the contractor has a guaranteed income based on the work done but the client has a very open ended measure of total costs and the risk that whatever goes wrong he has to pay for it.

In between these extremes exists quite a lot of different forms of reimbursement which all amount to dividing the risk between parties in different ways. In this context reimbursement is not to be confused with remuneration, reimbursement deals with the tasks the contractor has to perform and how he is compensated for those tasks, remuneration deals with the specific schemes used to compensate the contractor, for instance whether or not he is paid up front or in instalments.

2.3 Collaboration

This paragraph focuses on collaboration in the construction industry and on models that represent collaboration. The principal-agent theory and the network theory are discussed and serve as a basis for comparing different contracts in construction. The discussion of these theories is supplemented with a treatise on the effect of trust and trust building in collaboration. The paragraph closes with conflicts and conflict resolution and how it can be applied to building contracts.

Principal-Agent theorem

The principal-agent theorem, or agency theory, details a specific relation between two parties and how power is distributed in that relationship. The theory describes the specific relationship where one of the parties acts as the principal and the other as his agent. The parties have engaged in a relationship where the agent is the subordinate of the principal. The principal has formal control over the actions of the agent but has contracted the agent to perform a certain task for him, delegating some measure of control to the agent. The principal needs the agent to perform that task, since he doesn't possess the knowledge or means required for that task. Knowledge here can either imply knowledge of the system as a whole or knowledge about the specific work the agent is contracted to do. For instance in a construction project it can be knowledge about constructing a building, the system, or the specialist knowledge needed during execution, the specific works.

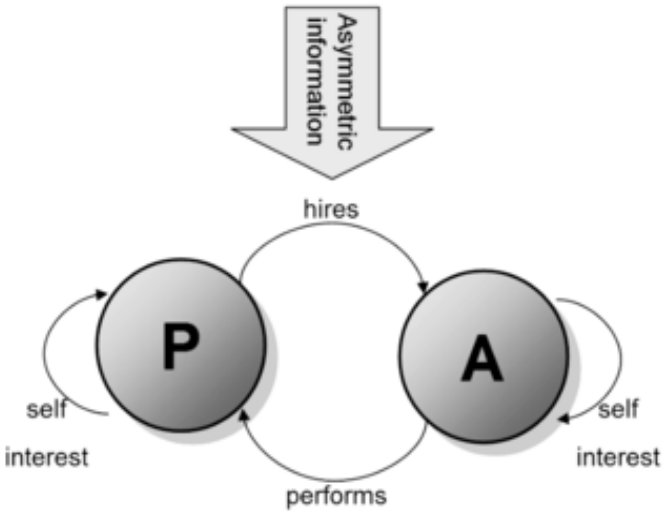

Figure 8 Principal-Agent model (Wikipedia CC)

Jensen and Meckling (1976) are the best known source describing the agency theory. They define the relationship between principal and agent as follows:

".. a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent. If both parties to the relationship are utility maximizers, there is good reason to believe that the agent will not always act in the best interests of the principal."

It seems the lines of power are clear; the principal hired the agent so the principal is ultimately in control. This however is only true in a situation in which the principal is able to check on the agent and to verify how well he is performing. The principal can only really check on the agent when he posses the knowledge to do

so, however he wouldn't have hired the agent in the first place if he would posses that knowledge. In reality, the agent always possesses more specific knowledge than the principal. There is an asymmetrical divide of information.

Zooming in on the principal and the agent roles it can be seen that both are independent parties with their own agendas and goals. These different goals almost always contradict, simple example is a contractor (agent) and a client (principal), the contractor strives to maximize his profit, while the client strives to get the most quality for the lowest price. Despite their formal relation both the principal and the agent will always try to fulfil their own self interests. Figure 8 gives a good overview of the theory.

The power in a principal-agent relation is divided in two parts. The first part is the obligation or control part owned by the principal. He has hired the agent, so he can withhold payment or force the agent to work in a specific way. On the other hand the agent has the power of knowledge, he knows more about the specific task than the principal and can use this knowledge as leverage. So while at first sight the control lies with the principal, both parties have a measure of control over each other. They will strive to satisfy their self interests and this could lead to conflicts. The principal-agent problem is often encountered in a work relation and multiple methods to remedy the power of the agent have been proposed, some of which will be revisited later.

The principal-agent theory can also be applied to the parties in a building contract. Especially the traditional contract is a perfect example of a principal-agent relation. The client hires a contractor to construct a building for him. The client is the principal here and provides the contractor, who is the agent, with money so he can construct the building. Constructing the building requires knowledge and expertise the client doesn't have and thus the contractor can use that knowledge against the client. A number of the typical problems that originate from a traditional contract, see paragraph 0, can be explained with the principal-agent theory. Some of the used countermeasures, like incentives or payment schemes are also used in other instances of the agency problem, some of which can be applied to construction contracts. The most used countermeasure is performance measuring; the idea is to tie the benefits of the agent to the realized benefit of the principal. The key is to (better) align the goals of the principal and the agent, incentives are an extension of this or can be linked to performance measurements.

The network theorem

While the Principal-Agent theorem works well for the relation between two partners, there is no extension for multiple partners in more equal relations. Often there are multiple parties in a construction contract so for that occurrence the network theorem is used.

The network theorem described by Koppenjan and Klijn (2004) offers another insight into decision making and uncertainties. Instead of focusing on just two parties they argue that in the current society there no longer are just two parties. All decision making is done in larger networks of parties which in varying degrees are dependent on each other. But not just the amount of players has changed also the type of problems changed. The problems that generate the biggest issues are so called "wicked" problems; problems that span the traditional boundaries between public and private institutions, that are inherently complex and most important that are hard to define.

The network theorem describes a number of ways how these wicked problems can be countered by all the parties involved. Often these solutions are more aligned with problems related to policy making and the influence of interest groups on that. Nonetheless some of the ideas from the network theory could be applied to a construction process. The key idea in the network theory is the fact that a party is connected in a higher or lesser degree to some or all other parties that concern the problem they face. Independent decision making is impossible since part of their knowledge comes from another party or part of their authority is based on another party. So solving a problem or dealing with a problem quickly becomes a juggling game in which all the parties need to think about others as well as their own interest.

Koppenjan and Klijn argue that wicked problems are no longer solved in the traditional way of describing it and applying a independent evaluation to choose the best solution. Problems are solved in an ongoing process between multiple actors and in multiple so called arenas, specific interaction points between different actors and on different levels. This system of actors and decision arenas even expands across multiple problems and the resolution of one problem influences the other problems. An important criterion that needs to be complied with is strategic learning. By interacting and playing in the different arenas the actors should work towards a shared goal or win-win situation. When this happens actors will stop trying to force their own preferred solution but work together towards solutions benefiting them both, thus increasing the quality overall. This could even extend into institutional learning where actors have forged long term connections and always seek mutual benefit instead of conflict.

The network theorem will be used to evaluate the interactions in the bouwteam contract and possibly for the Aronsohn contracting vision.

Trust

Regardless whether the collaboration consists of two or multiple partners, trust plays a very important role both in maintaining and in establishing the collaboration. Trust is often seen as the binding force in the collaboration. Below a definition of trust is devised and an insight given into how trust can be built and maintained.

Trust as a concept has been widely researched in other fields, most notably social sciences, but with the rise of integrated contracts it became a field of interest for construction research as well. Before trust in collaboration is discussed a definition of trust has to be defined. Over the years there have been multiple definitions of trust depending on what the authors wanted to accomplish with the definition.

"Trust is a means of coping with uncertainty" (Butler & Gill, 1995)
"Trust is an enabling condition to which facilitates the formation of ongoing networks" (Das & Teng, 1998)
"Trust is one of the three primary control mechanisms which govern economic transactions between firms"(Bradach & Eccles, 1989)
All taken from Vangen and Huxam (2003)

These definitions above however are more an indication of the effects of trust and not a true definition. The Dutch dictionary has the following definition of trust:

"Belief in some ones good faith and honesty" (Van Dale online, 2010, personal translation)

This definition is aimed at a person but can easily be extended to include a corporation or organization as well. So from a pure literal sense trust has to do with believing in others. This belief is the underlying principle for the above effects of trust, e.g. by believing in a partner's good behaviour a ongoing network can be formed despite the uncertainty of his behaviour or his intentions.

From a literature standpoint there is no single right definition of trust to give, in part since trust is something different to each person, but also since trust between companies works differently than trust between persons. While part of the success factors and benefits are the same, there are also distinct differences, mainly in how trust is build and in the effects of trust.

Trust between persons is build on shared experiences and often based on a feeling, or by taking a risk, akin to definition one. Trust between companies often comes from experience from the past but is also based on more economic principles. In this definition it closely relates to control and power in collaboration as is used in the principal-agent relationship, described in paragraph 2.3. The second and third indications of trust will be used in this thesis. Trust is a basic building block in the formation of networks and serves as one of three closely related principles in governing economic transactions. Both trust and economic transactions are dominant in a construction organization.

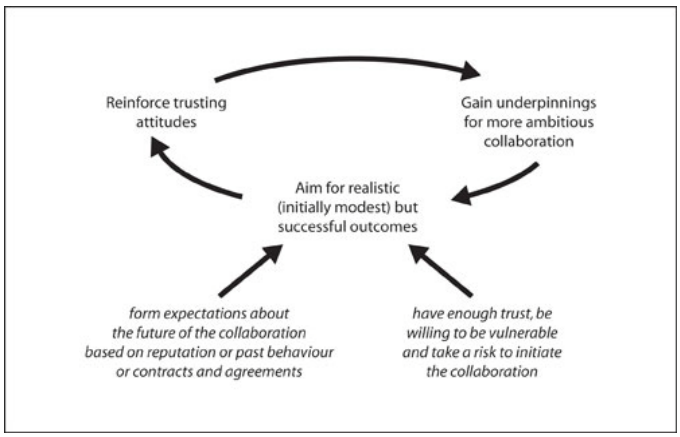

Figure 9 Cyclical trust building loop

Trust plays an important role not only in the construction sector but also in a lot of other fields of study, for instance in business administration or economics where trust is an important factor in transactions between companies. Vangen and Huxham (2003) researched how companies could build a trust relationship from the ground up. They found out that trust building takes on a cyclical aspect, involving risk taking. They argue: *"Trust leads to risk taking, and providing that the initial expectations materialize, risk taking in turn buttresses a sense of trust."*

What they prove is that every time partners deliberately act together in a collaborative way with prior established shared objectives, they build a shared history of successes if those objectives are successfully met. This shared history in turn strengthens their (positive) prejudices about collaborating and mutual success, making it easier to work together the next time. They conclude that trust has been created and build upon. This can be summarized with the cyclical trust building loop in Figure 9.

The two initial factors needed are; realistic expectations about the future of the collaboration and a minimal measure of trust, or the willingness to expose themselves, to initiate the collaboration. When the first collaborative project is completed successfully a basis for further and more far reaching collaboration is created. This process can and should be continued to create more trust, every time a cycle is completed. Derived from this they argue that trust building should not only take on cyclical approach but also that it is a delicate process that needs to be undertaken in small steps to be as effective and lasting as possible.

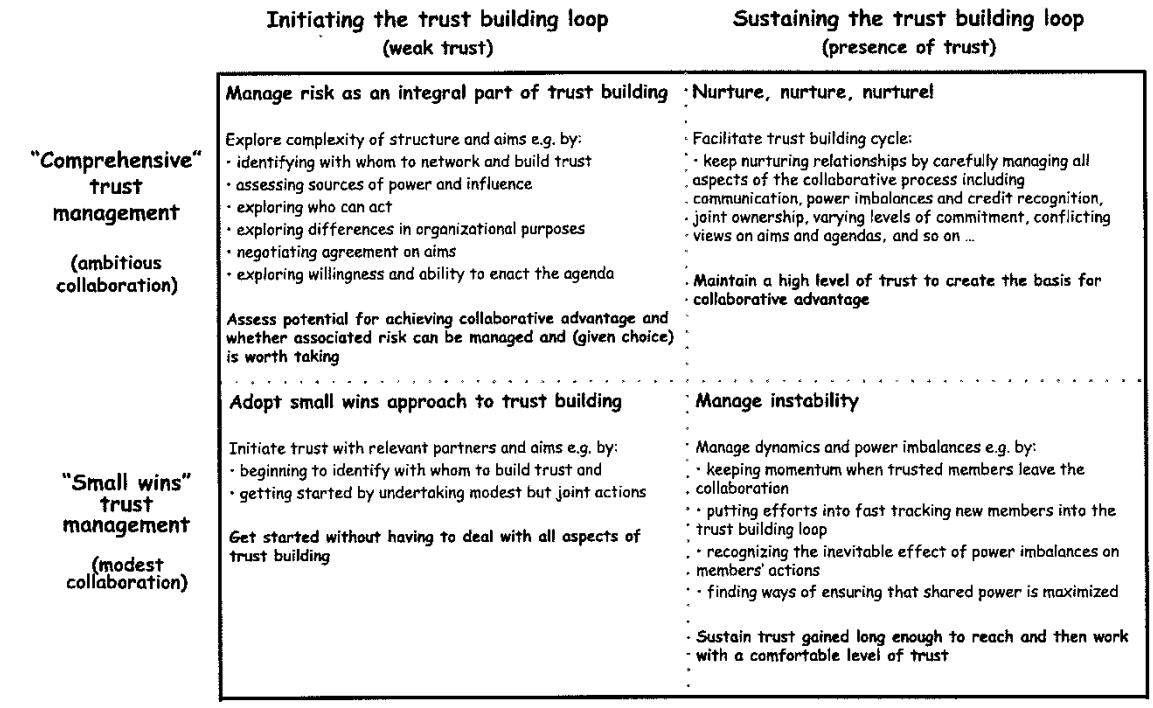

Figure 10 Managing trust

Depending on the situation between partners a mode for trust building needs to be found. Vangen and Huxham define two aspects to check before engaging in a collaboration, namely the level of trust between partners that already exists; either high or low, and the goals and ambitions of the collaboration; either ambitious of modest. This combination of factors points to four basic approaches to build trust between organizations. See Figure 10 for an overview of the four trust building approaches.

These four basic approaches can be applied to building trust between contract partners as well. Trust building can be done in almost any contract form, but the most benefit can be gained when used in a contract that supports collaboration between parties. Since normally no or a very small measure of trust is present, the focus should lie on initiating the trust building loop. Referring back to the four basis approaches most construction contracts then fall in the upper category of ambitious collaboration and low prior trust. So to make it work, hefty agreements should be drafted and the risks should be controlled very tightly. This is a difficult process and can fail in a large number of ways. As can be seen with traditional contracts, agreements grow larger and parties entrench themselves and oppose the other party using the strict rules.

An easier way to nurture good collaboration and trust is to define small goals and strive to establish a sense of previous success during the project. This small start allows the parties to adjust to each other and learn to work together, creating more commitment further down the line in the project. In practise the bouwteam contract tries to do something akin to this. All parties unite with the same common intention to construct a building and by working together in drafting the design adopt the modest but joint activities approach. This hopefully creates more trust between parties for the collaboration in a latter phase, namely during the execution.

Extending this concept even further, parties could even opt to work together on more than one project, called partnering. When this happens and parties have some measure of trust their relationship can be maintained and expanded to create even more benefits for all parties involved. Supply Chain Integration (Vrijhoef, 2007) gives an overview of how this can be implemented. The ideal here is that by engaging in long term collaboration with a specific partner both parties could benefit from each others expertise and that certain cost raising precautions can be lessened. Normally a company always includes a premium in their prices for certain risks related to the possible opportunistic behaviour of their partners. Increased and long term collaboration could reduce or abolish these risks and thus lower prices and guarantee a steady influx of work.

In the construction industry a contractor could enter in a partnership with a special concrete factory. The contractor agrees to only buy his concrete from this factory with a fixed price, the factory can benefit from the steady stream of work for a good price while the contractor has a fixed (competitive) price and therefore won't have to go to the market for a new price every time he needs concrete. In a further stadium the contractor could even communicate about his demand to the factory early allowing them to always produce just enough concrete to meet the demands.

An interesting dilemma surfaces when definition 1 and 2 are taken to the extreme. One could argue that when there is a large amount of trust between two parties that a contract is no longer needed to govern their formal relationship. Their relationship actually changes to a more informal one. This could probably work well with small contracts but will almost always go wrong when a conflict arises. Both parties need to trust each other enough and know that their partner will not behave opportunistic in the face of that conflict, it tests the relationship. In practice this will almost never happen since there are not enough boundaries to keep companies from opportunistic behaviour and the moment those are implemented the contract returns, albeit in a different form. While more trust in collaboration helps the collaboration, a contract can never be truly replaced by trust, not in projects with the size and stakes of a construction project.

Conflict Resolution

When we take trust as the binding force in collaboration then conflicts are often the splitting force. Partners can work together pleasantly until the project hits the first speed bump and then all of a sudden they are direct opponents. Conflicts often arise over risks that fire in the project and the damages and claims that follow those risks. When the contract doesn't foresee in a clear and official means to deal with those risks the parties often end up in conflict on who is to blame or who is responsible for the consequences.

Whenever multiple people or organizations work together on a project, misunderstandings, irritations and other forms of friction arise. This friction is inevitable but can often be simply resolved or remedied. When the friction persists or the cause is not remedied it can lead to conflicts between employees or organizations. Jones and Deckro (1993) extensively analyzed the underlying reasons for conflicts that can arise in a matrix organization, using role theory, a concept from the social psychology. While the collaboration between client and contractor normally isn't in a matrix form they do have a number of interesting findings that can be applied to construction contracts and the client contractor relation.

In role theory a role is defined as:

"A set of desired and undesired behaviors of an individual occupying a position of office"

For an organization that would imply an individual has a job inside that organization, so he fulfils a role based on his activities. Jones and Deckro continue to derive four types of conflict, drawn from role theory, and four common sources of conflict in a matrix organization. The four types of conflict are:

- Intersender conflict, deals with conflicts stemming from conflicting demands placed by others upon one role.
- Intrasender conflict, deals with conflicts stemming from multiple directives and demands for a certain role from the same person.
- Interrole conflict, deals with conflict between one of the multiple roles a person fulfils.
- Person-role conflict, deals with the conflict between the person's ethics and the role he should fulfill.

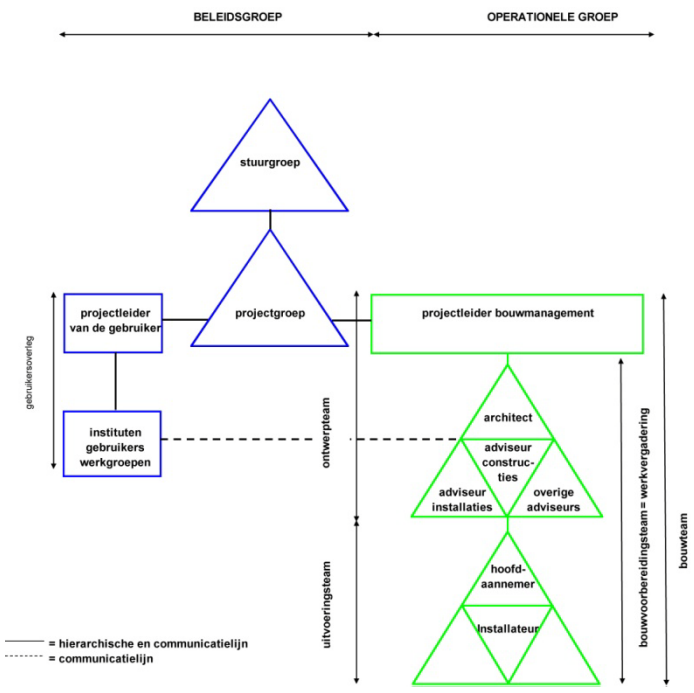

Figure 11 Project organization Aronsohn Management

Aronsohn Management uses the following project organization, shown in Figure 11. Figure 10 is divided vertically between the organisational group and the operational group. The organisational group concerns the control of the project, while the operational group deals with the design and execution of the works.

On the highest level the project manager from Aronsohn regularly meets with a representative of the client and a representative of the future users. This meeting is called the "Stuurgroep", all the executive decisions about budget, time and performance are made in this meeting. The Stuurgroep also functions as the principal for Aronsohn Management, the project manager from Aronsohn reports about progress and receives instructions. One level lower is the

project team, here the project manager, a representative of the client, a representative of the future users, the architect and the advisors take a seat. The project team makes most common decisions and reports to the Stuurgroep on the issues of budget, planning and performance. The project team is authorized to make small scale decisions for the project, also since the client is represented in it. Below the project team is the building team, it's members are the project team supplemented with the executive parties. In the building team the day to day management of the project takes place. Below the building team a number of sub groups operate, mainly the design team, the coordination team and the preparation team.

Focus lies on the project team since the most problems will arise and be solved there, only when something seriously escalates will it go higher up. The Stuurgroep remains the highest decision making organ. The following basic roles are identified, the project manager, the client, the future user, the architect, the advisors and the executing party. Formally the architect, advisors and executing parties report to the project manager who reports to the client. The future users can only influence the client. The project manager reports to the client and represents him towards other parties.

Jones and Deckro distinguish four sources of conflict of which two are applicable to the project organization Aronsohn Management uses, of the other two one is partially applicable and one is not. The two most applicable are technical complexity and internal politics. Technical complexity due to the scope of the projects and the size, internal politics since multiple representatives of the same organization (client and users) are participating and because all the parties are united in the project team, but still have their own organization's goals to tend to. The bifurcation of authority source is weak but can be found in conflicting interests between the client and the users. Since the project team operates mainly during the execution phase there are very few life cycle changes so those don't play a significant role.

The high complexity leads to more inherent uncertainties and to more people working on solutions. These uncertainties also form risks that if they fire, could prove a source of conflict. All these people have their own different roles but together create a large number of interfaces in the project and they all influence each other. More interfaces also leads to more uncertainty for the management which could also lead to conflicts.

The other source of conflict is internal politics, this one can easily be adapted to a construction organizations. Since people from different companies work together in a construction organization smaller groups of likeminded (from the same company) people exist and it's to be expected that certain games are played between those groups.

The solutions or remedies Jones & Deckro propose all deal with specific subsystems and are tailored to the problems in a matrix organization, making some remedies easier to implement. Regardless a number of remedies can be applied in a construction organization. The most important one Jones and Deckro bring up is to deal with the internal politics; this applies even more for a construction organization. By creating shared leadership, fostering shared decision making and most importantly set common goals the level of internal politics should decrease. Also creating a single role to be responsible for the authorization of assignments should limit the problems with bifurcation of authority. This also applies to dealing with risks and uncertainties. By agreeing on a clear division of risks and extending those to true uncertainties parties know who is

responsible when something happens. A general agreement on how to deal with totally unexpected events could also remedy potential conflicts.

Further they touch upon team building and also on interpersonal conflict resolution techniques. Outlining six techniques for resolving interpersonal conflicts based on the nature of the conflict and the parties involved. The interdependence of their tasks on each other and their functional similarity points towards possible solution methods. The more dependent and similar both tasks are, the quicker the conflict should be resolved since it can escalate easily. However the method applied can be far blunter if the functions are similar. The range of methods goes from smoothing and withdrawing from the conflict to defuse it to confrontation and imposing orders from higher up on the parties. The more confrontational methods carry the inherent problems of dealing with the problem at hand but not resolving the underlying situation, great care should be taken when mediating between long term partners. Only by restoring their relation and trust in each other can the partners continue a fruitful working relationship.

2.4 Conclusions literature study

From the literature study above a number of key concepts about project control, contracts and collaboration are derived. How these aspects apply to the Aronsohn contracting vision will be researched in the case study and interviews. In short these aspects are related to the three pillars of contracting; namely organization, risk and reimbursement.

Organization deals with how the collaboration is set up and how this setup works in reality. Focus will lie on whether the network theorem or the principal agent theorem is more applicable. Under organization also falls the trust between parties and how they deal with information. These are researched as coupled aspects since the use of information has a close link with the trust that exists between parties. Lastly conflicts are researched, mainly whether the Aronsohn contracting vision leads to less conflicts and whether conflicts are easier to resolve.

Risk covers the topic of obvious risks in the contract and in the collaboration but also deals with how the parties resolve true uncertainties and the consequences on those. The risks and certainties for all parties involved and whether parties perceive other risks and problems with the contract form are the main lines of research.

While reimbursement is an important part of a contract in general, not much research will be done into it. Instead the focus will lay on the incentives that are used complementing the actual reimbursement and on how additional work is dealt with.

Lastly the theorems of Turner and Dobson and Feickert will be used to find out which constraint is the driver and which constraint the easiest to sacrifice on and whether this differs from the other contract forms.

Chapter 3 The standard contracts

In this chapter three common methods of contracting in the Dutch construction sector and one method, not used in the Netherlands but, closely resembling the Aronsohn contracting vision are discussed. For each method a general overview and an evaluation are given, resulting in a list of pros and cons and some discussion about the method. The pros and cons are based on Masterman (2002), he gives a very theoretical analysis of the contract forms so the pros and cons often don't incorporate the experience from the field. The reviewed contracts are: the traditional bid-build contract, the Dutch "bouwteam" contract, the design-novate-construct contract, and the design-build contract.

These contracts are chosen based on their resemblance to the Aronsohn contracting vision. The traditional contract serves as the most basic comparison while the design-build contract is the most innovative one. The contracts are presented in an ordered fashion, ranging from the traditional contract to the desing-build contract. This range shows the improvements that were tried on the previous contracts. For the design-build contracts only the design and execution is reviewed, any variants also including financing, maintenance or other forward integration falls outside the comparison with the Aronsohn contracting vision and are therefore not included in this thesis.

For all contract forms information is drawn from the following general sources, these sources aren't referenced anywhere specifically in the following text. (de Ridder & Noppen, 2009)(Rowlinson & McDermot, 1999)(Janssen, 1991)(Bruggeman, Chao-Duivis & Koning, 2008)(Anon, 2004)

3.1 The traditional contract

For years the traditional contract was the most common contract used for works in the construction sector. It is based on a very basic relationship between contractor and client and is in essence nothing more than a purchase order. The parties have clearly defined and separated roles and each fulfil a different part of the building process, the basic underlying relationship is called the principal (owner) – agent (contractor) relation.

Overview

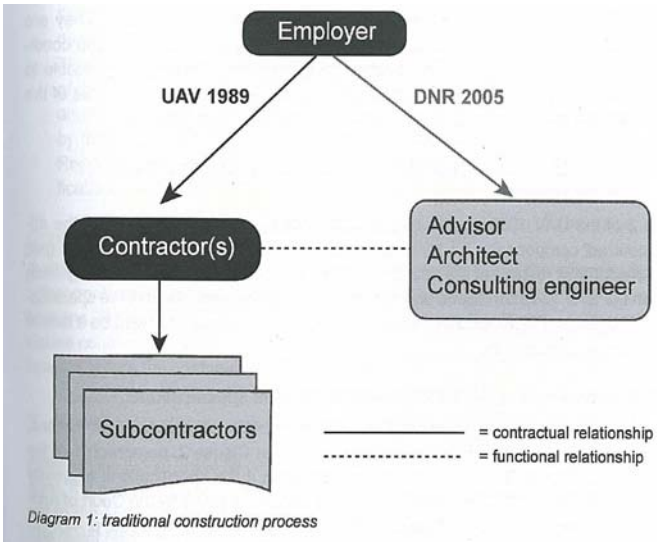

Figure 12 Traditional contract

The owner or client commissions an architect to design a building according to the wishes of the client. This design process is iterative until the client is content with the final result. This design is then further detailed by the architect and broken down to the core level. Piece by piece the building is detailed in the specifications, everything is fixed and listed. The final drawings and the specifications are then put on the market for tendering, almost always with a lowest price selection criterion.

Reasoning behind this is that the client gets exactly what he wants for the lowest price possible. Especially for governmental organizations this is seen as the most efficient way of spending public money.

The contractor in a traditional contract has the sole role of constructing the works. He bids on the contract based on the materials needed and the work that needs to be done. When he is awarded the contract it is often on the basis of a lump sum. He will get his tendering price but will have to deliver the building regardless of the true price or any other risks involved. His only influence is on how he is going to construct the works and even that is often limited by the design wishes (limitations) of the client. This rigid form of contract often leads to disputes and claims for added works, often arising from problems with the design or from unexpected events

During the execution the contractor is constantly supervised by the client who has the obligation to check on the works. During and for a set duration after the construction the contractor is liable for any defaults and problems that arise with the building, including the so called hidden defects. To assist in creating certain parts of the work the contractor often hires subcontractors to do specialized work. These subcontractors work for the contractor and can have a certain liability towards the contractor but in the end the contractor is the only one who has a relation with the client. Anything his subcontractors do wrong the contractor is reliable for in respect to the client.

The basics of this contract are laid down in the UAV 1989. These general conditions specify the responsibilities and rights of both the client and the contractor and deal with the division of risks. It is very clear that the contractor and the client are opposing parties with conflicting goals; the lowest price of the client eats into the profit of the contractor, while more revenue for the contractor means a higher price for the owner. More modern incarnations of this contract sometimes include positive or negative incentives for the contractor to speed up construction or to safe money.

The traditional contract is a prime example of the principal-agent relationship. The client (principal) hires the contractor (agent) to perform a job for him, since the client lacks the knowledge and/or the manpower for the job. For this relation to function the client gives a very detailed description of the works and allows different contractors to bid on that. In his assignment to the contractor both scope and quality are defined and the client will make sure to enforce these constraints. The cost constraint is based on the price the contract bids during the tender, the time constraint is often part of the bid or is drawn up by the client.

The whole contract is rather rigid and fixed, but this works two ways; it’s safe for the client but also has limited to no room for change. Any uncertainties that go off or changes wanted by the client can be the source of additional work claims and thus extra profit for the contractor. Since the parties have a formal and opposed relationship small disputes can easily change into large conflicts.

Evaluation

Masterman (2002, chapter 4) gives an extended overview of the traditional contract. He lists the following benefits and drawbacks of the traditional contract:

Benefit:

- If the design is fully developed and uncertainties have been dealt with before tendering the traditional contract has the lowest tendering cost, fair competition between bidding parties and the lowest total costs. In addition the best bid is easy to decide upon.
- If a bill of quantities is used interim changes can easily be checked and priced accordingly.
- There is a higher degree of certainty that price and quality standards will be met.

Drawbacks:

- If the design is not fully developed the client is vulnerable for added work claims from the contractor.
- Due to the sequential, fragmented and confrontational nature of construction, the standard contract can lead to lengthy design and construction phases, poor communication between parties and problems with constructability.
- While making changes during the design leads to satisfied customers it is found to be the main cause of delays and increased costs.

3.2 The "bouwteam" contract

The bouwteam contract arose as a new way of integrating the contractor into the design process. It was introduced as an improvement on the traditional contract. In a true Dutch collaborative way all parties participate in the project from the start. Ideally a contractor is present to advice on the design process and offer it's expertise of the execution phase, then when the design is finished it is tendered and the contract is given out in competition to a(nother) contractor. In reality, partly due to regulations, the designing contractor is also often the executing contractor and no competitive tender is held.

Overview

The "bouwteam" or design team contract is something often used in the Netherlands. Outside of the Netherlands it hasn't seen much use, however partnering, somewhat akin to the bouwteam contract is often used in the UK, the USA and other places around the world.

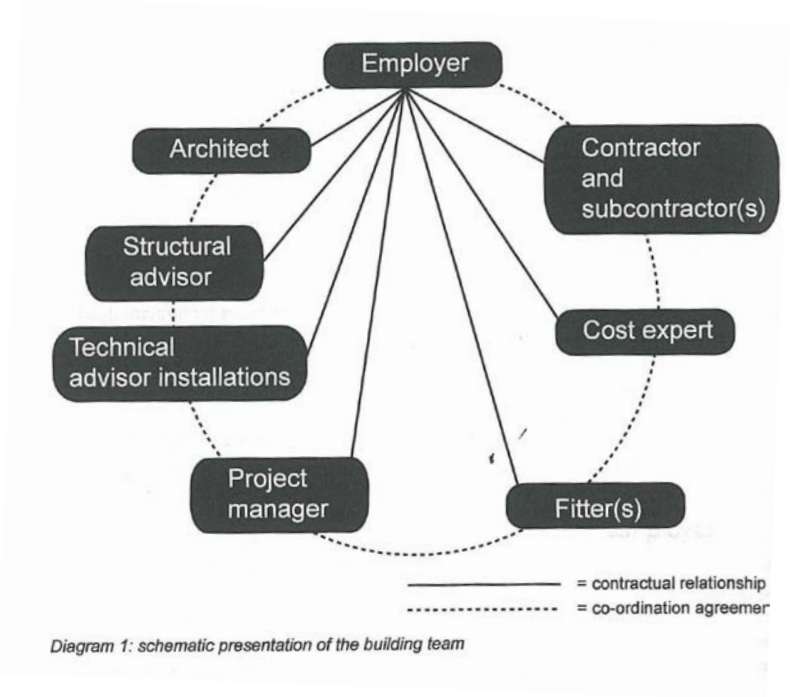

Diagram 1: schematic presentation of the building team

Figure 13 Design team contract

The goal of a bouwteam contract is to have expert knowledge of the contractor available from the start of the design instead of from the start of the execution. This is achieved by including both a contractor and one or multiple installation experts into the design team from the start of the scope design. The basic idea is that by bringing in all important parties from the start of the design process a better, more optimal solution is found for the construction. This optimum is a combination of construction time, construction costs and total performance of the construction.

In a design team contract the employer enters in a single contractual relationship with each party of the design team, including a contractor and possibly even subcontractors for specific tasks. These are advisory contracts and are between the employer and one other party. Then to form the design team all parties together enter into a co-ordination agreement specifying the goals of the collaboration and indicating their willingness to work together to reach those goals.

The bouwteam contract has two models describing the relations between parties, on one hand the client engages in a principal-agent relation with each party and on the other hand all parties engage in a collaborative contract, covered better by the network theorem. The second contract

is interesting since the members of the bouwteam need to work together and trust each other to do that. The chance of conflicts is lower and true uncertainties can be dealt with swifter and more open. This also feeds into the number of constraints in the project, from the start the client gives insight into his budget, setting it as maximum while scope and quality are open to be defined by all partners. This allows for innovation but is also a risk for opportunistic behaviour.

This form of partnering is called project partnering, collaborating on a single project. Some companies are also experimenting with strategic partnering. Strategic partnering involves two companies who get into multiple projects together and share the risks of those projects. (Cooke & Williams, 2009) This thesis focuses on the design team contract as used in the Netherlands, which is best compared to project partnering. The biggest difference between a design team contract and a partnering agreement is the amount of involvement. With a partnering agreement both parties sign on with the same goal and often the same motives, while in a bouwteam contract all the contracting parties only sign to collaborate on the project but with their own goals still in mind.

In a design team contract all parties ideally should share the same goal, namely to construct the building. Key is to make this goal of interest to all parties; this ensures honest collaboration and ensures that all parties are on equal footing.

When all the parties share the responsibility for the design of the works, sound agreements have to be drafted about the design liability of the different partners. Often a single person or partner in the contract remains responsible for a small part of the design or for his own expertise area. The other partners can advise and critique on his designs or offer other solutions but this specific partner retains design liability for his part. He is obliged to take the other solutions and critique into account but can overrule it with probable cause.

Sometimes the contractor in the design team won't be the contractor to construct the work but often he is. When the contractor in the design team is guaranteed of acquiring the work after the design is complete, the element of competition is gone and agreements have to be made about provisions and profit margins to gain a price comparable to a competitive tender. In theory the benefits of the specialty knowledge useable during the design phase weighs against the loss of competition. When the contractor from the design team also acquires the work the original contract remains in effect, when another contractor is chosen to construct the works this often happens based on a traditional bid-build contract. The latter is an exceptionally rare occurrence since the contractor in the design team applied his own specialty knowledge to the design, another contractor might have very different methods and expertise. (de Ridder & Noppen, 2009)

The reimbursement in a design team contract is often based on a combination of cost plus fee and on incentive based payments. The total project costs are constrained by the employer's budget which is communicated from the start of the design. All parties work together to realize the project within budget and with normal profit margins for themselves. Thus cost is the biggest constraint and the idea is to maximize scope and quality. This demands trust between the parties and the willingness to attain the shared goals. The risks of the project are shared as is the profit or loss at the end. Often this is not with all partners but between the employer and the contractor, other parties only have an advisory role.

Evaluation

There has been a lot of research into the effectiveness of partnering or alliancing as it is sometimes called, Masterman (2002) gives a good indication of that. He continues to point out that most research is done in the USA and has shown widely differing results. The figures range from large increases in performance to very small increases in performance that could be attributed to other causes as well, however all researchers conclude that performance indeed increases with the design team contract. The same goes for cost and speed, both are observed to be lower but the exact margins are unknown. Most important feature is the diminishing of the adverse culture in projects. Companies work together, share expertise, communicate more freely and as a result have lesser conflicts and conflicts that do occur are solved easier.

The main benefits of the design team are:

- Use of contractors expertise on construction costs, methods of execution and products early in the design
- Designing and constructing parties share their views and knowledge
- Design and execution better tuned together, which decreases costs and speeds up construction
- Better budget control

The biggest drawbacks are:

- No competition in tendering, so there is no lowest price mechanism and the possibility of opportunistic behaviour from the contractor.
- Design responsibility is difficult to assign and control due to the multitude of contract partners

3.3 The design-novate-construct contract

This paragraph gives an overview of the design-novate-construct contract (DNC). The DNC contract is mainly used in the UK, Australia and Hong Kong and hasn't received much attention lately. It shares a lot of characteristics with the Aronsohn contracting vision and therefore is part of this comparison. Ng and Skitmore (2002) and Doloi (2008) both did an extensive evaluation of the DNC contract, this section is mainly based on their papers.

Overview

There are some who argue the design-novate-construct (DNC) contract is part of the design and construct contracting family while others have claimed it is a stand alone form. This thesis assumes the DNC contract is a stand alone contract, since the differences between a D&C contract and a DNC contract are rather big. Key idea of the DNC contract is that the design team commissioned by the client remains the design team for the whole design process, even when the contractor takes over the formal lead in the design process and the subsequent execution phase. The deed of this transfer of ownership over the design team is called novation and this is where the contract derives its name from. An overview of the contract form is given in Figure 14.

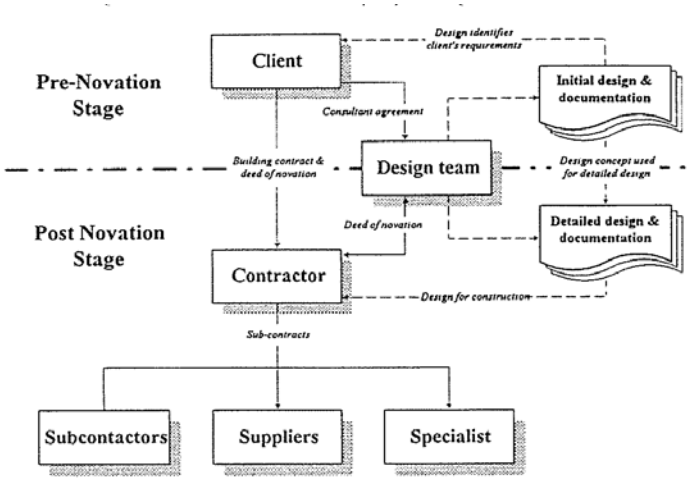

Figure 14 The design-novate-construct contract

The client starts by creating a design team to draft his terms of reference and an initial design with documentation for him. The design team is bound to the client under a consultant's agreement (DNR) at that time. Based on the terms of reference and the initial design and documentation a tender is held in which contractors submit a prize for the detailed design and construction of the project.

When the contract is awarded the design team together with the initial design is transferred to the contractor, the act of novation. With the original design team, the contractor finishes the design, drafts the execution drawings and constructs the building.

With the acceptance of the deed of novation the contractor assumes all responsibility for the work of the design team. This includes the work already done when the design team was still bound to the client. The contractor thus caries a significant risk if anything was done wrong in the first phase of the design.

The reimbursement for the contractor often is based on fixed price, the client pays him for the delivery of the whole project. The design team will have to be paid by the contractor as well,

often based on pre agreed rates per hour. When the deed of novation is done, the contractor becomes fully responsible for the reimbursement of the design team.

Fitting the DNC contract to the above derived theory of Turner is difficult. Since the design is split between two parties it is hard to give a precise mapping. Since a DNC contract has its roots in a D&C contract part of the answer can be drawn from there. First the often used fixed price contract points at a fixed price component, time is variable but has a constraint, the two independent variables are scope and quality. While the client uses the design team to lay down his initial terms of reference and the preliminary design he also gives the control of those aspects away at the moment of novation, in essence he draws the boundaries for scope, both minimum and maximum but lets the contractor free in how to fill those out in terms of quality.

The model best describing this contract is difficult, there is no real collaborative agreement between parties but the ownership of the design team changes. There are two phases in the process, first the client acts as principal for the design team, then the contractor acts as principal. This can be difficult for the design team and carries risks for both the contractor and the client. The client releases all control towards the contractor and the contractor faces the problem of being the second boss of a team with personnel he didn't choose himself but "inherited". To make this work the contractor should trust the client about the pre novation design and the client should trust the contractor not to compromise on the design after the novation.

Evaluation

Key idea is that by working with both the client and the contractor the knowledge and wishes of both parties are incorporated into the design but the problems when working with multiple designers are minimized. Furthermore it eliminates the costs associated with double design work and with interface problems when handing over the designs to another party. Masterman (2002) implies that the use of the (novated) design team ensures a swift progress through the design phase, while still including the operational knowledge of the contractor in the design as happens in a D&C contract. Masterman but also Doloi and Ng & Skitmore also raise a number of very specific drawbacks including:

- Loyalty to two bosses
- Forced team on the contractor's side might not work
- Client needs to employ external consultants to monitor the post novation design
- Inheriting of design faults by the contractor
- Cost reduction enforcement by contractor

The main benefits as sketched above are:

- Same design team throughout design and construction phase.
- Elimination of interface problems between client's and contractor's design team
- Reduction of overall costs associated with the design team

Multiple successful examples of project completed with a DNC contract exist but a study from the University of Reading (Bennett, Pothecary and Robinson, 1996 cited in Masterman, 2002) found it to be the worst possible form of D&C contracting. Doloi (2008) has very opposing findings; she concludes that when DNC is properly implemented it leads to lower costs, reduced time and better quality delivered. The benefits however are heavily dependent on the previous experience

with the DNC contract, which would explain why initial studies show so many problems with it, and the quality of the pre novation documents. Doloi even goes so far to propose to take in the contractor in the pre novation phase to enhance the collaboration and the performance of the design. Almost like a more standard design and build contract but with a client picked design team or like a bouwteam contract but then with market competion.

There are no standard contracts or general conditions defined for DNC contracts although the reminiscence with D&C is fairly high so any standard D&C contract with general conditions should be easily adaptable to the DNC contract, the biggest change is the novation and that needs to be documented well.

3.4 The design-build contract

The design and build contract is the farthest implementation of backwards integration of the executing parties that is investigated in this thesis. The goal of the contract is to bring all the work towards the executing parties. The client specifies his wishes and needs in a very broad and functional oriented way and the executing parties interpret this and turn it into a design. Basic idea is that all the knowledge is with one party and so the most benefit can be reached for both the client and the contractor, for the contractor it means working with his own design which can be tailored to his practise. The D&B contract goes a step further as the bouwteam contract with the idea to increase the efficiency even further.

Overview

Design and Build started as procurement method back in 1950 under the name of package deal. The name referred to the total package the building company offered the client in contrast with the more traditional fractured approached which was common then. The package deal projects never received much attention until the early 1980. The JCT drafted the first standard for design-build contracts and the economic changes drove the new form of collaboration up. From then on the use of Design-Build contracts has increased vastly. Currently over 30% of the total turnover in construction is realized with Design-Build contracts (Cooke & Williams, 2009).

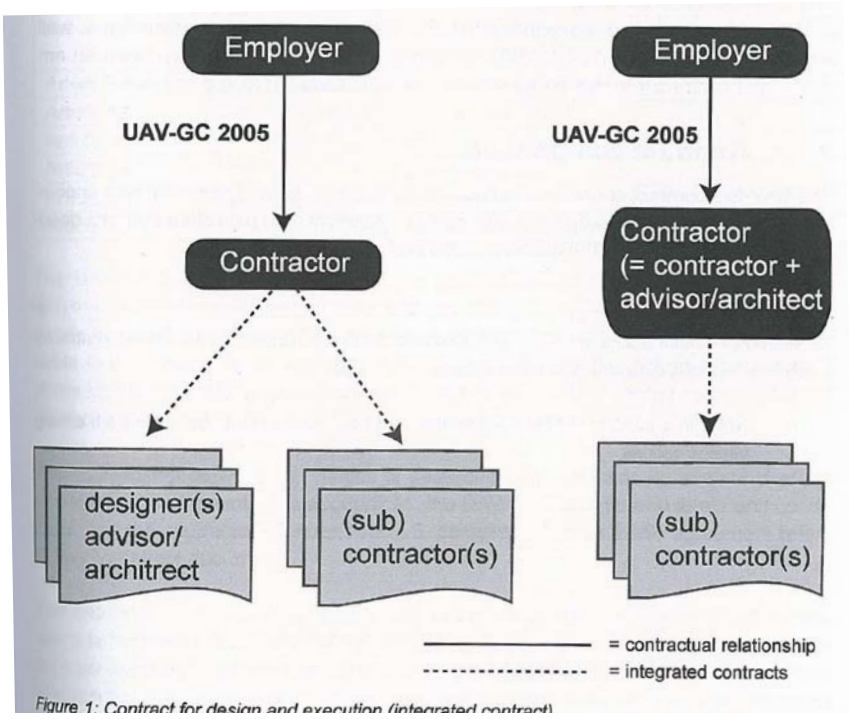

Figure 15 Design-build contract

The term Design-Build contract is in reality not one type of contract but a collective term for a number of contracts based on the same principle. The biggest variance is in the amount of design work the contractor performs instead of the client. Common forms range from Develop-Construct to Turnkey, the first deals with finishing the basic design of the client and build it while the second is drafting the entire design and building it. This thesis will focus on the "standard" design-build contract, in this contract the client, aided by advisors, develops a brief stating his requirements and objectives. This brief is then tendered. A number of contractors will draft a design accompanied by a fixed price for the construction of that design. Based on the design and price one contractor is chosen to develop the project.

In the design phase the contractor appoints consultants to draft the design for him or uses an in-house design team. Since the design team works for the contractor they can benefit from his

expertise on constructability and exploit chances with cheaper materials or new production methods. The client has the benefit of one single point of responsibility during both phases of the project.

During the construction the contractor is once again the only contractual partner of the client, implying a principal-agent relation. Any subcontractors or nominated contractors will be managed by the contractor. The client in principle has no influence on the design or the construction phase and the contractor is obliged to prove to the client that he is working with the minimal quality demands. For this he drafts a quality plan, which gives the client insight into the working processes, and he builds in a number of inspections to verify the plan and its execution.

In a traditional design-build the contractor takes on all the risks for the design and the execution of the works, in return he also gets total freedom to design the works. This freedom is off course limited to the requirements of the client but the client cannot change anything after the tender. The integration of design and construction should lead to quicker building and earlier completion dates while maintaining or even increasing the performance. This also translates into the constraints of Dobson and Feickert. The client specifies a minimum of scope to the contractor and leaves the other constraints open. Often price is limited by the amount offered by the contractor and time is limited by a fixed delivery date, quality is the loosest constraint. The idea is that the contractor can generate added value for both himself, profit, and for the client, more scope or better quality. This assumes a measure of trust in the contractor.

For any of the design-build contracts the general conditions are laid down in the UAV-GC 2005. These general conditions specify the rights of client and contractor in the different phases and how quality and oversight should be dealt with. Contrary to the contracts main idea, there is also a clause to allow for client induced change to the design in the execution phase. While the normal risk is all with the contractor the true uncertainties are for the client, however that distinction is often difficult to make and thus lead to fierce debate when uncertainties manifest. At the end often discussions arise over how to interpret the clients brief and parties can fall back in a traditional pattern.

Other forms of design-build mainly chance the amount of design done by the contractor or deal with the true uncertainties in the project. An accepted format battling these uncertainties is the design-build with repayable performance. Instead of spending a large amount of money on trying to predict the future, which is impossible, agreements are made on how to deal with the uncertainties. In a design-build contract with repayable performance a certain point on the performance-cost line is fixed, this point is decided upon by the tender. Further agreements are made that deal with how to compensate when performance increases and costs increase as well. This method deals with certain problems facing design-build contracts but it adds a layer of complexity and possible debates.

Evaluation

Design-build contracts have a number of unique benefits and drawbacks not found in other contract forms. Masterman (2002) summarizes them as follows:

Benefits:

- A single point of contact and responsibility makes communication easy and swift and infers a simple relation between the parties.
- With good requirements laid down by the client, lower costs and more price certainty for the client can be reached.
- The integrated approach to design and execution allows for shorter construction time and more efficiency.
- Contractor can apply specific expertise and knowledge to increase the performance of the project.

Drawbacks:

- When the requirements of the client aren't clear difficulties can arise in evaluating the different proposals by contractors.
- It is very difficult to change things when the contract has been signed. No formal way of accounting is in place for that.
- Certain less tangible values for the client, like architectural value, could disappear in pursuit of profit for the contractor.
- Contractor expertise is very important for the final outcome; inexperienced contractors could drive the price up.

Chapter 4 Comparing the Aronsohn contracting vision

This chapter details the workings of the Aronsohn contracting vision. An extensive overview of the method is given as well as a detailed discussion on a few specific aspects relating to the contract form and the tender. The description of the contract form is followed by the comparison with the other contract forms described in chapter 3. The final paragraphs contain the conclusions of the literature study, the comparison and present a number of hypotheses that serve as input for the rest of this research.

4.1 Overview

In this paragraph the general idea behind the Aronsohn contracting vision and an overview of how the vision works is presented. Both aim to give a basic understanding of the vision.

The idea

The first ideas for the Aronsohn contracting vision were centred on two key concepts. First is the financial insecurity of the client for a large construction project. The market for construction is very competitive, sometimes even beyond the point of fair competition. Companies go trough great lengths to acquire a project and sometimes even bid lower than the real price of a project. To make sure they still make a profit they try to get added work out of the contract, capitalizing on design mistakes and lack of knowledge on the part of the client/owner. This leads to low initial bid prices but to outrages claims of added work. The other way around the vision also works in periods with a stressed market, due to the inherent complexity of the projects and the risks contractors might decide not to bid, instead favouring easier and safer projects. With the Aronsohn contracting vision they have a chance to deal with the risks and the complexity early in the project and might be more prone to bid on the works.

The second key concept is the forward integration of contractor's knowledge. It is a generally accepted notion that contractors are always ahead on both technological and construction aspects of the execution. By adding their knowledge to the project earlier both parties can reap the benefits. The owner can get more quality for his money and the contractor can optimize his profit by reducing failure costs and by helping design a work that is easier to construct.

The vision is based around identifying and solving problems before they can arise or become critical. By identifying these problems early there is more time to solve them which leads to less conflict during the execution phase and possibly a better performance of the construction. Key point here is eliminating uncertainties in the execution phase by bringing them forward and dealing with them in a collaborative manner during the last stage of the design process.

The execution

The "Aronsohn contracting vision" is an innovative form of collaboration between owner/client, represented by Aronsohn, contractor and design team members. During the development of a building the tendering will start in an earlier stadium of the design process, the tender will be held on the basis of a Definitive Design+ (DO+). DO+ means that the basic design for the work is done and the performance demands are defined but the final specifications haven't been drawn up yet.

The initial design process to create the DO+ is called phase 0. After phase 0 a tender is held based on the DO+ design. In this tender bidders submit a price for two phases. The contract is awarded based on EMAT criteria mainly concerning quality and price.

The main design effort is made in phase 0. The client together with an advisor drafts his program of requirements and the architect will develop that into a preliminary design. The design process goes through multiple iterations, in which client and architect work closely together. Determining boundaries, like budget and local regulations. The architect drafts a design that satisfies the client's needs and lies between the established boundaries. Finally a definitive design is drafted and validated whether it is still in line with the customer's demands. This design and a number of quality specifications are the basis for the tender.

In phase A, the specifications phase, the contractor works together with the owner, the architect, the advisors and the nominated subcontractors to draft the final specifications. Together they ensure that the designs and the specifications are complete, uniform, unambiguous, without errors and feasible. The contractor has the chance to use his expertise to advice on materialisation and propose small improvements for the design. The basic design is set in stone but he can influence detail finishing, material use and the construction method. Of course implementing these chances can only be done in good collaboration and agreement with the other parties.

At the end of phase A the contractor signs an agreement stating that the specifications are complete, uniform, unambiguous, without errors and feasible and that the contractor ensures that those won't be the source of problems or changes during the execution phase leading to added work (claims). Any changes the owner wants to make during the execution phase can be implemented albeit with costs for the owner. After phase A the contractor will most likely be awarded a contract for phase B, the execution phase.

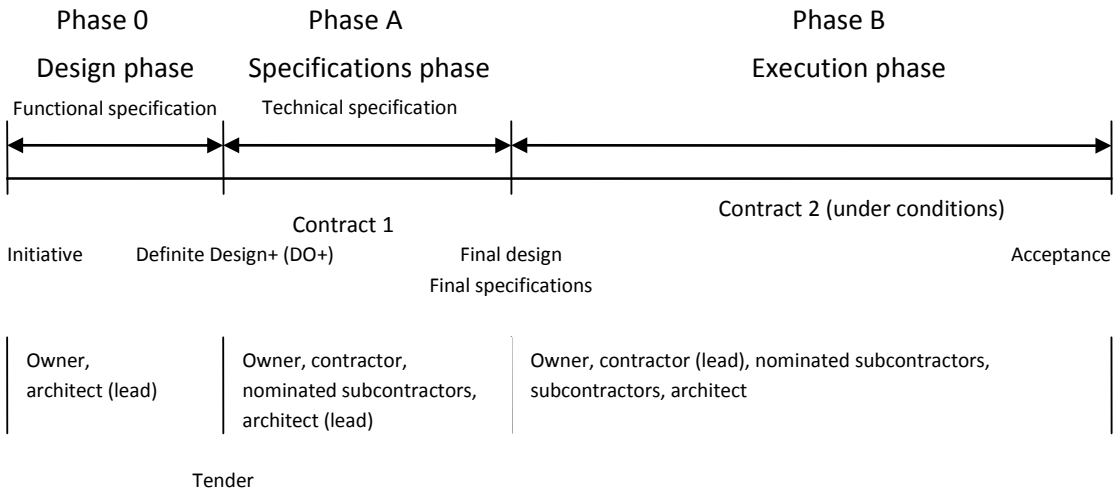

Figure 16 Visualization of the phases

Before awarding the contract for phase A a maximum price, based on the tender bid, is established for the final design. The contractor cannot deviate from this price, during the process in phase A. If this condition on price is met, the contractor has signed off on the specifications and he is in agreement with other terms, he will be awarded the contract for phase B. From this point

forward the contractor will be the managing contractor, leading the execution and managing the (nominated) subcontractors.

A visual representation of the contract form is given in Figure 16. For each of the phases mentioned above the important parties are noted. In each phase one party is considered leading; this means that this party has the formal control over the process in that phase. Off course the owner will always have final say in any decisions that have to be made. In most projects the owner is represented by Aronsohn Management, for clarity however this isn't put in the figure. Same goes for the advisors in phase A, they are considered to be managed by the client. In phase B the leading role transfers to the contractor including the contractual obligation to manage the nominated subcontractors.

4.2 Highlights

This paragraph delves further into the workings of the Aronsohn contracting vision. Emphasis is put on the tendering procedure, the contract and the used form of collaboration. Together with the previous paragraph this gives an in depth review of the Aronsohn contracting vision.

Tender

The first step of the Aronsohn contracting vision is the tender. After the initial design (VO) and the definite design (DO) are drafted the tender is initiated. The first part of the tender is analogous to a normal tender process. Since most projects are larger than the European thresholds, a European tender is started. First a public call for contractors is posted, detailing a number of criteria which the contractors should comply with. These criteria are mainly about the financial state of the contractor and about their experiences with both the kind of project that is tendered and the more innovative way of collaboration. Based on these criteria and the submitted documents of interested contractors, five contractors are invited to make a proper bid for the work. In specific projects those remaining contractors have received a small compensation for the work on their bids.

Their bids will not be evaluated solely on price but also on a proposed approach for phase A and phase B and on possible optimizations of the tendered work. This is called a tender under the Economically Most Advantageous Tender (EMAT) principle. Price is still a core component of the evaluation though, weighing in at about 90% of the total score.

Each individual bid is evaluated based on five criteria:

1. Price phase A
2. Price phase B
3. Program phase A
4. Program phase B
5. Optimizations

For this example an actual tender is used, figures and proportion deviate between tenders but the general method is applied with all tenders. The final score is determined by adding the prices of phase A and B together for each contractor. The contractor with the lowest total price gets 400 points, all other contractors get points based on their score relative to the lowest price. Their total price divided by the lowest total price times 400 determines their amount of points.

Then the approaches for phase A and B are scored. All proposed approaches are compared to the others on a one by one basis. When a certain approach is much better it gets 5 points, the other 0 points, when the two are comparable both get 2 points. Theses points are then totalled per contractor. This is done for the approach for phase A and for the approach in phase B. Finally the proposed optimizations are graded; this is done on the following criteria:

- Performance consequences
  - Architectural
  - Technical
  - Functional
- Time consequences
- Price consequences

Only optimizations with an impact larger than 5 ‰ are considered and only when they have a positive price component, so they lower the total price. For each of these aspects a score is given ranging from -5 to +5, with -2, 0 and +2 being the other options. The total of these scores determines the rating of this optimization. The sum of all optimization ratings are taken to the main evaluation.

At the end all the criteria are rated and the final evaluation is done. From the points for their price the scores for their approaches and half the total points of optimizations are subtracted giving a final score per contractor. The contractor with the lowest number of points has the best value for money and is awarded the contract. For an expanded example evaluation see Appendix A.

The contractor who offers the highest value for money is awarded the contract. This initially means the contract for phase A. After successfully completing phase A and complying with all demands he is awarded the contract for phase B.

Contract

From a legal perspective the Aronsohn vision uses a different contracting standard than other comparable methods. The forward integration of the contractor is usually incorporated with an UAV-GC contract, however due to the split between phase A and phase B the Aronsohn vision uses two contracting standards. One for phase A and one for phase B, this can be explained by the different roles the contracting parties have in those phases.

In phase A the main contractor works as an advisor to the client and therefore is given a normal advisors contract under the conditions of the DNR 2005 (sometimes the old RVOI 2001 or SR 1997). The other parties who collaborate in phase A also receive such a contract under the conditions of the DNR 2005, this include the nominated subcontractors and all the advisors of the client.

In this phase the architect is still the leader of the design team but the contractor already has a set of tasks he must complete. The objective of this phase is to finalize the design and draft the final specifications. It's the responsibility of the main contractor that these documents are complete, uniform, unambiguous, without errors and that the design is feasible. Furthermore the contractor is responsible for and obliged to work together with the design team to detail the construction planning and to incorporate any optimizations that were discovered during the

tender or during the course of phase A. Here the specialty knowledge of all parties is used to improve the design and to reduce the risks during execution. There is an incentive in place to stimulate the contractor to come with smart optimizations, 1/3 of the realized profit goes to the contractor as a bonus. The parties here collaborate on the design details and on possible optimizations, the collaboration is best described by the network theorem. Each party has a single contract which is a principal agent relationship but the overall form of collaboration is more akin to the network theorem. Each party has his own goals and the general goals in mind. This allows for creative solutions and collaborative thinking, the incentives that are in place serve to enhance this or to detract opportunistic behaviour.

Based upon the Definite Design a number of properties of the works is set in stone while others can be changed. The general outlook (architectural) of the works, the size and shape of the buildings and the baseline dimensions are fixed. During this phase the contractor should steer on architectural quality, technical quality and functional quality. The main purpose is to use the contractor's knowledge in the detailed design and in the construction planning.

At the end of phase A and part of the requirements to be awarded phase B is the confirmation that the design and the specifications won't be the source of added work during the execution. Despite the early involvement of the contractor and his responsibility in ensuring the quality of the design and the specifications, the architects and the other advisors still remain liable for any design failures that are discovered later. The contractor however is unable to claim any additional work based on the specifications as he guaranteed that those wouldn't be the source of any additional work. Off course reasonableness and fairness remain important, issues the contractor couldn't have foreseen remain a point of discussion and often fall to the client like a traditional added work. This guarantee is part of the contract documents for the commission of phase B.

In phase B the contract takes on a more traditional outlook. The contractor and the client have one contract detailing their relation. This contract is based on the UAV 1989, the standard conditions for a contract between contractor and client. The nominated subcontractors from phase A become official subcontractors of the contractor, despite article 6, paragraph 27 of the UAV. This means that the contractor assumes the full responsibility and liability for these subcontractors. Here the contract is an example of the principal-agent relationship. To make this even stronger the client picked subcontractors are placed under the main contractor who gets all responsibility over them as well. This ensures the client has one contact point during the execution.

The main objective in phase B is to construct the building and to manage the entire process. In this phase the design is fixed and changes can only be made by the client, these changes are called scope change. In collaboration these changes are evaluated and the impact on cost, quality and time are estimated as well as a possible reimbursement for the extra tasks. For these changes initiated by the client, the contractor gets rewarded based on an open budget.

The contract as a whole is fixed on scope and quality, those are established at the tender although the contractors have a small influence on those. The costs are fixed at the start of phase A, while time is the loosest principle, the contractor and owned decide on the planning together. All in all the control is rather strict in the contract form and the constraints strictly set.

4.3 Comparison with the other contracts

The Aronsohn contracting vision is compared with the other forms of contract described in 0. To facilitate this, a framework is drawn up encompassing the important aspects of contracting and collaboration. The criteria for this framework are based on literature on construction contracting. This framework is the extended basis for the comparison, at the end of this chapter a simplified table lists all the pros and cons of the different contracts and how they relate to each other. Based on that table a number of hypotheses are formulated that form the input of the interviews and case studies.

Description of the framework

For the comparison between the methods, a framework is constructed to facilitate an easy comparison. Key components of both contracting and collaboration are used to give an overview of the differences and similarities between the various forms of contracting. First the criteria of the framework are drawn from existing literature on procurement. Those criteria are clarified and defined for use in this thesis.

The intention of the framework is to provide an unbiased backdrop on which the Aronsohn contracting vision can be compared to the other standard contracts. The criteria are drawn form a number of works on (construction) contracting and serve to show the differences between the evaluated contracts. The criteria are rated per contract based on the literature and are all relative towards each other. They should not be used as absolute values.

Developing criteria

A great number of project management handbooks (Cooke & Williams, 2009) (Marsh, 2000) and a number of procurement manuals (Bower, 2003) (Walker & Hampson, 2003) detail the procurement process that is the lynchpin of tendering in the construction industry. From these works a number of general criteria describing a construction contract are lifted.

All authors share a general corresponding view of procurement but put emphasize different aspects as the most important. The defining criteria are the division of design work between client and contractor and the division of risks between contractor and client, inextricably linked to the division of risk is the means of remuneration. Masterman (2002) however argues that remuneration is not linked since any form can be taken with a specific contract, so they division of risks semi dictates the method of remuneration but doesn't enforce any specific form.

One other very important aspects of procurement is; who will have the lead in different phases, who reports to whom and the amount of power each party has after the contract has been signed. These are lumped together under organization. These three align nicely with the pillars of a contract devised in paragraph 2.2.

Different authors also name other important aspects, in decreasing order of occurrence:

- How to deal with work beyond the initial specifications
- How to deal with quality and quality control
- How liability factors into the contract
- Moment of tendering in the building cycle (often named as amount of uncertainty remaining)
- The use of incentives
- On which bases the contract is awarded to a contractor
- General conditions that might apply

It should be noted that the last three were only mentioned once or twice.

Presenting the framework

From the literature fourteen criteria have been chosen to be the most important in describing the contract. These criteria are grouped in five important overarching aspects for easy qualification, namely:

1. Scope
2. Risk/Cost
3. Quality
4. Organization
5. External

These groupings are chosen based on similar groupings found in the literature; most of them consist of one to three criteria. Below the criteria are presented and an overview on how they are used in the framework of this thesis is given. The actual completed and filled in framework can be found in Appendix B.

I. Scope
   1. Influence on the scope design (subdivided per party)
   2. Influence on the engineering design (subdivided per party)
   3. Responsibility for design failures
   4. Additional work

II. Cost/risk
   5. Financial risk (subdivided per party)
   6. Liability
   7. Reimbursement
   8. Incentives

III. Quality
   9. Quality control

IV. Organization
   10. Moment of tendering in the building cycle
   11. Party leading the design
   12. Organization model

V. External
   13. Award criteria
   14. General conditions

Describing the criteria

Influence on the scope / engineering design

Design can be broken down in two important parts during the project; the first is scope design or design of the terms of reference, the second is the engineering or detailed design. Scope design takes place at the start of the project, the client specifies his requirements and those are translated into the terms of reference by either an advisor, an architect or the main contractor. Engineering design focuses on the detailed design of the project. In this design step the conceptual plans are developed into actual drawings and plans for the execution. Depending on the contract form this can be done by either the contractor or by the architect or a combination of both. Masterman (2002) lists four criteria often used to categorize procurement systems. He continues to use the interaction between design and construction as the key identifier when choosing a procurement system. Also Marsh (2000) lists the division of design influence as one of the three aspects a client has to decide upon when choosing a contract form.

Normally both the contractor and the client have an influence on the design, however dependent on the contract form their influence may be smaller or larger. These criteria are broken down in three parties for which this is most applicable; Contractor, Client and (Nominated) Subcontractors. Subcontractors are included since they can influence the design in certain methods, advisors are assumed to be on the client's side.

For each of these parties is determined; how much, if any, influence they have on both the scope design and the engineering design. For each party is listed: how much they can influence this process. Input is based on a five point scale ranging from none to all, encompassing low, medium and high influence.

Responsibility for design failures

Depending on the contract different parties can be liable for failures in the design phase. This criterion covers those failures. These often manifest as hidden defects and can have disastrous consequences. The party or parties responsible will be mentioned including any possible restrictions on their responsibility. None of the authors explicitly specify this criterion but all acknowledge it is part of the general conditions that apply, see for instance Cooke and Williams (2009) who use design risk as part of the evaluation of all contract forms.

Additional work

Additional work, meaning work outside the original design, can be divided into two distinctly different kinds; added work and scope change. Rowlinson (1999) calls both together the flexibility or the need for variations when the project has started. Variations can originate from both parties but are limited by the certainty of the design. The first is actual added work due to design failures, incorrect drawings and interface or alignment problems between contractors or designs. Often these are the result of lack of collaboration or inconsistencies in the design. Contractors haven't accounted for the extra work that is involved with solving these problems so they claim extra time and money from the client as compensation.

The second, scope change, comes into play when after the design is finished and fixed, the client wants to add extra features. This happens most often when progressive insight is gained during the project or due to the incorporation of special wishes that are added last minute. Technological advances during construction are also sometimes a reason for scope change. Scope change is always client driven and will always have to be negotiated with the contractor to establish a suitable price and possible time compensation. This criterion defines if additional work is possible and how it will be dealt with between the parties.

Financial risk

Walker & Hampson (2003) use the notion of cost and risk to underpin their whole theory of procurement selection. They argue that the contract form is mainly characterized by how the risks are divided between parties and how these risks are paid for.

This criterion states how large the financial risk is to a certain party. Financial risk is defined as the possibility to incur extra costs over the expected amount of costs for the project. So for the client that would mean costs over the total building expenses, for the contractor it would mean costs on top of the already budgeted costs. This criterion establishes which party is most prone to incur extra costs in the project due to unforeseen risks and outside circumstances. This financial risk is closely related to the method for remuneration laid down in the contract, as discussed in paragraph 2.2. Here per party an indication is given on a five point scale, ranging: none, low, medium, high and all.

Liability

As discussed earlier in this thesis, liability follows from the being given a task. When the entire project is seen as a single task one or multiple parties have to be liable for any risks that fire. Liability is closely related to financial risk, but not entirely the same. Financial risk can be shared while only a single juristic party can be liable. Cooke and Williams (2009) make the distinction between commercial risk and execution risk. The first is the financial risk as detailed above, the second is liability. Being liable is defined as *being responsible by law*, which means that being liable can create obligations towards other parties. This criterion defines which party is liable for what happens at the works.

Reimbursement

While Masterman (2002) reasons that the method of reimbursement isn't a leading factor in the defining of contracts it is included as a criterion here. Others, namely Janssens (1991) and Bower (2003) have argued that it is an integral part of the procurement process and has a large influence on the contract, especially when coupled with an incentive scheme. Since both points have their merit and indeed the same contract type can have multiple forms of reimbursement, the most common type of reimbursement will be listed in the framework. It will be stipulated whether this is the only available reimbursement type or whether others are possible too.

Incentives

According to standard economic theory persons and organisations only do something when it is in their own interest, next to that parties are also seen as amoral and opportunistic. According to Bower (2003) this is the key concept behind incentivisation in construction contracts. For all parties involved being willing to take that extra step a method of incentivizing has to be in place. This can range from handing out a bonus if the contractor finishes ahead of planning, to share part of the profit on the project or to the awarding of extra works.

There is a myriad of possible incentive schemes, all with various methods to achieve collaboration or other similar goals. All these methods can be distinguished on two different key aspects, mainly: bonus-malus and active-passive. Winch (2002, chapter 6) gives a good insight into the theorem behind incentives and on the criteria needed for incentives to work.

Bonus-malus concerns rewarding parties for a job well done or penalizing them when the job is done badly. Most methods focus on either bonus or malus but combinations also exist. The distinction between active and passive is somewhat less clear. A passive incentive is an incentive that one of the parties cannot actively strife for but that is used as a stick. For instance a penalty if the party doesn't deliver the necessary documents. If they don't show effort to collaborate they won't be considered for the next contract. An active incentive is a goal where a party can actively strife for, they can earn it, but must put effort towards it. For instance finishing early nets them a bonus. In the framework will be explained if and how incentives are used in the listed contracts.

Quality control

During the execution of the works all parties are obliged to work to certain standards of quality. These standards are often determined at the start of the construction, either by building law, special norms or as specific demands in the contract. One of the parties in the contract is in charge of testing and proving that a minimal level of quality has been reached.

Often the contractor has the obligation to prove that he has reached the minimal quality but it is also possible that it's the duty of the client to ensure that the contractor reaches the minimal quality. Certain contracts then also hold the clause that the client may check on the contractor but then automatically resumes responsibility for the things he checked. Harris and McGaffer (2006) describe the different forms of quality management in great detail, making the distinction between quality assurance and quality control. Quality control deals with maintaining and checking on the quality, quality assurance is proving that a certain quality standard is attained. Quality assurance deals with the systems that assure that the needed quality is delivered. This criterion gives insight into how quality control is agreed upon, in the framework will be listed how the quality control is arranged and which party is responsible for it.

Moment of tendering in the project life cycle

In new and innovative contracts tendering often takes place before the final design and the specifications are completed. The moment of tendering is a big factor in determining how much other parties can influence the design process and how much the different phases can overlap (Rowlinson, 1999, p. 45). The project life cycle can be divided in a number of phases. A short summary of the phases is given below.

The standard project life cycle starts with the idea to construct something, most often as a solution to a perceived problem. This first moment is called the initiative and the corresponding phase the initiation and concept phase. In the initiation and concept phase different ideas are developed with the goal to come to a solution for the problem that was perceived. At the end of the initiation and concept phase a clear idea has been formed what the solution would be and how it looks. Then in the design and development phase the idea (or ideas) from the initiation and concept phase are further developed and turned into real designs, including specifications. Based on those designs a tender is held and a contractor is selected to construct the building, this is the tender phase. Final phase for this comparison is the construction phase, the designs are constructed and at the end the building is turned over to the client.

More holistic approaches to the (project) life cycle exist, these include the whole life of the building, but for simplicity these are not mentioned here. Those other phases have no direct impact on the contracts that are being compared.

Party leading the design

If there are multiple parties collaborating on the design, one of them needs to be in the lead. While ultimately the final decision is always in the hand of the client this party makes all the executive decisions and is in charge of managing the process and bringing it to a successful end.

Organization model

When parties work together they can do that in different forms. The two extremes are competitive and cooperative. In a competitive collaboration parties might work together but have opposing goals, a contractor strives to maximize his profits while the client strives to minimize his costs. While in cooperative collaboration the goals of both parties align. During collaboration a certain party will be the formal lead. Depending on the form of contract and collaboration these roles could shift or parties could be equal. Bower (2003) even goes as far as describing all the different standard forms of contracts by their organisational form and the division of power. This criterion describes how the relationship between the parties is laid down in the contract. Either by description or with a graphic overview the organization model is clarified, detailing the relations between parties and the formal distribution of power.

Award criteria

When awarding a contract through tendering multiple methods can be used to evaluate the bids of the contractors. This criterion describes the most used one for this specific contract. Only Cooke & Williams (2009, p. 24-25) and Walker & Hampson (2003) specify this can influence the contract. They mostly aim on whether or not there is any competition in the tender and whether or not aspects other than price are important. The basic choice here is between a lowest price tender or an EMAT tender, in case of the latter the main criteria will be specified.

General conditions that apply

For all the standard contracts in the construction sector general conditions have been drafted. Only Bower (2003, p. 69) references the general conditions at all. He argues they clarify grey areas in contracting and their usage leads to fewer misunderstandings. This criterion states which general conditions apply to the contract. There is a choice of four:

- DNR 2005; specifying the relation between client and his advisors
- UAV 1989; specifying the relation between client and contractor in a traditional contract
- UAV-GC 2005; specifying the relation between client and contractor in a contract in which the contractor has been responsible for part of the design.
- Model building team agreement 1992; specifying the relations between all parties in the design phase of the building team agreement.

4.4 Comparison using the framework

This paragraph discusses the preliminary results from the literature study regarding the Aronsohn contracting vision and the comparable methods. Obvious differences are explained and the pros and cons are discussed. Here a baseline idea is developed on whether the Aronsohn contracting vision offers added benefits over other contracting methods and where those benefits manifest themselves. These ideas form the base for the case study and the interviews to validate whether those suspected benefits indeed surface when using the Aronsohn vision.

Influence on the scope design
For the traditional contract and the Aronsohn contracting vision the client has all the control, together with his advisors he draws up the scope design and uses that to tender the project, although when using the Aronsohn vision the contract has a small amount of room to influence the scope after the tender. When using a DB or DNC contract the client loses some influence on the design since the other parties are engaged earlier in the process, this loss of influence is even larger in a bouwteam when the contractor actively shares in drafting the scope.

The contractor and subcontractors in general have little influence on the scope design except in a bouwteam where they are an equal partner. In a DB and DNC project the contractor can influence the scope in a small way since he can interpret the contract documents differently than the client. In a traditional contract and in the Aronsohn contracting vision the scope design is finished before the contractor is appointed so he can only follow. The influence of the subcontractors is largely based on the room he is given from the main contractor. In a DB and a DNC contract he could be asked to help the main contractor, in this case his influence is low, otherwise it is none. In a bouwteam he often takes a seat in the whole process as equal partner, like a secondary contractor.

Influence on the engineering design
This is the realm of the contractor and subcontractor in most projects. The influence of the client is limited by choosing materials or a preferred execution method, however the contractor usually has the last word on this. In a DB the contractor is the sole influence although he often uses his subcontractors as well. In a bouwteam the client and contractor both have influence but the contractor has the upper hand due to his experience. The Aronsohn contracting vision is special here since it not only gives the contractor a large influence but also the subcontractors, even the client keeps a small amount of influence here. In the other contracts the subcontractor is at the whim of the contractor when it comes to influencing the engineering design, often though he gets to do the engineering design on his specialty works as part of the subcontracting.

Responsibility for design failures
Most contracts establish firmly who is responsible for design failures, often this is the party in charge of the design. For the traditional contracts the architect and the advisors are responsible since they have drawn up the designs. The Aronsohn contracting vision keeps this responsibility as well but adds a check by the contractor on the final design and specifications. While the architect and advisors remain responsible the contractor signs for the completeness and correctness of the contract documents taking on a limited responsibility as well.

In a DB and a DNC contract the contractor takes the full responsibility for the design failures, in a DNC contract even for the failures made when the design team still worked for the client. In a bouwteam contract the responsibilities are often shared between the parties or attributed to the specific designer who was responsible for the part of the design contained an error.

Additional work

Added work is only possible in a number of contract forms. In the DB, DNC and the Aronsohn contracting vision the contractor cannot claim any additional work. This is impossible since in the first two contracts he was also involved in the design while in the last there is a specific clause in the contract in which the contractor agrees that no added work claims can be made based on the contract documents. There is an exemption though for claims based on events that couldn't be foreseen. The traditional contract uses claims by the contractor in which he states the extra costs and time needed for the added work, in a bouwteam a collaborative solution is found for added work.

How the project deals with added work is closely related to how the reimbursement is arranged so the listings in the table represent the most common clauses per contract form.

Scope change breaks down into two possible ways, all scope change is cost based and either client driven or contractor driven. In the traditional contract and in the Aronsohn contracting vision the client can always order scope change, the contractor will give the consequences and the client decides whether those are worth it or not. Contractor driven scope change only occurs when the contractor proposes an optimization and the client agrees on it, effectively turning it into client driven scope change. Using a DB or DNC contract the client can only ask the contractor if he is willing to go along with the scope change, if so the same procedure is followed as with the traditional contract. Contractor driven scope change can be done without approval of the client as long as it remains within the terms of reference. The bouwteam contract is the exception since the client and contractor collaborate on the project a collaborative solution has to be found, in bouwteam the difference between scope change and added work is rather small.

Financial risk

The financial risk in the project is divided between the contractor and the client and the division is closely related to the method of reimbursement. The division listed in the table is an indication based on the most used method of reimbursement. The financial risk is never entirely with one party but often a large part lies with one.

The traditional contract puts the risk with the client, the contractor can claim added work and if things go wrong the client is often responsible. The other contracts put more risks with the contractor, often based on the fact that he had more influence on the design or is unable to claim added work. The bouwteam contract is an exception where all the parties share the risks, often the client indicates a budget and will strive not to cross over that so with good control he hasn't got much risk, the contractor knows what more he can claim so his risks are limited too. While the risks for the contractor initially are high in the Aronsohn contracting vision, he has the chance to lower those during phase A of the contract. Interesting is that the Aronsohn contracting vision is the only method which also directly involves the subcontractors, often they are only at risk through their contract with the main contractor and not directly.

Liability

In a traditional contract and in the Aronsohn contracting vision the client and the contractor are both liable for certain aspects of the project. The specific division of this liability for the traditional contract is put down in the general conditions. In the Aronsohn contracting vision the client has a limited remaining liability due to the contractor signing off on the design at the end of phase A. In a bouwteam contract all parties share in the liability, while in the DNC and DB contracts the contractor takes on all responsibilities.

Reimbursement

Traditional contracts are almost always reimbursed based on a fixed price. The same goes for the Aronsohn contracting vision although it can be argued that during phase A there is a maximum price based on the bid which turns into a fixed price at the start of the execution. The DB and DNC contracts often use a fixed price but there are also a myriad of other possibilities including the financing by public and private parties or with exploitation schemes. Bouwteam is often based on the actual costs where all parties share the profits and losses accrued in the project.

Incentives

Incentives are often added to the more innovative contracts to stimulate the contractor to work with the other parties. Most traditional contracts don't have real incentives although sometimes passive malus incentives, fines, are put in the contract. DNC and DB contracts sometimes contain a form of incentives, but the possibilities vary widely per contract. The Aronsohn contracting vision incorporates two distinct incentives; a passive malus and an active bonus. The first one is to motivate the contractor to perform his budgeting tasks in phase A while the second is to stimulate the contractor to come with possible improvements to the design. Phase B is more akin to the traditional contract when it comes to incentives.

Quality control

Quality control is divided in two possibilities, either the client checks on the contractor or the contractor has the obligation to prove the quality to the client. In the traditional contract and in the Aronsohn contracting vision the client checks on the contractor, this is often also the case in a bouwteam although a collaborative solution is used as well. In the DNC and DB contracts the contractor has to prove to the client that he complies with all quality standards.

Moment of tendering in the building cycle

The moment of tendering influences a lot of other aspects as well, mainly the influence on the design and the liability. Bouwteam contracts are often tendered based on just an idea. The DB and DNC contracts can be tendered at different moments and this is often a point of discussion, in general the DB contract is based on the preliminary designs or even earlier while the DNC contract gets tendered somewhere between the preliminary and final design. The traditional contract is tendered when the definitive design is completed and the tender is based on the specifications. In the Aronsohn contracting vision the tender is based on the definitive design but the specifications are only in draft available to specify the minimum quality.

Party leading the design

This criteria is once again closely linked to the amount of design influence a party has in the contract. In a traditional contract and in the Aronsohn contracting vision the client is in charge of drafting the design. In a DB contract the contractor takes charge of the design, while the DNC contract forms a middle ground, the client starts with the design and is halfway replaced by the contractor. It should be noted that the design team doesn't change, only the formal lead changes. In bouwteam all the parties together take the lead in the design.

Organization model

The organizational model is important for the distribution of power between parties. The principal-agent model is used in the traditional contract, the Aronsohn contracting vision, the DNC contract and in a DB contract. The Aronsohn contracting vision also incorporates a collaborative model in phase A, just like the bouwteam contract.

Award criteria

The traditional contract is almost exclusively tendered with a lowest price system. The other contract forms almost always have other important aspects incorporated in the tender as well. The DB contract is often based on a sample design and on plans for the process. A bouwteam contract is tendered based on the hour wages of the contractor and on the vision he presents for the project. DNC tenders often incorporate quality as an aspect but also use lowest price now and then. The Aronsohn contracting vision is based on price, plans for collaboration and execution and on possible improvements to the design.

General conditions

Here for each contract the governing general conditions are listed. Of note is the fact that the Aronsohn contracting vision uses the UAV and not the UAV-GC which is specifically drafted for collaborative contracts. The DNC contract isn't used in the Netherlands but the best approximation would be the UAV or the UAV-GC.

4.5 Conclusions of the comparison

Using the frameworks as a basis the Aronsohn contracting vision is compared to all the other contracts and given a place between them. The main differences with the different contracts are presented and these are used to formulate a number of hypotheses in the next paragraph.

Traditional contract

Compared to the traditional contract the Aronsohn contracting vision has quite some benefits. The client keeps a firm control on the scope design of the project and participates with the contractor on the engineering design, this ensures the clients wishes are safeguarded but that the contractors knowledge can be applied to the project. Furthermore the client is protected against added work claims and has transferred a small part of the design liability to the contractor. Based on the contract for phase B the financial risk for the client is low and his liability limited, giving him more security and certainty. Through the collaborative approach in phase A the client can benefit from the contractors inclusion but the principal-agent relation in the execution phase ensures tight control and a single point of contact. By including incentives and award criteria based on more than just price he stimulates the contractor to participate.

Bouwteam

The bouwteam contract compares really well to the Aronsohn contracting vision but is different in a distinct way. Instead of a collaborative process for both scope and engineering design the Aronsohn method only uses a collaborative approach for the engineering design. This can be both a pro and a con for the client; there is less room for innovation but more control of the client on the scope design.

Biggest change from the bouwteam contract however is the competitive tender based on price, if a bouwteam contract is tendered it is often based on a vision and the hourly rates, while the Aronsohn contracting vision features a full competitive tender based on the design. The risks and organization are really different in the two contracts, the bouwteam contract has a shared risk pool between all parties while the Aronsohn contracting vision has a strict risk policy. For the client this means less exposure but the contractor has more risks. In phase A the Aronsohn vision and the bouwteam contract both operate in a collaborative form, in the bouwteam contract the collaboration remains throughout the contract leaving lots of possibilities for opportunistic behaviour; the Aronsohn vision changes the organization to a principal-agent relation at the start of the execution, limiting the risks for the client. The moment of tendering differs as well, for a bouwteam contract the tender is really early in the project while the Aronsohn vision tenders based on a almost completed design. The first has the benefit of contractor knowledge throughout the design but leaves room for the contractor to sit back and relax and is difficult to do in a competitive tender, the second has enough substance to base a competitive tender on but limits the use of contractors knowledge to the engineering design.

Design novate construct

The Aronsohn contracting vision and the DNC contract share a lot of features but differ on one key point. The scope design is governed by the client in both methods and the engineering design is done by the contractor however the DNC contract transfers all control to the contractor after the project has been tendered. This leaves the client without a means to influence the contractor or to “protect” his design. The moment of tendering is also slightly different, the DNC contract is often tendered earlier in the design process. Additional work is impossible since the contractor takes on all design responsibility during the novation, the client loses some control but gains security. With this responsibility the contractor picks up quite some risks, in the Aronsohn vision the contractor also picks up some added risks due to the no added work claims clause but he has the possibility to remedy those in phase A.

Design build

The comparison with the de DB contract is difficult, since the idea of the DB contract is to tender very early in the design process while the Aronsohn vision tenders rather late. The client looses almost all influence on the design but can benefit the most from the contractor’s involvement. All the risks are tendered along to the contractor so a DB contract gives a lot of security to the client but also the loss of all control and the risks of the building not ending up like he imagined. The single contractual relation makes it easy for the client, he puts the work to tender and then only has to work with one party. There is no additional work and the contractor works for a fixed price, when the client wants to initiate scope change it is for the contractor to decide whether or not to go along with this.

Conclusions

From the literature and the above comparison it can be concluded that the Aronsohn contracting vision is a mix of the bouwteam, DB and traditional contracts. The early involvement of the contractor and the abolishment of added work claims make it like a DB contract while the strict roles in the execution phase are more like a traditional contract. The collaboration in phase A is reminiscent of a bouwteam contract approach. Placing the contracts in order the Aronsohn vision would fall between the bouwteam contract and the DNC contract.

This based on the viewpoint from a client perspective. It offers more contractor involvement than a traditional contract but less than all the others, however it protects the client from opportunistic behaviour and keeps the client in control of the design. This can be better than handing all the design work over to the contractor when the client is very informed about his wishes and the possibilities. The client misses the chance to let the contractor propose large innovative changes, regardless bringing in contractor knowledge earlier can benefit all parties.

The collaboration in phase A should prove to assist in trust building between the parties and lead to the easier resolution of conflicts during the execution. The design can be optimized, leading to less overall risks in the project and to a better planned execution with fewer problems, leading to lower failure costs for the contractor and more security for the client. The project is prepared better so can be delivered more easily on time and within the budget.

The tight control of the client can be both a pro and a con. It brings safety for the client but he risks forcing the parties back into a traditional mindset in phase B, deteriorating the collaborative effects of phase A. The fixed price brings security and (early) certainty for the client but can be pressing on the contractor.

4.6 Hypotheses Aronsohn contracting vision

This paragraph summarizes the hypothetical pros and cons of the Aronsohn contracting vision. These pros and cons are derived from the framework discussed above and from general comparison between the different contract forms. The pros and cons are discussed here and the idea behind them illustrated. Further research, namely the case study and the interviews, should prove whether or not these assumptions are correct. For now they are used to direct the questions in the interviews and to focus on during the case studies.

The possible benefits

In the table above the hypothetical pros and cons of the Aronsohn contracting vision are listed.

Pros	*Cons*
• Lower price uncertainty for client • Earlier price security • Low financial risk for the client • Reduction of risks in the project • Less failure costs for contractor and subcontractors • Use of specific contractor and subcontractor expertise during the design • Smoother execution phase due to less problems • Higher chance to adhere to planning on budget and time • Easier conflict resolution • Client remains in control throughout the whole process	• Tight control of the contractor • Chance to fall back into competitive roles • Design is mostly fixed save for detailing • Less room for innovation

Table 1 Pros and cons of the Aronsohn vision

The most important benefit of the contracting vision is the possible reduction of risks for the contractor, the subcontractor and the client. These risks are reduced by the increased collaboration and synchronizing between the partners in phase A. This reduction leads to a number of derived benefits for all parties. The client can profit from an earlier certainty on the final price, as well as a lower uncertainty during the process, this all leading to less financial risk for the client.

The alignment of the designs and between the parties makes for less failure costs during the execution and allows for contractors expertise in the design. This all should lead to a better execution with fewer problems, and should these problems occur, the collaboration and trust building in phase A should make the resolution of conflicts easier. Together this leads to a higher chance to deliver on time and within budget.

The client staying in control throughout the process can be seen as both a pro and a con. The pro is that the lines stay short, the responsibilities are clearly defined and contract remains an essential principal-agent construction. Problem is that the parties can easily slip back into

competitive roles which deteriorate the benefits gained from phase A. The other con of this is that the contractor can feel like the lesser party, not having much room to work and being pressured by the client to comply to certain demands. This tight control is also seen in the amount of design room the contract, the contractor can apply his knowledge of the execution to the project but can't do much else. This breeds security for the client but also limits the amount of innovation possible.

Part 2 Practical study

Chapter 6 Overview of projects

This chapter details the four different projects that were analysed in the case study. A brief description of each project is given as well as the main reasons for using the Aronsohn contracting vision. For completeness a short description of the baseline projects is also provided.

6.1 Elementary school "De Springplank" Vught

Figure 17 De Springplank

The renovation of elementary school "De Springplank" is the smallest project in this case study. With a building sum of just over 1,5 million Euros (excluding VAT) it is a relatively small project. The renovation was part of the Integral Housing Plan of the municipality of Vught. This plan consisted of the renovation and modernization of three schools in the municipality. Most of the buildings were aged and needed to be renovated to comply with modern building law. The case study only focuses on one of the three schools, namely "De Springplank", however some observations regarding the other two schools also feature in this part of the case study. The choice to only focus on one school is made to limit the amount of interviews needed, including the other schools would add at least six extra interviews which would cost a lot of time.

The project started in November 2007 in the middle of a booming market. Due to the relatively small size of the projects and the risks coming from the renovation, Aronsohn feared that no contractors would bid on the works. Therefore, based on an advice from Aronsohn Management, the municipality opted to use the Aronsohn contracting vision, hoping that contractors would be drawn to the chance to have influence on the design. Aronsohn visited a number of local contractors and explained the method to them and asked whether they would be interested in submitting a bid. In the end all invited contractors placed a bid despite the market conditions.

Despite some problems with the subcontractor responsible for the mechanical installations the project went well. It was delivered according to planning and within budget.

6.2 Vliegtuighal Aerospace Engineering Delft

This project was part of a larger project to modernize the faculty of Aerospace Engineering in Delft. The main building was refit with rooms for experiments and an extra building was realized next to the existing buildings. The case study only deals with the renovation and with a small extension on the roof of the existing building of the project. With a total cost of 3,8 million Euros it's still a small project but considerably bigger than "De Springplank".

Figure 18 Faculty Aerospace Engineering

This project was the first ever to be completed with the Aronsohn contracting vision. There are two reasons the vision was used; one was the fact that the project was highly complex and the second was that it needed to be more attractive for contractors to bid on the project. The complexity stemmed from the fact that the renovation had to be done while the building remained functioning, a high degree of phasing was needed to get this done. Another reason for complexity was that a rather large proportion of the total work was installations.

The new way of contracting was a bit of trial and error for all parties involved but in the end worked really well. The project was delivered on time, within budget and with minimal disruptions to the normal procedures in the building.

Figure 19 FNWI

6.3 Faculty of Science Amsterdam (FNWI)

This is the biggest project in the case study, with a total building sum of 114,4 million Euros it dwarfs the other projects. The project consists of both renovation and green field construction, it's a mixed and complex project. The project encompasses offices, laboratories, practical and educational spaces divided over a total of one greenfield building and three renovations. The project started early 2003 and was initially intended to be tendered traditionally. Last minute spending cuts however were the cause of a redo of the design process. The complexity and size of the project were huge risks in a traditional contract so another solution was needed. So Aronsohn developed the Aronsohn contracting vision to deal with these risks.

A total of three different architectural firms worked together to do all the design work and a large number of subcontractors were working at the site at one time. The project has recently been completed within budget and with only a small delay. The execution went without any serious problems and besides a large disagreement about asbestos cleaning, no conflicts disturbed the project. The Aronsohn vision is initially developed to manage this project and according to Aronsohn Management has proven to be effective.

6.4 Amsterdam University College

The Amsterdam University College is a greenfield construction project that has yet to be build. The tender for the project is just finished and contractors are selected. The AUC project is a relatively small educational building specifically designed to house a new collaboration between the Free University and the University of Amsterdam. The project is a mix of educational purposes and informal meeting purposes all too support the new bachelor's degree focussing on the mix of liberal arts and science. The design consists of educational rooms, various study places and meeting rooms.

Figure 20 Artist impression AUC

The AUC project is not part of the case study to evaluate the Aronsohn contracting vision. The project is used to evaluate how contractors view the method when confronted with it in a competitive tender and whether they made any changes to their bidding strategy.

6.5 Baseline projects

Nine projects have served as a baseline for the comparison between a traditional contract and the Aronsohn contracting vision. These projects are selected from the portfolio of Aronsohn Management based on size and type of building. To keep in line with the projects selected for the case study most are educational buildings or closely related to an educational institute, falling in a price range from 3 to 25 million Euros. The following projects are used:

- Construction of a research institute with offices and research facilities in Amsterdam
- Construction of a university building with labs and offices in Eindhoven
- Construction of a university building with labs, clean rooms and offices in Eindhoven
- Construction of an educational building with offices and a new restaurant in Delft
- Construction of an office building in Utrecht
- Redesign and rehousing of a research institute, mainly offices and a small library in Delft
- Redesign of an educational building into a student facility and offices in Delft
- Renovation and construction of a educational building with labs, ateliers, offices and educational rooms in Eindhoven
- Renovation of a high tech data centre in Amsterdam

The names of these projects aren't disclosed for confidentiality reasons.

Chapter 7 Quantitative Case Study

This chapter details the results of the quantitative case study. The results of the financial and planning analyses are presented and the findings of analysing the project reports are documented. At the end of this chapter general conclusions are drawn from the results. These will serve as handholds for the further study of the projects during the interview round.

7.1 Financial Benefits

For the baseline projects and for the projects managed using the Aronsohn contracting vision an in depth analysis of the construction costs is done. By analysing the estimated costs at the start of the project and comparing them to the amount of additional work a measure is devised of how much additional work is assumed common for a project. A distinction is made between two sources of additional work; the first being scope change and the second being added work. Scope change is initiated by the client and seen as a beneficial and wanted change. Added work can be initiated by either the client or the contractor, though the client has the final say, and is seen as a necessity to fix a failure in the design or to deal with an unforeseen problem often this change isn't wanted.

The nine baseline contracts were managed with a traditional contract so any changes to the design needed to be cleared with the contractor and are billed separately. For these traditional contracts the total building sum, excluding VAT and other indirect costs, is listed and the costs for both scope change and added work, together forming the total additional work are presented. The last three figures are presented as a percentage of the total building sum to account for the different sizes of the projects. Table 2 gives an overview of the numerical data for the baseline projects.

Projects	Building costs		% Scope change	% Added work	% Total
Project 1	€ 14.649.453		1,9%	13,4%	15,4%
Project 2	€ 6.576.898		2,7%	2,8%	5,4%
Project 3	€ 7.371.928		1,3%	9,4%	10,7%
Project 4	€ 23.136.696		2,2%	6,2%	8,4%
Project 5	€ 3.175.867		4,5%	1,5%	6,0%
Project 6	€ 2.964.011		1,4%	2,2%	3,6%
Project 7	€ 11.487.279		4,6%	5,3%	9,9%
Project 8	€ 17.700.897		1,9%	3,3%	5,2%
Project 9	€ 6.731.402		3,4%	0,7%	4,1%
		Total	**2,7%**	**5,0%**	**7,6%**

Table 2 Baseline projects

From the table it can be quickly gathered that all tradition projects have a measure of added work during the execution. The amount of added work ranges widely from about 1% to more than 13% of the building costs. Since added works only surface during the execution they can greatly inflate the total cost of the project. In general there is about 5% worth of added work. As can be seen scope change happens less often in traditional contracts and also has a smaller range. Together scope change and added work add up to a mean of 7.6%. This is interesting since Aronsohn Management reserves about 5 to 10% of the budget for unforeseen costs in their projects and the total change neatly falls into that range so it seems an adequate estimate.

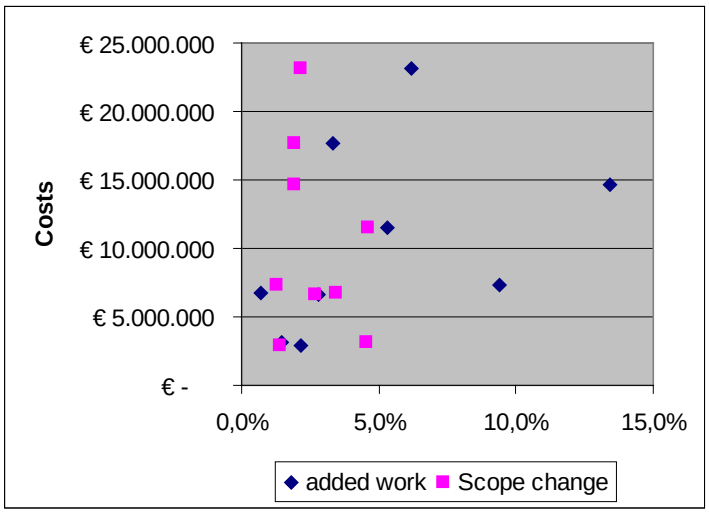

Figure 21 Relation between costs and additional works

There is no clear relation between the size of a project and the amount of added work or the amount of scope change as can be seen in Figure 21. This establishes that the total change is independent from the size of the project.

Projects managed with the Aronsohn contracting vision (Table 3) show very different results from the traditional contracts. There is more scope change and this seems to be related to the size of the project, so larger projects have more wanted changes. Possible reasons for this are discussed below.

The amount of added work has diminished to less then 2%. Table 3 also features the fixed price for phase A, this is the compensation all the executing parties receive for participating in this phase. The total amount of added work is added to the fixed sum for phase A to give a measure of the total cost incurred in dealing with added work. This comes down to an average of 3.1% which is lower than with the traditional contracts. Also the total amount of change is lower but this is not by a large amount. This assumes that the compensation for collaborating in phase A is used solely for fixing possible sources of added work, instead the contractors also offers improvements so this is an overestimate, the figure should be slightly lower.

	Projects	Building costs	Costs Phase A		% Scope change	(1) % Added work	(2) % Phase A	(1)+(2)	% Total
A	FNWI	€ 114.444.471	€ 855.000		5,7%	1,0%	0,7%	1,8%	7,5%
B	Springplank	€ 1.511.980	€ 30.470		1,2%	3,1%	2,0%	5,1%	6,3%
C	Vliegtuighal	€ 3.799.888	€ 50.900		2,0%	1,2%	1,3%	2,5%	4,6%
				Total	**3,0%**	**1,8%**	**1,4%**	**3,1%**	**6,1%**

Table 3 Projects managed with the Aronsohn contracting vision

Peculiar to see is that the total costs for phase A seem to increase as the projects grow smaller. This can point out that the overhead of the two phases might be too large for small projects. The same relation seems to hold for the amount of added work, the larger the project the smaller the total amount of added work and the bigger the amount of scope change. Since the total amount of additional work seems to be about the same between the traditional and the AM projects, it appears there is a change from unwanted added work to wanted scope change in the projects.

7.2 Planning Benefits

To check for the existence of a benefit on planning when using the Aronsoh contracting vision the same nine baseline projects are used. Comparing the initially planned project delivery date with

the realized turn over date, a measure is devised about the timeliness of project turn over. The planned turn over date and the start of the execution phase date are taken from the commission of the project to the main contractor. The realized turn over date is taken from the project turn over report (proces verbaal van oplevering) therefore it does not include the time needed to finish the rest points, however rest points occur in all projects and in a normal project there are few, so these don't pollute the figures much. The dates are reduced into a duration measured in days, due to practical difficulties this are calendar days and not working days and no provision for holidays is included. Since this is the case fort all projects relatively the terms can be compared. Table 4 gives an overview of both the tradition baseline projects and of the Aronsohn vision contracts.

Dplan is the planned duration of the project, Dreal is the real duration the project took and Delta is the difference between those. Positive Delta means a time overrun, negative Delta means a time reduction.

	Projects							
		Start	Plan delivery	Real delivery	Dplan	Dreal	Delta	
	~~Project 1~~	~~1-11-2006~~	~~16-2-2008~~	~~19-6-2009~~	~~472~~	~~961~~	~~489~~	
	Project 2	8-10-2001	8-11-2002	18-11-2002	396	406	10	
	Project 3	7-10-2002	17-10-2003	12-1-2004	375	462	87	
	Project 4	19-3-2001	15-4-2002	24-6-2002	392	462	70	
	Project 5	9-1-2006	29-9-2006	19-10-2006	263	283	20	
	Project 6	29-11-2004	22-7-2005	14-12-2005	235	380	145	
	Project 7	23-12-2008	26-5-2009	20-8-2009	154	240	86	
	Project 8	12-3-2001	19-4-2002	2-7-2002	403	477	74	
	Project 9	18-2-1998	1-11-1998	12-2-1999	256	359	103	
						Gem	**74**	~~120~~
	Projects							
		Start	**Plan delivery**	**Real delivery**	**Dplan**	**Dreal**	**Delta**	
A	FNWI	1-6-2007	15-4-2010	29-6-2010	1049	1124	75	
B	Springplank	24-9-2008	10-7-2009	10-7-2009	289	289	0	
C	Vliegtuighal	2-4-2007	15-2-2008	15-2-2008	319	319	0	
						Gem	**25**	

Table 4 Project delivery dates

It is immediately clear that none of the baseline projects were delivered on time and all of them suffered delays. Some projects only suffered a minor delay but certain projects took a lot longer then expected. Project 1 is definitely an example of what can go wrong in a traditional project, it took more than twice as long as planned to complete it and it also had quite a large sum of additional works (see Table 2). Since it's so off the scale, the mean is calculated with the project, the black number, and without it, the red number, and the difference is quite distinct. All comparisons will be made with the adjusted average.

The other delays all fall between 10 to 145 days, still a large spread. There is no relation between the duration of the project and the total delay, this is best seen at project 6, which was a short project but suffered quite a large delay.

The figures for the Aronsohn contracting vision projects look a lot better. Two projects were delivered exactly on the planned date and the third only ran long for two and a half month. Taking into account that the contractor for that project made an agreement very early in the execution phase about a two month fine free extension, the project actually was delivered within 14 days of the planned turn over date. Here it does appear that a larger project has more chance to suffer from delays than a smaller project, although on the other hand the size might also have nothing to do with it, as with the traditional projects.

7.3 Project reports

In this paragraph the results of the analysis of the project documents are presented. Per individual project the reports from the project team meetings are analysed. The project team consists of the project manager, a representative of the client and a representative of the user. All decisions regarding changes in the design and other changes that have a financial, planning or quality related impact must be agreed on in this counsel. Per project an overview of the different roles and groups is given and a general analysis of the reports. Focus is on changes made to the specifications or changes made to the final design and the effect of those on the total performance of the project.

De Springplank

User:	School board “De Springplank”
Client:	Municipality of Vught
Project manager:	Aronsohn Management raadgevende ingenieurs

The project for the “De Springplank” included both renovation and some new construction work. The architect based his designs on the program of requirements drafted by the school board and the municipality and on a site visit. The initial design ended up quite a bit cheaper than estimated so there was some room in the budget to account for a number of uncertainties there still were. Biggest of those was, whether the strength of the first floor would be in line with the new building regulations. It was decided to keep the extra budget reserved for this and other uncertainties. That proved to be a wise decision since the final design proved to be just within budget and was consequently put on the market. Three parties offered a bid and after some negotiation about a price reduction one was awarded the assignment for phase A.

During phase A the contractor made a thorough review of the building and came up with a number of improvements and problems. His assignment was to come up with a cut for every extra expense he thought was necessary, his price should not increase during phase A. He tried his best but didn’t manage to accomplish that, during phase A, a number of problems appeared. The roof at the back of the building was deteriorated far worse than the architect had foreseen and the electrical installation was insufficient in certain places. Together with some minor other problems this would cost quite a lot more money than budgeted. The contractor however advised that the rear side windowsills could be partially replaced and partially repaired instead of replaced entirely. Repairing them was significantly cheaper then a total replacement and the benefits could be used to cover the costs for the roof. At the end of phase A there was an increase in price for the execution but this increase was wanted by the client and not forced by the contractor and this increase still felt within the total budget by using some of the reserves.

A small number of problems only surfaced during the execution phase and these were solved in the project budget. The renovation of the stairs proved to be very expensive and alternatives were proposed and accepted. As the execution proceeded it became clear that the budget for unforeseen costs wouldn't be used up entirely. Earlier the school board had drawn up a list of additional wishes for the project should there be room in the budget. Using the excess money from the unforeseen costs reservation a number of these wishes could be fulfilled, among them the installation of beamers and smartboards and the redesign of the terrain surrounding the school.

In the end, the project was concluded within budget and a number of additional wishes of the school board were implemented. In the final evaluation the parties agreed that the Aronsohn contracting vision seems to work, the project was realized within budget with less additional work than in other projects. The participants did indicate that a lot is dependent on the attitude of the contractor and the other parties.

The reports don't extensively discuss the specifications so no real idea can be formed about the improvement of those. They do list that the contractor has used his influence to check them, the task of drafting the specifications remained with the architect and the advisors.

Vliegtuighal

User:	Faculty of Aerospace Engineering
Client:	TU Delft Facility Management and Real Estate
Project manager:	Aronsohn Management raadgevende ingenieurs

The renovation of the airplane hall (vliegtuighal) was the first project to be completed with the Aronsohn contracting vision. The vision was chosen to remedy the problems with the stressed markets. The project was small but rather complex, and installations made up a larger chunk of the project than usual. The project also needed to be delivered in phases and with continued use of the building. Therefore Aronsohn Management feared that no contractors would submit a bid and the project would be difficult to tender. For these reasons the client chose to tender using the Aronsohn contracting vision, in addition it was decided that the contractors would be selected on a one-on-one basis from among the current maintenance contractors. The idea was that they have superior knowledge of the building and would also be responsible for the maintenance when the project was finished; maintenance however was not part of the contract though since long term contracts were already in place for that.

With an architect and an advisor the initial draft of the design was created, this draft was developed with the client and user into a full fledged definite design. The architect and advisor added the qualitative demands to the specifications and based on these documents the contractors, one per parcel, were asked to submit a price for the works. After calculating and negotiations about their price they were given a contract for phase A in which the final specifications were drafted. The advisor and architect remained responsible for drafting the specifications while the executing parties were tasked with advising on the documents. The directive of the executing parties was to come up with possible improvements but to keep to their original calculated price. During this phase no large optimization were realised although all the parties offered improvements and even a few cuts to the budget. The electrical contractor also offered a list of proposed bigger improvements which would cost more than his initial bid, the

other parties only finished the specifications and didn't come up with serious improvements. Most of the offered improvements were accepted and paid for out of the budget for unforeseen issues. The executing parties did influence the planning and signalled that in order to finish in time they needed to start with the detailed drawings before the end of phase A. Pre assignments were given for the drawings and the work commenced normally at the end of phase A.

When the specifications were finalized the executing parties could start with the execution, phase B. There was a large number of changes during the execution phase although almost all of them were initiated by the client. There was a totally unforeseen complication though, during phase A the space below the foundation was found to be large enough to house a crawl space. The designs assumed that this crawl space would be available under the whole building, this however proved not to be the case and additional measures where needed to adapt the design to this. In a traditional contract this would be the example of an added work claim. With the Aronsohn vision those cannot be claimed but since none of the executing parties could have known or foreseen this the costs were reimbursed by the client. It was unfortunate that the building physics advisor commented on the specific proposed optimizations from phase A after the execution had started but most of these were implemented nonetheless. There were also some last minute additions by the users.

The project was concluded within budget and delivered on the planned delivery date. This was possible despite some problems with the W-installation contractor early on. He was unable to deliver drawings on time due to capacity problems with his subcontractor. In the end the executing parties needed to work hard, even in the weekends, to finish on time but they managed it. The reports don't give any specifics on the changes made to the specifications but do hint at optimizations the executing parties came up with. The overall performance of the project seems to have been improved by the input of the contractors. A number of cost reductions and smarter solutions were designed and implemented. Important side effect is the smoothness of the execution phase, apart from some start up problems no major problems surfaced and all parties were able to finish the project quickly.

After completing the project, the client held an extensive evaluation of the project, the parties involved and the contract form used. The main conclusions from this evaluation are:

- Both installation contractors thought that the DO+ design was too detailed. They would have wanted to be involved earlier with the design and also be responsible themselves for drafting the final specifications. The installation advisor, despite his initial sceptical attitude towards the earlier involvement of executing parties, agrees with them on who should write the specifications, he would like to see his role change into a more verifying one.
- The same as above also applies to the main contractor. The architect believes he could have drawn up the final specifications, so the architect could serve in a more controlling role.
- The preliminary specifications are detailed enough to base a price on
- All parties saw benefit of the contract form in resolving problems early and making a better start with the execution.

FNWI

User:	Faculty of Science
Client:	University of Amsterdam
Project manager:	Aronsohn Management raadgevende ingenieurs

The combined renovation and green field construction of the Faculty of Science in Amsterdam was a truly huge project. Three architectural agencies, chosen through a competition, worked together to draft the initial designs. Aronsohn Management became involved as project manager during the first phase of the design. The three architects worked together with one of them being the head architect. Together they designed plans for the renovation of three buildings as well as a new one. Their work was divided over the different buildings so each architect designed a particular outer façade. This ensured they could operate semi individual and wouldn't be too dependent upon the others.

The design process ran its normal course going from a preliminary design to a final design and being agreed upon by the client and the users. Special interest groups were established for certain key aspects of the project; mainly logistics, interior design of workplaces and laboratories. This initial design process took about two years to complete. For the execution a building team construction was envisioned based on a definitive design+.

Everything was ready for a tender and the client had agreed with the design, when the board of directors of the university though threw a wrench in the process. Despite the fact that the project met the quality standards and was within budget they asked for a 30% reduction in costs to be realized. The cost reduction measures took over half a year to hash out and design and took the project back to the preliminary design phase. Apart from the large changes to the design also the contracting approach was different. Based on the market at that time and the involvement of the installations advisor it was decided that both installations would be tendered based on the preliminary design (VO). The architectural contractor would be tendered on definitive design (DO). Both executing parties would be responsible for drafting the specifications and bring in their knowledge to improve the design.
While the design process continued for the architectural aspects the installations contractor took over all the design work on his aspect. The installations advisor adopted a more controlling and benchmarking role. With only the preliminary design as a framework the installations contractor did a lot of the design work on the installations. The project reports detail the progress but not any significant changes that were made. When the tender for the architectural contractor was finished he was also added to the design team. His input sparked a number of large changes to the design.

Biggest change was the total redesign of the exterior façade system. All three architects had made custom designs and with the help of his specialized subcontractor the main contractor managed to create a single design for the façade without compromising on the architectural outlook. This change was necessary to ensure the performance of the façade, since the initial design wasn't wind and water tight.

During the collaboration in phase A numerous small changes were made to the design sometimes leading to cost reductions or sometimes to ease the execution without compromising on quality or price. Interesting to see was that the contractor and architect collaborated on finding solutions to design problems. The contractor tried to maintain the architects design while still focussing on constructability and utility for the user. To facilitate the larger changes a special counsel was held including both contractors. This counsel resulted in the solving of drawing errors, the

improvement of the roofing and the choice for different floor finishes. Large changes were investigated in separate tracks to not disturb the ongoing design and budgeting process.

The new design took less time to complete than the previous one but the final financial reports of the main contractor took some time to be finished. This added to the feeling that phase A took a long time.

Once execution started it was a tightly planned project but went very well. All parties worked together on solutions and proved that they wanted this project to be a success. When the first partial turn over came near there was some resistance from different parties but this was resolved quickly in a joint meeting where all parties together pledged to try their utmost best to make the deadline, each new partial turn over showed the same determination and all were done on time.

During the execution there were no major setbacks except for one rather large conflict surrounding the removal of asbestos. There was a falling out between the contractor and the project management over how to deal with the removal. The works were shut down for six weeks but after potential legal claims everyone started working again. Despite this delay and the very harsh winter of 2009 the last turn over was only two weeks overdue, somewhere in the project the deadline was already extended four weeks for this turn over and that new deadline was nearly made.

7.4 Conclusions quantitative case study

In this paragraph the results presented above are drawn together and used to give an opinion on the measurable effectiveness and efficiency of the Aronsohn contracting vision. Per sub research question a conclusion will be presented. This paragraph concludes with a number of hypotheses to be used in the next part of the research.

Financial benefit

From the above presented figures it can be clearly surmised that the Aronsohn contracting vision has a tangible financial benefit. The costs for unwanted change (added work and the costs for phase A) are lower than in a traditional contract, leaving more room for wanted change (scope change). This extra room is used in all the projects as can be seen from the increased amount of scope change and thus the increased amount of total change. This increase in scope change can be seen as both good and bad. From a client point of view it means more of his wishes are catered for so the total performance of the project increases, however on the other hand more scope change means more work for the contractor. He gets paid for this extra work so no direct financial loss, he even makes more profit but dealing with the changes during the execution can be difficult, relatively costly and disturbs the normal execution process.

The main financial benefit of the Aronsohn contracting vision is not the lower amount of cost but the earlier certainty of the total costs. In a normal project the costs are only tallied at the end while with the Aronsohn method the costs are fixed after phase A and before the execution. The only extra costs that the project incurs are scope change and thus are initiated by the client. This benefit however is difficult to prove with figures and will be researched in the interviews.

For their average projects Aronsohn Management calculates about 5% of unforeseen costs during the execution phase. The traditional contracts also average out around this percentage so this is a good estimate. The contracts managed with the Aronsohn vision however all end up with a lower

percentage. The remaining budget for unforeseen can be used to add additional performance to the project as is done in all projects. No project takes the profit, all projects use the extra money to invest in more performance or a higher quality. It's unknown why but appears like a common phenomenon seen in IT projects called gold plating (Addison & Vallabh, 2002).

Concluding, there certainly is a financial benefit to using the Aronsohn contracting vision. This benefit mainly falls to the client with less unwanted change and more wanted change. The benefit of financial security cannot be proved with the above figures and will be researched in the interviews.

Planning benefit

The presentation of the accuracy of delivery dates above makes it very clear that the Aronsohn contracting vision makes it easier to deliver projects on time. While the traditional projects are invariably delivered later than initially planned nearly all projects managed by the Aronsohn contracting vision were delivered on time. The one project that was delivered late was only slightly delayed and measuring it by the duration of the initial planning the delay is very small and nothing compared to the delays in the traditional contracts.

These figures however only prove that the execution phase of the project goes much smoother or is better to predict than in a traditional project. The total time expenditure is very difficult to compare between the projects. In a traditional project the designing parties work until they have a final design with specifications and then the project is tendered. In the Aronsohn contracting vision the tender is earlier in the design process and the winning parties are integrated in the last step of the design. For both types of projects the tendering can be assumed to be equal in length, however the last step of the design phase could be longer in a project managed with the Aronsohn vision. Whether this is the case, is difficult to asses. Some of the projects managed with the Aronsohn vision were originally planned as traditional contracts and the time frames for the preparations look about the same length, regardless of which contract is used. On the other hand bringing in more parties is always going to cost more time. Interesting is to see if the possible longer duration at the start is made up for by the better planning and smoother execution. No clear verdict could be reached however due to lack of data. This aspect of the Aronsohn contracting vision will be further researched in the interviews.

From the accuracy with which the delivery dates are kept to it can be surmised that the Aronsohn vision offers a real benefit for planning. The real reasons for this are unclear at this point and the interviews will contain additional research into this.

Performance

Analyzing the project reports gives a good overview of the large events in phase A and B but it doesn't touches upon the fine details. It is therefore difficult to give a clear cut verdict on whether the performance of the project indeed increases also since performance is very difficult to measure objectively. The conclusions here are based on interpreting the project reports which are created by a single party in the project team so the information might be slightly skewed in the interest of that party, the project manager. Comparing the specifications on a one on one basis proved rather fruitless since the specifications used for the tender aren't complete. Completing them and removing ambiguities and errors from them is an important task in phase A so the

documents at the end of phase A will always be more complete and with fewer errors than at the time of the tender, whether they are better than in a traditional contract remains a question.

The project reports do however give a good idea of what happened in phase A and whether or not large changes were made to the design. In all the case study projects it is clear that the contractors worked together with the design team to improve the design and fill in the last gaps. The best example of this is the facade of the FNWI; by using the expert knowledge of a (sub)contractor the whole constructive design of the facades was changed to be water and wind tight and be applicable for all three different exterior designs. This redesign gave a lot of benefit to the client without eating into the profit of the contractor.

In all the project reports there is also the mention of catching a number of mistakes or suggested small improvements that were either budget neutral or would result in a better overall performance for the client with a small financial impact. There is strong evidence that the inclusion of the contractors in the last part of the design phase leads to a better design and a higher total performance of the project. Based on this it's not a big stretch to assume that the specifications improve compared to a traditional project.

All the evaluations are positive about the Aronsohn vision and the collaboration but raise a number of possible improvements. The contractors felt that being involved even earlier would benefit the project even more, although they were the only ones to mention that. In most of the case study projects the traditional advisors were responsible for drafting the specifications, while the executing parties indicated they would like to do that and the advisors should perform a check on their work. All parties agreed that the method seems to work, the projects were delivered on time and with less additional work than in a traditional contract.

Hypotheses

The conclusions above lead to a number of hypotheses that need to checked in the interviews since they couldn't be objectively proved. Questions in the interviews will be used to address these hypotheses and used to form a better opinion on the method.

The hypotheses are listed below:

1. It appears that there is a higher total performance for the same budget; is there an effective increase in the quality-cost ratio?
2. Is the biggest financial benefit of the Aronsohn contracting vision, the earlier financial security for the client?
3. Is the total project delivery time less with the Aronsohn contracting vision?
4. Is there a smoother process during the execution phase?
5. Do the specifications for the execution improve?
6. Does the collaboration and preparation in phase A lead to a better execution?

Chapter 8 Qualitative Case Study

This chapter deals with the interviews that were held as part of this research. The interviewees are listed and a general overview of the interviews is given per project. This overview is based on the structure of the interviews. At the end of this chapter the conclusions from the interviews are presented. This chapter does not contain the fully worked out interviews, these can be found in Appendix C. That appendix also contains the basic outline of the interviews.

8.1 Structure of the interviews

For all interviews the questions are based on the same outline. The outlines of the interviews can also be found in Appendix C. The discussion of the interviews below follows the same outline. These descriptions are kept short on purpose, more attention is given to the general conclusion later in this chapter. The questions in the interviews are based on the results of the literature study and the case study, supplemented by general questions about the project and the contract form.

All interviews for the case study project are asked about their first impression of the Aronsohn contracting vision and their experience with the other researched forms of contract. The DNC contract is left out since it is never used and almost unknown in the Netherlands. Then the two phases of the contract are revisited and specific points pertaining to that phase are discussed. In closing a number of direct statements about the method are posed to the interviewee and their opinion asked. The main goals of the interview were to find out how the Aronsohn contracting vision performs in a real project and whether the perceived benefits from the literature research and case study also appear in the real projects and are seen as such by the different parties in the project.

The interviews for the AUC tender have a different goal, since this project is just past the tender phase the focus is on the effect of the contract form on the tender strategy and on how different contractors perceive the Aronsohn contracting vision. The interview is divided in three parts, first focussing on the first impression, then on earlier experience with innovative contracts and then on how the bid was placed and what the influence of the contract form was.

8.2 Elementary school “De Springplank” Vught

The following people were interviewed in relation to this project:

1. O. Jacobs and P. kuipers, Aronsohn Management, Project Managers
2. H. van Berkum, AREC, Architect
3. M. van den Bouwhuijsen, Van den Bouwhuijsen, Contractor
4. P. Koolen, Municipality of Vught, Owner

*. H. verhofstad, VS Building Care, Delegate of owner
(no official interview, questions send using email)

The first impression of all interviewees is positive towards the Aronsohn contracting vision. All recognize the potential of added value from the method but also raise some concerns. Comparing with the other standard contracts everyone sees the Aronsohn contracting vision as a sort of bouwteam contract. Most interviewees had experience with the other contract forms as well.

Revisiting both phases of the project the interviewees agree that the project was executed well and that there were no major problems or conflicts. All complain about the attitude of the

subcontractor (who didn't wish to participate in the interviews), special mention is made of the contractor who was attentive and very proactive in the project. The changes and improvements in phase A helped to draft a better design, or at least add more value for the same amount of money. Working with a running list of extra costs and budget cuts worked out really well, the contractor aided this process with good results in lowering costs for the window renovation and paint works thus compensating for additional costs for the roof and the stairs.

The conclusions about the method agree on certain points but also differ on others. It's interesting to see that all interviewees agree that using the Aronsohn contracting vision leads to more value for money in the project, but an actual increase in performance is hard to specify. While the method leads to a much smoother execution it is doubtful and difficult to assess whether there is a time benefit. There are some concerns as well, the contract caries a risk for the contractor and it only works when all parties are willing to participate. Most interviewees prefer the Aronsohn contracting vision over the traditional contract but not always over the other forms of contract that are available.

8.3 Vliegtuighal Aerospace Engineering Delft

The following people were interviewed in relation to this project:

1. G. van der Panne and P. van den Boom, Aronsohn Management, Project Managers
2. P. Schoenmaker, E3D Architecten, Architect
3. N. van Duijn, Van Oosten & de Vette, Contractor
4. M. ten Brummeler, GTI, Subcontractor
5. S. Leijh, TU Delft FMVG, Owner

In this case study the interviewees were less positive about the contract form than in the project above. Some of this can be accounted to the initial hesitant attitude of some of the parties, despite this some valid concerns were raised. The interviewees agree on the potential of including the executing parties earlier to benefit from their expertise. Comments were made on the level of detail of the tender documents and the amount of design space left. The contract shares the most features with a "bouwteam" contract but performs better in respect to competitive bidding, although there was no competitive tender in this project. All parties involved indicated they had previous experience with the other contracts.

Phase A went relatively smooth but the allotted time was quite long, not all parties really grasped the idea of phase A and coupled with the hesitant attitude made that not all of the parties came up with improvements and budget cuts. In the end a lot of things were discussed in phase A but some of them came back during the execution phase for a final discussion. The collaboration did lead to a better design for the roofing and a smooth execution. Interesting problem that came up was the assumed subsidence of the ground in the foundation. Destructive research during the preliminary design showed that there was enough room to create a crawl space and install pipes and wires, this was used as a given in the design. During the actual execution this proved not to be the case below certain floors and an alternative had to be found. This true uncertainty was resolved reasonably and fair, since the contractor could not have foreseen this it was paid by the owner as a "normal" added work. At the end there was discussion about other added works but those were declined based on the grounds of the contract.

The interviewees conclude that bringing in the executive parties earlier can definitively work and that the execution can be finished a lot smoother by the adapting between the different parties. For the vision to really work it is important that all parties understand the concept of phase A and are willing to work with each other. If not a traditional contract might even perform just as good or better. The method improves the price-performance ratio of the project but it doesn't actually improve the total performance, more on this in the conclusions.

Interesting observation is that another type of contract might have worked equally well for this project, since the project used mainly known contractors the trust and collaboration could also have originated from the earlier relations and not be fostered by the use of the Aronsohn contracting vision. Some of the interviewees hinted at this being the case.

8.4 Faculty of Science Amsterdam (FNWI)

The following people were interviewed in relation to this project:

1. G. van der Panne and P. van den Boom, Aronsohn Management, Project Managers
2. M. Romano, Uytenhaak architecten, Architect
3. E. van Rijswijk, Ballast Nedam SP, Contractor
4. F. Julien, Burgers Ergon, Subcontractor
5. T. Looman, UvA vastgoed, Owner

The opinions on the Aronsohn contracting vision vary from slightly positive towards very pleased. Some see this as the new contract for all buildings while others see it as a stepping stone on the way to better contracts. Once again all interviewees agree the early inclusion of the executing parties is a good thing, they argue however over where in the process they should be included. Most interviewees had experience with the other contracts as well and related the method to a traditional contract with a "bouwteam" approach. The improved security for the client and the possibility to deal with problems before the execution is an important benefit.

This project had a slightly different approach than the others; the installations part of the project was tendered based on a preliminary design (VO) instead of a definitive design (DO). The installations contractor had a head start on the architectural contractor and this proved ground for some friction in phase A. Most interviewees said that phase A took a long time, probably too long but this had to do with some extensive budgeting rounds and the long start of phase A in which the parties adjusted to each other and the new contract form.

phase A had a high impact on the design in this project, due to the fact that there were three architectural firms designing it three different facades were developed. The contractor immediately spotted a number of flaws in the facade and made an entire redesign of the structural part of the façade, so that all three exterior designs could be placed on the same inner structure. There was quite some back and forth between executing parties and project management about the price, in the end improvements were made to the design and the required spending cuts were also found so the final contract for the execution was signed.

The execution went very smooth and without serious problems, one of the interviewees even stated that world records were broken in pouring the concrete. Up until just before the first partial turn over everything went well, when time became pressing small problems started to arise and parties became hesitant about the turn over deadline. To remedy that all parties sat

down together and stated their intention to complete on time, from then on it went really well again.

Most problems arose with the renovation part, halfway through it became apparent that most of the attention in phase A had been on the green field construction and that the renovation had been done a bit to the side. This didn't interfere with the project as a whole though. Biggest problem and nearly a conflict arose near the end of the project. One of the buildings contained a lot of asbestos that needed to be removed. Due to misunderstandings between parties this took far longer than expected and also was more expensive. This escalated into a debate between the contractor and the project management and the project was delayed for six weeks. Finally the contractor resumed working when legal steps were threatened. The financial consequences of this conflict are resolved. The additional and unknown sources of asbestos were paid for by the client, since the contractor couldn't know about them they fell outside of the no added work claims clause.

It was interesting to see that all parties agreed that in the end they were very adapt at working together on solutions and started to account for each others preferences in solutions that were provided to small problems. Parties trusted each other and this showed itself by implementing changes without formal assignment and the openness in which problems were discussed, problems that would normally not be discussed with project partners.

All interviewees agree that the effort in phase A plays a role in facilitating the smoother execution. Whether there are direct financial benefit remains to be seen, they do all agree that the method allows for the reduction of risks and the prevention of serious problems which indirectly is a financial benefit in lowering uncertainty. They all agree the price-performance ratio improves. Once again none of the interviewees can state whether there is a time benefit, the execution is quicker but phase A takes extra time and the net result is difficult to judge.

The method offers more security for the owner, since whether the design and the specifications really improve or not, the contractors sign off on them and thus attest to their completeness. A critical remark is placed with the collaboration, the benefits are obvious but appear only if all parties participate, the moment a conflict arises then the contract can become very restraining on the executing parties. In some way the concept of fairness and reasonableness should be included without compromising the strictness of the contract as it is now.

8.5 Amsterdam University College

In addition to the case study and the interviews with selected parties from the finished case study projects, the tender procedure for the Amsterdam University College is also evaluated. Interviews are conducted with all architectural contractors that made it through the selection and were asked to submit a bid for the contract. All contractors were interviewed based on the same list of questions dealing mostly with how they perceived the Aronsohn contracting vision and whether they deviated from their normal bidding procedures due to the used contract form.

These interviews were conducted after the contract was offered and the term for appeals closed. The idea behind this was twofold, on the one hand it made sure the interviews would not interfere with the tender process and on the other hand it would minimize the need for the contractors to behave opportunistically during the interviews, the project was awarded so there

was nothing to gain with lying or painting a nicer picture. Below a short summary of all the interviews is given, for a transcript of the complete interviews see Appendix C.

Originally five parties were selected to bid on the architectural part of the project but during the last stage of the tender one of the selected contractors backed out because of the quantity of work they had in their portfolio. They made no offer and also declined to give an interview because they were too busy for that. Therefore only four contractors were interviewed. For completeness it should be added that Bouwbedrijf de Nijs was ultimately granted the contract and no appeals were filled against that decision.

The following parties were interviewed on this subject:

1. D. van Engelenburg and R. Geuzebroek, Ballast-Nedam
2. E. Veenman and R. Elshout, JP van Eesteren
3. W. Ruigrok, Bam
4. C. Scherpenzeel, Bouwbedrijf de Nijs

The first impression of all the interviewees is slightly negative, only one contractor actually sees opportunities to influence the design process. According to the others the contract is very formal and highly theoretical in approach. They immediately see risks in the clause that no additional work can be claimed and that the design room in phase A is limited to non existent. In contrast they all agree that involving the executing parties earlier is a good development, therefore they all favour the contract over a traditional contract.

It's curious to see that all interviewees compare the contract to another innovative standard contract, be it "bouwteam" or D&B. Depending on their preference of those, they state that the Aronsohn contracting vision works less well. Most heard comment is that it is too restrictive and that the moment of tendering should be earlier so that they have more design room available. The contractors all see benefit in working in an innovative contract, those benefits lay mainly in using their expertise for a better execution, additional time for preparation, increased financial security and the reduction of failure costs.

The Aronsohn contracting vision contains incentives to collaborate but those seem very negative and slated against the executing party. For some it looked like the owner wanted to shift all the risks to the contractor. The trade off between the influence in phase A and the abolishing of added work claims gets mixed reactions, some find it very restricting and argue there will always be added work while others think it is an good deal but see risks in the attitude of the owner, project manager and architect.

None of the contractors significantly altered their bidding procedure due to the use of the Aronsohn contracting vision. Most of them said that the opportunities and the risks in the contract don't necessary balance out so they were conservative with their bids. Only a few saw the opportunity to reduce risks in phase A instead of calculating additional risks for it. All contractors saw potential problems in the design and specifications that could become added works in a traditional contract, most of them also saw good opportunities to save money and improve on the design.

All see the potential benefits of the method and agree that they could manifest but a lot depends on the people involved in the project. Concerns are raised about the length of phase A, which is short, and the strict division between phase A and B. More benefit could be attained by partly overlapping those phases so purchasing can start earlier.

8.6 Conclusions qualitative case study

This paragraph summarizes the conclusions drawn from the interviews and provides a short explanation of these conclusions. The conclusions presented here are used to verify the different hypotheses in the next part of this research and feed into the main conclusions of this thesis.

The conclusions from the interviews can be roughly grouped into three different types; conclusions pertaining to (innovative) contracts in general, conclusions pertaining to the content of the Aronsohn contracting vision and conclusions pertaining to the benefits of the contract form. These three groups will be discussed in order. A last groups of conclusions is presented based on the interviews with the contractors for the Amsterdam University College, these contractors base their opinion on the tender and not on actually working with the method.

Contracts in general

The conclusions in this part relate to (innovative) contracts in general. They serve as a backdrop for the specific conclusions of the method and also point towards possible improvements taken from other contract forms or towards general problems encountered in innovative contracts.

- All contractors like that they can offer input earlier then in a traditional contract.

It is clear that regardless of the contract form contractors want to influence the design and offer their expertise on the execution. No matter the form most contractors would jump at the opportunity to do this in a project. This is reinforced by the opinion that the traditional contract is not favoured by any of the executing parties.

- Contractors want to be included even earlier.

As stated above the earlier inclusion in the design process is very wanted by the contractors but most of them state that they want to be included even earlier. Depending on the type of contract even as earlier as the first design steps, preliminary design (VO) or even initial design (SO). The owners and architects are often sceptical of this.

- Contractors would like more design space.

In line with the above contractors want to do more design work in a project, they want to do more than just the detail engineering and argue that important early design decisions can have a large impact on the constructability of the final design. Some do see that the current practice isn't ready for that and see the limited influence as a way to prove that they are able to work as a design partner.

Content

The conclusions presented below deal with the specific workings of the Aronsohn contracting vision as encounter in the field. These serve as a base for possible improvements or to signal problems in putting the contract form on the market.

- The contractual documents and incentives are very strict.

Parties who worked in the contract find that the tone of the contract and the incentives are very strict, but found that working in the contract was pleasant. For clients the strict conditions and incentives are seen as a benefit while the executing parties agree that the contract works out fine in practice but looks strict on paper.

- Executing parties would like to participate in writing the specifications.

In line with the contract the executing parties like the increased responsibility and ability to influence the design in phase A, they argue however that they should take part in writing the final specifications. Especially since they sign the clause that those are correct and without errors, they should also be responsible for drafting them. The role of the advisors should then change into a more verifying and advising function.

Benefits

This last part deals with conclusion actually pertaining to the benefits that are realized when using the Aronsohn contracting vision. Some not only contain benefits but also place a critical note with a benefit or indicate that this is different for each party in the contract. Some peculiar observations are also placed under this heading to give them the necessary attention and discuss them.

- The method leads to a smoother execution.

All interviewees agree that the method leads to more time to prepare for execution and that this leads to an execution with fewer problems and also with less failure costs. More time can be given to the pre execution planning which leads to fewer problems.

- The execution phase is smoother but the total project delivery time is not quicker or slower.

While the execution runs smoother most interviewees doubt whether the project as a whole is delivered earlier than in a traditional project. It seems logical that the step from DO+ to specifications takes more time than in a traditional contract due to the number of involved parties, and it is hard to predict whether the smoother execution phase makes up for that. Curious is that most interviewees don't think the method is faster than a traditional contract but also don't think it is slower.

- The performance increases for the same price, but the method doesn't lead to a "better" design.

Whether the total performance of the design improves is very hard to establish but all parties agree that when using the Aronsohn contracting vision the price-performance ratio improves, the client gets more value for the same amount of money. This seems contradicting but one of the architects puts it like this: "the design as a whole didn't get prettier, but the client got more value for his money". The logical explanation for this is that the influence on the design doesn't foster any major changes but only small details, the design as whole concept doesn't improve in performance but the quality of the individual parts increases, thus giving a higher value for money ratio.

- The drawings and the specifications improve but more important the contractor agrees that they are correct, so for the owner they are 100% right.

This is a very important point, most interviewees agree that the specifications become better than in a traditional contract. However they all also pointed out that one of the main problems with traditional contracts is the quality of the specifications, these are almost always very poor. Key here, according to one owner, is the fact that whether the specifications really improve is not the main interest. The fact, that the executing parties proclaim that the specifications are correct and don't contain any errors or causes of added works makes them in respect to the owner better, even 100% correct. This provides security at the start of the execution.

- The method offers more security on price for the owner.

Owners agree that the method offers more security on price earlier in the project, this is an important benefit for them. The total project expenditure is defined earlier and the fluctuations are damped. They are conflicted on whether there is an actual financial benefit.

- No direct but indirect financial benefit for the involved parties.

Elaborating on the conclusion above it seems that only a few parties see a direct financial benefit in using this method. For instance most contractors see that the Aronsohn contracting vision could lead to lower failure costs and less problems during the execution but don't see this as a direct financial benefit. They can improve their profit but don't automatically do so by using the method. The same goes for the clients, they see the benefit of earlier security on price but the fact that less added works are claimed is not seen as a direct benefit. Thus concluding it can be seen that the contract form offers mostly indirect financial benefits to the parties instead of direct benefits.

- There is more trust between the parties.

Almost all parties agree that the collaboration was more open and that parties trusted each other more than in a traditional contract. The roles were less opposing than normal and parties worked more towards shared solutions.

- Information is shared more open and fewer games are being played.

It is impossible to abolish all opportunistic behaviour and the use of information between parties, this is clear from the interviews. However despite that all parties agreed that there probably was some use of information, but in general parties shared more information and collaborated more open than in other projects.

AUC Contractors

These conclusions are drawn from the interviews with the contractors for the Amsterdam University College. These conclusions are separated from the others to distinguish between interviewees who have worked with the Aronsohn contracting vision and interviewees who haven't. The conclusions below only pertain to contractors who haven't had previous experience with the Aronsohn contracting vision.

- Contractors only understand the method when they have worked with it.

It is very curious to see that contractors who have worked in the contract form understand how it works while contractors who face the contract during a tender raise a lot of doubt about it. Most contractors fail to see the benefits of the contract when it is explained on paper but can identify them when they have worked with it. The presentation of the contract and the intent behind it isn't clear (enough).

- The risks are often estimated higher than normal, most contractors don't see phase A as a possibility to remove risks.

- The attitude of Aronsohn Management, the client and the other parties is very important for the success of the method.

These conclusions coincide with the earlier conclusion that the executing parties find it difficult to understand the benefits of the contracts. The interviewed contractors agree that phase A offers a chance to remove risks but don't assume that this will happen since it depends too much on the owner and the other parties. Some even went as far as calling this an additional risk instead of an opportunity. This was a common concern for the contractors who haven't worked with the method but also a few of the other contractors saw this as a potential risk when something in the collaboration should go wrong.

- The contract documents and incentives are very strict and not conductive to the meaning of the contract.

All the parties indicated that the contract is very strict while the whole intention of the contract is to foster a more collaborative relation between the parties. This seems contradicting for most interviewees. The strict and formal tone and the mostly negative incentives towards the executing parties seem to hinder the initial step towards collaborating.

Part 3 Analysis

Chapter 9 Analysis

This chapter draws on the conclusions and hypotheses of the literature study and the qualitative and quantitative case studies. The hypotheses are evaluated and the different conclusions taken together and discussed. The discussions here will lead to the conclusions in the next chapter.

9.1 Introduction

The analysis in this chapter are based on the conclusions from the literature study, using the literature study as a canvas the results of the case study and the interviews are fitted to the literature to fill in the blanks about the Aronsohn contracting vision. The analysis focuses on the organization, the risks and the reimbursement within the contract. The management and choices observed in the contracts will be used to come to an conclusion about the driving constraints and the analysis is rounded out with a number of observations that don't fit any of the above categories.

9.2 Organization

This paragraph describes the organization of the Aronsohn contract vision, it deals with the (contractual) relation between the parties and how trust and conflicts play a role in the collaboration.

Contractual relation

Based on the literature study the Aronsohn contracting vision was placed between the traditional contract and the bouwteam contract. This was based on the two distinct different phases that are used in the contract form. The interviews confirmed this placement, although the opinions differ on whether it is possible to compare the Aronsohn contracting vision with any of the other contract forms. Most interviewees indicate that phase A has something of a bouwteam contract approach while phase B resembles the traditional contract. One interviewee even went on to call the method "bouwteam+", a contract that encompasses the ideas of the bouwteam but incorporates them better.

Furthermore it was curious to see that all the contractors had picked their preferred innovative contract and used that to compare the ideas of Aronsohn with. The most common conclusion among them was that it was better than the traditional contract but didn't quite match their preferred method of innovative contracting, they wanted "more".

So the Aronsohn contracting vision shares the most aspects with the traditional contract and with the bouwteam contract. Specifically, the collaboration in phase A is akin to a bouwteam and the execution (phase B) is almost like the traditional contract and thus an example of the principal agent relation. However in phase A the executing parties are bound tightly through a number of measures; namely a number of incentives and, most prominent, the prospect of getting awarded the commission for the execution. So despite the very different natures of the two phases the relation between contractor and client can best be characterized as a principal-agent in both of them.

Keeping the same relation in the different phases has a number of important benefits for the client. Since he releases some amount of influence on the design to the contractor he should be wary of opportunistic behaviour. The contractor for instance could try to lower the quality of the

design so he can improve his profit. Another problem would be the two different contracts the contractor works with, in phase A he is a consultant and according to the DNR he would only be liable to the maximum of his fee, while in phase B he is a contractor under the UAV with different conditions. He could use this change in contract to his benefit by willingly making a mistake in phase A which would forfeit his fee but would net them more extra work in phase B and thus more profit. This is a typical example of a moral hazard. The Aronsohn vision has a provision against this, ensuring this won't be an interesting option for the contractor, but these kinf of problems could surface during the contract.

Mapping the principal-agent theory to an innovative construction contract shows a very typical conflict of interests that exists in the literature as well. It's the conflict between clients control over the design process versus contractors involvement in the design process. Between these two interests a certain tension exists, the further the contractor is integrated into the design process the smaller the influence of the client becomes and the harder it is to find appropriate measures to control the contractor.

Finding an optimal division between client control and contractors influence is very difficult. The number of variables that affect this division is very large and to boot these also change with the different types of project. An extensive discussion of this division is outside of the purview of this thesis and could warrant an entire new research. However the division also surfaces with the Aronsohn contracting vision so a small discussion is provided.

The basic conflict is between the clients control on the design and the contractors influence. As in the principal-agent relation these parties have opposing goals, the client wants the best design for the lowest price while the contractor wants the project with the highest profit margins. Integrating the contractor earlier in the design carries the risk for the client that the design gets compromised by the contractor, on the other hand the contractor can also supply valuable expertise pertaining to the detail engineering and the execution of the project. From the contractor's side there are mostly benefits of being included early, he can influence the design in a favourable direction and he gets additional revenue from the earlier consulting. Off course the contractor has to be able to offer these additional services, when he has to hire an architect to do his design work it starts to become counter productive for both the client and the contractor.

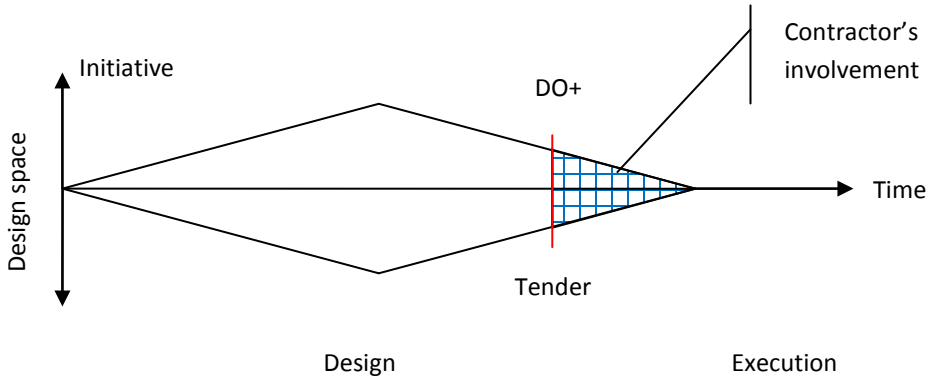

Figure 22 Contractor's involvement Aronsohn contracting vision

In the case of the Aronsohn contracting vision the choice is made to include the contractor almost at the end of the design process. Based on the final design and an outline of the specifications he consults on the detailed engineering and the constructability. He has the possibility of proposing optimizations but those can't influence the design too much. Using the basic design approach to visualize this, the contractor sits in the last part of the contraction, see Figure 22. The contractor has a limited possibility to influence and large optimizations are impossible due to the contract, this leaves certain opportunities untaken. Truly innovative ideas of the contractor cannot be used since they influence the design too much.

The limited amount of freedom coupled with strong incentives to collaborate makes this a safe relation for the client in phase A. In phase B the relation gets even stronger since the contractor signed the clause that no additional work could be claimed. Theoretical the client could use this clause against the contractor, turning the tables and introducing the agency problem the other way around. In the analysed projects this hasn't happened though and despite the strong principal-agent relation on paper the parties collaborated in a more network like fashion. Especially in the larger projects parties anticipated the other parties' preferences and adopted solutions that would benefit both, working towards a win-win situation.

Despite how the contract is set up now, all the contractors indicated that they would love the possibility of being involved earlier. Off course this is possible using a more integrated contract like a DB contract but that would compromise the control the client has in the Aronsohn contracting vision. One solution to that would be to keep the moment of tendering as it is now but to redo a small step of the design process, for instance the step from preliminary design (VO) to definitive (DO) could be revisited to find possible improvements. This is visualized in Figure 23. Drawbacks are the double costs and the amount of time that is needed to retake a whole design step. Another approach is to keep the tender as it is now but to release a small number of constraints for the contractor to influence. This would broaden the design space and gives the contractor more room to find possible optimizations. This approach is shown in Figure 24. Drawbacks here are the increase in price and a slight loss of control.

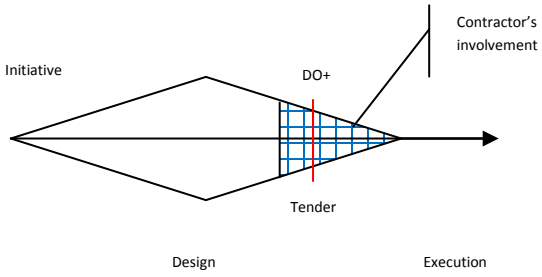

Figure 23 Retake the design step

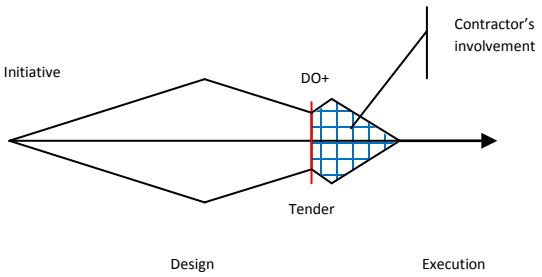

Figure 24 Open up design space

For the Aronsohn contracting vision the easiest solution to implement would be the second one. Currently the possible optimizations are evaluated using strict rules, freeing these up could lead to better and more optimizations. Strangest among these rules is the fact that optimizations are only accepted when they don't cost any money. This is very restrictive since a theoretical optimization that costs €1 and offers €1000 in returns over the coming years would not be considered. This is deliberately chosen to keep a lid on the costs and since most of the clients of Aronsohn, namely education institutes, have different funding streams for realization and

maintenance. Making this kind of expenses hard to divide between the two budgets. This however forecloses on certain very good opportunities.

Trust and conflicts

Trust plays a key role in (the success of) collaboration. In the literature study the small steps approach to trust building was presented and it appears that this is indeed the case with the Aronsohn contracting vision. While the opinions of the interviewees differ wildly on this subject and most indicate it is hard to quantify, there are some very strong anecdotes indicating that there is indeed more trust between the parties. The strongest anecdotes of increased trust are found in the larger project, where the installations contractor and the main contractor shared information on a personal conflict and other confidential cases that would normally not be shared.

Despite some interviewees that claim there is no more trust than in a traditional contract, all parties agree that the collaboration in phase A has a positive influence on the collaboration in phase B. Getting to know the other persons and finding out how they work and what their preferences are, are the most common cited benefits. This is a strong indication of the small step approach to trust building in chapter 2.3 and that it indeed seems to work.

The use of information is further evidence that there is more trust between the different parties. While all the parties agree that there always are some games played concerning information, most indicated that they had the feeling parties were more open and honest in sharing information. There are even examples of more information sharing than in other contracts.

The last indication of an increase in trust is the amount of conflicts that have arisen. No qualitative data has been gathered on this but the interviewees indicated that there seemed to be less escalating conflicts during the execution phase. While there remained conflicts most were quickly resolved by mediation from the project manager or by the mutual parties themselves. Interviewees said that a number of conflicts that would have escalated in a traditional contract were resolved easier and quicker due to the earlier collaboration in phase A.

9.3 Risk

Risk is the second pillar of contracting. A contract often carries an obligation to perform a task or to deliver a good, that obligation also comes with numerous risks, some for the client and some for the contractor. However opposite to the risks a contract could also create certainty or security. Part of the Aronsohn contracting vision is meant to provide just that, namely certainty.

Certainty

The Aronsohn contracting vision provides the client with price certainty by abolishing added work claims during the execution and ensuring better worked out contractual documents. The biggest financial benefit originates from the smoother execution phase. The fact that projects won't be plagued by added work claims makes it interesting for clients to participate and offers an indirect financial benefit.

The case study showed that the projects managed with the Aronsohn contracting vision were delivered better on time and with fewer delays than any other traditional projects. The interviews confirmed this. All interviewees indicated that the collaboration in phase A led to a better and

smoother execution. Problems were identified beforehand and solutions drafted when there was enough time to deal with them. So during the execution fewer problems arose that needed to be solved immediately. Problems that did surface could be dealt with more easily since parties had formed a strong bond and knew about each others preferences. An execution that runs smoother and with fewer problems automatically leads to a quicker and cheaper execution phase. Interviewees confirmed that the execution phase was finished quicker than in traditional projects.

Many interviewees complained that, currently contractual documents (design and specifications) often are seriously flawed. They contain mistakes and are poorly worded. This is often due to time constraints in the design phase. The Aronsohn contracting vision remedies this by letting all parties collaborate on the contractual documents and more importantly by requiring the contractors to sign a statement that the contractual documents are in essence flawless and won't be the cause of added work claims in the execution.

While the case study did not indicate whether specific improvements to the contractual documents were made, something else is much more important for the client. That is the fact that the executing parties sign a statement indicating that the specifications are without errors and will not lead to added work claims during the execution. Regardless of the real state of the contractual documents this statement ensures they are 100% correct for the client. This is one of the key points of security for the client.

A full comparison between the method of Aronsohn and the traditional contract was not made since the contractual documents are difficult to compare. At the start of the tender the contractual documents for the Aronsohn contracting vision are a detailed design coupled with a rough outline, with minimal quality descriptions, of the specifications. During phase A the contractual documents are developed by all parties into the final documents. In a traditional contract the contractual documents are entirely developed without a contractor and used as is in the tender. So there is no moment in which the contractual documents of both contracts could be

The executing parties have a role as advisor here but aren't actually involved in drafting the contractual documents, the client's advisors do that. This is somewhat strange since in the end they will have to sign off on them stating that the documents are without error and won't lead to added work claims. A few of the contractors mentioned that they would like to be in charge of drafting since it is something they sign for in the end. The role of the advisor would then change into a more evaluating one.

Risks

The contract form also carries some inherent risks off course, from the client side these are strongly related to the principal-agent problem described above but for the contractor other risks apply. The biggest risk for the contractor is the clause that abolishes the ability to claim added works based on errors in the contractual documents. This risk is mitigated by the ability to participate in the detailed and technical design in phase A but for many contractors this remains a risk. Especially contractors who haven't worked with the method before are therefore reluctant to try it.

This is best seen in the contradiction between the tone and intention of the contract. Multiple interviewees indicated that tone and the intention of the contract are not really clear. While the

contract envisions a collaborative relationship between all the parties there are a lot of negative incentives for the contractor to ensure his collaboration. The initial trust must come entirely from the side of the contractor. The interviews with the project managers from Aronsohn also indicate that one of the key ideas behind the contract is the giving and taking between contractual partners.

There are multiple ways to bring these two more in line; the first involves revising the tone of the contract and clarifying the intention of the client and project managers and the second involves another approach to trust

The second option is closely linked to increasing the understanding of the contractors. By clarifying the contract form and the intention before the tender the contractors would be able to better anticipate the inherent risks and opportunities. This could lead to lower bids on the tender and more willingness to think along with the contract and collaborate.

The new approach to trust would be even more in line with the small steps approach to trust building presented earlier in this thesis. By lessening the negative incentives on the contractor and showing initial trust in him the contract will be more inviting to participate in. Off course a strict system to deal with opportunistic behaviour needs to be in place. This approach could be used with contractors who have some experience with the Aronsohn contracting vision, although those often are already convinced of the benefits and know the intention of the client.

Going back to the risk continuum posted before the Aronsohn contracting vision lowers the risk for the client by agreeing on a more fixed price but tries to do so without needlessly increasing the risks for the contractor, by offering them a chance to remove any problems beforehand.

True uncertainties

In modern times risk management is done on nearly every project, however there are still differing opinions on it, especially on the division of risks between contractor and client. The Aronsohn contracting vision has a very clear risk division, at least when it concerns risks originating from the contractual documents. The contractor has signed that those won't be the source of added work claims so he will have to deal with those risks. The contractor however has the chance to reduce these risks in phase A.

More important than the "normal" risk are the true uncertainties, events that none of the parties had or could have foreseen. The consequences of these uncertainties often lead to debates between client and contractor over who should pay for them. In the Aronsohn contracting vision there is no specific clause detailing what happens with these true uncertainties. It could be argued that they should fall to the contractor since he signed for the no added work claims but this isn't entirely fair. There are always things he couldn't have foreseen and it isn't the intention of the contract to hand all the risks to the contractor.

This situation appeared a few times in the analysed projects and always was handled in a good way between the parties. The ideas of Aronsohn try to incorporate the reasonableness and fairness that was described earlier. The client, therefore always paid for the added works originating from these uncertainties. The contract could be improved by drawing up risk division

beforehand, this can be done in big strokes but gives some handholds when discussing these evetns.

9.4 Reimbursement

The reimbursement method of the Aronsohn contracting vision is not the most interesting part of the contract. Payment is based on a lump sum derived from the tender, plus any scope change the client wants to implement. In the USA this is known as a Guaranteed Maximum Price. The real benefit of the Aronsohn contracting vision also doesn't lie in the direct financial compensation. While for the client it appears that contracts become a little cheaper, in the order of a few percent, the contractor doesn't get any direct benefit.

The indirect benefits are large though, this is confirmed in the interviews where multiple interviewees state that the projects aren't actually cheaper but carry financial benefits nonetheless. For the clients this benefit is found in the lesser amount of added work claims ad the more certain adherence to the construction planning. Projects managed with the Aronsohn contracting vision were delivered (more) on time and with fewer added works than comparable traditional contracts. Even taking into account the costs for phase A the Aronsohn contracting vision still outperforms the traditional contracts. The case studies show that there is a shift from unwanted added works to wanted scope change, this shift will discussed more elaborately below.

Incentives

As discussed above the relationship between the parties in the Aronsohn contracting vision is best characterized as a principal-agent relation. As the agent the contractor could be tempted to use the asymmetric information to his advantage. This risk is especially high in phase A when he is just an advisor, like the architect or the installations advisor. The two different contracts make this an exploitable opportunity for the contractor, the Aronsohn vision has taken this into account and closed this but to limit other opportunistic behaviour from the contractor a number of incentives are in place.

The largest of these incentives is the awarding of the contract for phase B. A contractors main focus is to construct a building and the contract for phase B is worth much more to the contractor than the remuneration for advise work in phase A. To evaluate the contractor a monthly review is asked from him and when the collaboration really doesn't work out the parties can separate after phase A. This is far from ideal and a real last resort however. The other incentives are mostly fines aimed at making sure the contractor does his part of the work. These incentives are all focused on punishing the contractor when he misbehaves, aimed at stopping negative behaviour.

The incentives aren't all negative though, if the contractor comes up with a clever optimization during the tender he scores points for winning the tender and if he proposes an optimization in phase A he gets a small cut of the profit. Most of the incentives in the Aronsohn contracting vision are negative however, to make the contract more appealing some positive incentives could also be build in. For example a small bonus when the plus and minus list is still at €0 at the end of phase A.

Added work & Project control

It was discussed earlier that the Aronsohn contracting vision outperforms the traditional contract. Key here was the observation that there is a shift from unwanted added works to wanted scope change. Despite the small direct financial benefit in all the researched project this “extra” money was invested again in the project, often to fulfil additional wishes or to add to the total scope, above the initial design.

Going back to the pyramid of Turner it is quite clear that money isn’t the real driver and that scope is seen as more important. It should be noted that using the extra funds this way was an intentional choice in all the projects. Curious is that most of the owners point out that time isn’t very important, especially for the educational buildings it is far easier to justify a 3 month delay than a small budget overrun, however there is no benefit in not consuming the entire budget. Making cost an important constraint but not driving as long as it stays within budget. The weakest constraint would be time then. Leaving quality as somewhere in between them. Judging from the interviews, quality comes close second. Thus in order of importance; scope, quality, money and time.

Seeing that scope and quality are important it is an interesting question whether the shift from unwanted added work to wanted scope change is totally intentional or whether this is a sign of scope creep or gold plating. In essence the project could be delivered to specifications for less money, despite this most of the budget is still used for scope change, this scope changes is wanted by the client and agreed on, however the question is whether this additional expenditure increase the price-performance ratio in line with the normal project spending. Possibly the lesser expenses on added work claims could be used to lower the unforeseen costs or be spent more efficiently on another part of the project. Apart from that there is also a risk that the contractor would try to claim a typical added work by turning it into a proposal for scope change. This hasn’t happened in the analysed project but could be pitfall for the contract.

9.5 Other

This last paragraph contains some peculiarieties that couldn’t be fitted in the framework above. These mainly concern the perception on the contract and it’s benefits.

Design improvement?

One of the architects had a very interesting take on the improvement of the design when using the Aronsohn contracting vision. He said: “The design as a whole didn’t get prettier but it became better.” At first glance this looks really contradictionary but there is a really logical explanation.

Throughout the interviews and case studies there is plenty evidence that the collaboration in phase A indeed improves the project as a whole. Multiple optimizations are proposed and realized, most notable the better façade for the FNWI project and the serious budget cut that was realized with the partial restoration of the back windows in the Springplank project. Still it is curious to note that in the interviews many interviewees state that the method didn’t led to a better design (esthetical and functional aspects) but did improve the price-performance ratio (technical aspects). Their rationale is that the design as a whole doesn’t improve that much, but that all the small optimizations do lead to a higher performance. So the project is optimized on constructability and then mainly in the implementation of the detailing from the architect. This is

in line with the original intention of the contract. Choosing this approach closes of more innovative possibilities but offers enough benefit to warrant the extra trouble of phase A.

Experience with the contract

During the interviews all contractors who had no experience with the method showed reservations and saw significant risks, often more than opportunities, while contractors who had experience with the contract form still had some reservations but were far more convinced of the benefits and less worried about the risks. For the Aronsohn contracting vision this could also be caused by the formal and strict tone of the contract. Many executing parties found this not to be in line with the intention of the contract and were wondering what the exact intent of the method would be. A more open approach could alleviate these problems, for instance an insight into the intentions of the client, coupled with a discussion and illustration of the contract form could be given to the final contractors who are to offer a bid on the works. This could increase their understanding of the risks, show them the possible opportunities and remove some of their doubts; thus hopefully leading to a better bid.

When studying the DNC contract Doloi also found that previous experience with the contract form was an important factor in the success of the project. It seems the Aronsohn contracting vision has a similar aspect. Whether this is because the idea of the contract is difficult to understand or that the text of the contract are difficult is hard to say.

9.6 Validation

The description of the Aronsohn contracting vision and the main conclusions and recommendations were validated with an external reference, ir. L.A. Roelofs. Ir. Roelofs has worked for over 40 years in the construction industry mainly in commercial functions for large contractors, the last years he has been involved as mediator in major disputes. He has a lot of experience with innovative contracting and lectured broadly on the subject.

The main conclusions from the validation were clear: the contract form as adopted by Aronsohn works very well but is sometimes hard to implement in the public sector and Aronsohn isn't the first to come up with the idea.

The idea of one tender for two contracts is found in the petrochemical industry and known as two-phased contracting. Engineering firms in the USA have a similar contract form for the client as Aronsohn offers. Large construction companies in the USA also adopted a similar method to this one. The construction industry in the USA is far more integrated so one contractor can supply for all the disciplines (engineering, construction, installations) and he uses this position to his benefit.

Engineering firms try to profit from this by offering a full package to a client, for a certain established price they will deliver a building to their specifications. The engineering firm works on the design with the client and then tender the building to a contractor who will assist with the detail engineering and the construction. This contract is called a Professional Construction Consultant (PCC) with a Guaranteed Maximum Price (GMP). The earnings of the engineering firm are depending on the results of the whole project so they try to work with the contractor to maximize the benefit for both of them, while the client has no risks and gets his building for the fixed price. In the Netherlands similar ideas have been tried but never caught on, most important was the Design to Construct invented by TNO Bouw.

Something that was missing from the report is the risk when companies actually wanted to play foul and use the rules for their sole benefit. During the evaluation some other minor points were discussed. The results of the validation are incorporated in the report and used to fine tune the text.

Chapter 10 Conclusions and recommendations

The conclusions and recommendations are presented in this chapter. First the main research question will be revisited and the findings presented about both the effectiveness and the efficiency of the Aronsohn contracting vision. These conclusions are supplemented with a number of recommendations that follow from the analysis and the conclusions. Recommendations to possibly improve or expand the Aronsohn contracting vision and recommendations for further study into a number of core concepts underlying the conclusions of this thesis are presented.

10.1 Introduction

At the start of this thesis the goal was to do a comprehensive evaluation of the Aronsohn contracting vision both in the field and in the literature. Aronsohn Management raadgevende ingenieurs wanted to prove the perceived benefits of the method and to promote its use with clients. To facilitate this, the research aimed to include both the experiences of clients and contractors and to identify potential improvements to the contract form. The position of the contract form in between other standard contracts has also been researched as are the benefits compared to the other contracts.

This has taken shape in the form of a comparative literature study to evaluate the different standard contracts in the construction sector and to set up a frame of reference for comparison with the Aronsohn contracting vision. Results of this comparison are then used in a case study on the tangible benefits of the contract form and as a basis to draft interviews with different parties that have participated in the contract form before. The conclusions from these three research venues are taken together, analysed and presented below.

10.2 Conclusions

The initial question at the start of this thesis was:

"What is the effectiveness and efficiency of the "Aronsohn contracting vision" in comparison to other forms of collaboration in the construction process and more specific in comparison with the design team, the design & build and traditional contracts?"

The two main indicators of the comparison are the effectiveness and the efficiency of the Aronsohn contracting vision. The effectiveness was defined as the benefit for the users of the method. The efficiency was a measure of the ability of the contractual partners to still secure a profit when working in this contract form. These two indicators are discussed separately and then a general conclusion is presented.

Effectiveness

It can be stated that the Aronsohn contracting vision is definitely effective from a client's perspective. Contracts using the Aronsohn contracting vision were delivered more on time, with less additional work claims and always realized a higher performance for the same budget, in comparison with traditional contracts.

In comparison to the traditional contract the Aronsohn contracting vision leads to a small direct financial benefit. Traditional contracts always have costs which are higher than initial budget, stemming from added work claims and often paid from the unforeseen reserves. Using the Aronsohn contracting vision these costs are almost zero and even when including the costs for

Phase A, they are lower than in the traditional contracts. These gains are difficult to quantify, since while the project becomes cheaper on paper the extra money is often used for wanted scope change and thus in the end the client doesn't pay less. It is clear however that the effective building costs are slightly lower.

Apart from the small direct benefit above most of the benefits are indirect. The research shows that almost the whole budget for the project is still used up despite the lower expenses on added works. The interviewees however indicate that the total performance of the project increases. So the projects don't take extra profit but use the money to increase the performance. The funds that are saved with the smoother execution and the lesser amount of additional work are mostly used to increase the performance or to incorporate extra wishes into the project. This manifests in lesser added works, even when counting the expenditure on phase A, but a higher total of changes. There is an obvious shift from unwanted added work towards wanted scope change.

Important for the client is also the increased security. In all the currently used construction contracts the client either has a lot of influence on the design but faces significant financial risks or he loses the financial risks but also the ability to influence the design. The Aronsohn contracting vision, akin to the bouwteam contract, offers both; the client oversees the design till it is almost done and then transfers most of the financial risks to the contractor with the tender. This seems unfair to the other party but the contract offers ways to mitigate this, more on the contractor's side of this latter.

Further the method ensures a better collaboration between the different project partners. Despite the constraints and the strict incentives in the contract, it fosters collaboration and trust between the different parties. The small steps approach to trust building as discussed in paragraph 2.3 Collaboration, definitely has an influence in the different phases. The "forced" collaboration in phase A facilitates trust building and allows the parties to adjust to each other and find out the others preferences and demands, which leads to easier conflict resolution and better collaboration during the execution.

The extra time for the contractor in phase A ensures a better thought out execution plan and thus results in fewer problems during the execution. The contractual documents in a traditional contract but also in the other contracts are often quite poorly written. This coupled with the wish of clients that the contractor should start as quickly as possible after the tender, ensures that there is not much time to properly for prepare the execution and to identify potential problems. These problems then surface during the execution when there is a lot of pressure to continue the project and thus not much time and/or design space to solve these problems. Extra preparation time creates the possibility of a better and more thought out plan for the execution and offers a chance to identify and deal with these risks in an early stadium when there is still time to come up with a satisfying solution. The Aronsohn contracting vision focuses on this.

Compared to the other contracts the effectiveness for the client is high. The contract form offers the collaboration benefits of a bouwteam contract without sacrificing control on the contractor. The main trade-off is in losing some design influence in return for contractor's expertise in the engineering design and more financial control. The contract form errs on the safe side for the client but can with the right conditions certainly offer benefits over the other contracts.

Efficiency

The efficiency of the Aronsohn contracting vision is more difficult to prove. Contractors who have worked with the contract form indicate that they are willing to work with it in future projects and see certain benefits in the contract form, but they also have some concerns. Contractors who haven't got any experience with the method however have difficulties to really value the method and are often negatively inclined towards it.

As with the effectiveness the efficiency also suffers a bit from the lack of direct benefit. For the efficiency it is however difficult to point out what exactly is causing this. All the contractors agree that with the use of an innovative contract that offers them influence on the design, they are able to reduce failure costs and optimize the execution phase. While this means less expenditure on problems and thus a higher percentage of profit, this benefit is difficult to quantify. Despite this, all contractors are eager to participate in the design process earlier and offer their expert knowledge, the earlier the better for contractors. Contractor participation in the design is important but care should be taken not to integrate the contractor too far in the design.

The two phased approach of the Aronsohn contracting vision does allow contractors more time to prepare for the execution. This relieves the pressure on the preparation, something that has been getting more rushed and thus filled with risks and mistakes. The lead time in phase A helps to remove problems and risks that might surface during the execution which have a negative influence on the project for all partners.

Despite the benefits contractors are hesitant to participate in the method, especially when they have no previous experience with it. While the ideas behind it and the implementation are solid, the first impression of the method to contractors is strict and not open for collaboration. Contractors feel they are getting all the risks and not anything in return.

The efficiency of the Aronsohn contracting vision in comparison to the other contract forms is less clear cut. While all contractors indicate they prefer the method over the traditional contract, most indicate that they prefer some more forward integration. Despite that wish the current incarnation of the contract form could serve as an intermediate contract in which the contractors can prove they are capable of participating in the design phase. The vision could also be a good addition for a contractor to try out an innovative approach before participating in more far reaching innovative contracts.

Findings

Concluding from the above there is definitely room for the Aronsohn contracting vision in the current building practice. It offers opportunities for both the contractor and the client to gain additional (indirect) benefits from the project. The increased certainty for the client and the earlier inclusion of the contractor are two of the strong points and align with the initial idea of the method. There is however a number of points the vision can be enhanced on to appeal to more contractors and perform better.

The key point of the contract form resolves around giving and taking in equal measure. If contractor and client align to more common goals and offer, within reasonable limits, space to each other to strive for individual goals all parties could benefit. The contract tries to facilitate this

but takes a very client centred approach to it, making the contract form more interesting for the clients than for the contractors.

As with any contract form the Aronsohn vision isn't a catch all method. It's not THE contract form, but in certain projects definitely has an added value over the other common contracts. There is no optimal contract form, each project requires a thorough analysis of which contract is most applicable. For large and complex contracts that involve clients with good applicable knowledge about their wishes and possibilities, the Aronsohn contracting vision can outperform the other contracts. Also for renovations there is a definitive benefit to collaborating on the final stage of the design.

10.3 Recommendations

As stated above there are certain features of the contract that can be improved or that can be experimented with. The recommendations below aim at two goals, on the one hand to identify possible improvements for the Aronsohn contracting vision and on the other hand to point out questions which arose during this research that are interesting for future research.

Improvements

Below is a list of possible improvements for the Aronsohn contracting vision. First the improvement is listed, followed by a short explanation.

Earlier involvement of the installations contractor (towards preliminary design)

The method could facilitate and benefit from even earlier involvement of the executing parties in the design process. It's clear that all the contractors, both architectural and installations, would like to be involved in the design process as early as possible. All have picked a certain common innovative contract and prefer to work with that contract form. Some of them have made large investments into developing their skills as designers, this is mostly seen with the installations contractors. They have invested in design and product expertise and can offer significant benefits with earlier inclusion in the design process.

An ideal point is hard to specify but certain key choices about installations are made in the preliminary design stage (VO). The installations contractor could be tendered based on this VO and collaborate with the architect on the definitive design (DO). The architectural contractor can then be tendered based on the DO or DO+ and assist with the detail engineering. This not only allows the client to draw on the expertise of the installations contractor but also deals with some of the interface problems that often exist between installations and architectural contractor about passages and structural adaptations for the installations. This has been done at the FNWI project and yielded favourable results.

Retake the DO step with the contractors on board

Another option is to redo (in a limited fashion) the last design step from before the tender but now with the executing parties included. In this case that could be a revisit to the design step from definitive design (DO) to definitive design+ (DO+) or a bolder take would be from preliminary design (VO) to definitive design (DO). Benefit would be that the client can first design the building to his specifications but that a thorough check with contractor's expertise remains. This will raise the costs though, due to the amount of work that is done twice.

Allow for broader optimizations to be proposed in Phase A

Optimizations are defined very strictly and have to comply with quite some rules, opening this up a bit could lead to more and possibly better optimizations. Currently optimizations are only evaluated when they save money, optimizations with a huge impact but with a small price are therefore officially not considered. This leaves valuable optimizations impossible. In practice these are probably considered and implemented as scope change but the rules in the contract seem very off putting for these optimizations.

Executing parties write or participate in writing the contractual documents

Since the executing parties sign for the state of the contractual documents and take on the responsibility of their contents they should be allowed to write those themselves. Currently the advisors of the client remain in charge of drafting these contractual documents, the executing parties can only review and advice in this process but still have to take responsibility for it at the end.

It would be more logical if the executing parties would also be in charge of drafting these contractual documents, this would be more in line with their later responsibility. The advisors of the client would still be involved and probably be in charge of the first draft but further in the process their role will change into a more auditing one. The advisors then verify whether the contractual documents are in order, they check on the contractor's work, instead of the other way around.

Another approach to trust

The current outline and explanation of the contract form seems very constraining to a number of contractors. Their understanding could be improved (see below) or the approach to trust and collaboration could be reversed. Currently the contract is very strict and the contractor is forced by a number of passive malus incentives to collaborate. This goes against the spirit of collaboration and the whole idea of giving and taking in equal proportions. A possible solution would be to reverse this and work by trusting the contractors up front and ensure systems are in place to deal with opportunistic behaviour if and when it arises. This approach is then more in line with the small steps approach to trust building in this thesis. For additional safety this could be done with contractors who have worked in the method before to foster further relations.

Better understanding of the contract form

The contractors who never worked with the contract form before indicated that the intent of the contract is difficult to assess due to the strict tone. This is seen as a risk for them, if the contract form was better understood this risk will be lower and bids might end up lower. The very strict tone of the contract could in places be revised in softer or more explaining terms.

Apart from the terms also the intention of the contract and the contractual partners should be made clear from the beginning. Contractors often fear that the possibility to influence on the design in phase A is limited and depends entirely on the will of the client and architect to participate. By making sure that at the start of the tender all parties involved know what the intention is and what the boundaries for the collaborations are, the trust in the contract form could be higher and the offered prices might be lower.

A common missed notion is that of reasonableness and fairness. While officially the contract is very strict about added work claims, in practice things happen that none could have foreseen. These risks don't automatically fall to the contractor due to the clause he signed, but are resolved between client and contractor based on reasonableness and fairness. The client does has more power here than the contractor since he theoretically could point to the signed clause and not compensate the contractor.

Future evaluation

During this thesis a number of interesting conclusions surfaced that could warrant further research. Some of these are related to the contract form while others are more academically inclined.

Contractor involvement when, how, how far and in which projects?

Standing apart from the Aronsohn contracting visions the most interesting question is how far the contractor should be integrated into the design process. The different contract forms each take their own approach and have their pros and cons, the fact that the design can improve from earlier contractor involvement stands without a doubt. However involving the contractor too early can also be pointless. When you tender everything to a contractor who proceeds to hire the same or a comparable architect as you would then there is not much benefit to be gained. A research into the key performance indicators for contractor involvement into the design process would shed an interesting light on this question. There are a large amount of factors that influence this choice, to name a few: contractors experience with innovative contracts, contractors design capabilities, stakeholder involvement, level of complexity, size of the project, technical knowledge required, design goals, client's knowledge and many more. While a lot of research has been done into the benefits of earlier inclusion of the contractor there are not many studies that specify how much earlier he should be included. This could be an interesting theoretical study for a graduation project.

Time benefit

It remains a question whether there is truly a time benefit for the whole project. Contracts delivered using the Aronsohn contracting vision were more on time than the traditional contracts but it remained unclear whether the extra time in phase A is compensated by the quicker execution. Research could be done comparing the total project time of a number of traditional projects with a number of Aronsohn contracting vision contracts. The focus should lie on the time phase A takes in comparison to a traditional contract and if it takes longer on whether this additional duration is compensated by the quicker execution.

Improving quality of contractual documents and design?

A thorough comparison of the contract documents from traditional projects and projects managed with the Aronsohn contracting vision should give insight into whether the contractual documents really improve. It is clear there are changes but the effect is less noticeable from the client's side. Due to the declaration of the contractor, they are 100% correct for the client but whether this is really true remains a question. Comparing the finished specifications with others might yield interesting results.

The same evaluation could be done on the optimizations that are implemented in phase A. While all parties agree the performance increases the design doesn't get better. Why is this perceived that way and how can the design (better) be optimized?

Why the budget is always consumed (scope creep, gold plating?)

In each of the evaluated projects the total budget was (nearly) consumed, the reduced expenses on added works were always used to incorporate additional wishes. None of the projects took the profit. Why is this happening? Further research should aim at finding out if the additional money is spent on improving the total performance and whether this was a beneficiary choice, did it indeed raise the value for money count or were the additional wishes not needed to satisfy the original scope and could the money better be spend elsewhere.

Whether the shift from unwanted added works to wanted scope change is genuine

Officially the contractor cannot claim any additional work during the execution, during phase A he can comment on the constructability and propose changes and optimizations. The research indicated the amount of added works decreased and the amount of scope change increased. This can be explained by the fact that the client uses the additional money to fulfil his wishes but it could also indicate that; something which is characterized as an added work in a traditional contract is now changed into scope change. In the analysed projects this was not the case but the risk exists that the contractor could try to do this.

In a traditional contract the contractor would demand an added work for a detail that is not designed properly and needs to be changed. Theoretically in the Aronsohn contracting vision the contractor could point that out and propose a better working detail. If this is accepted by the

client it is counted as scope change, if the client declines it as scope change the contractor officially has to find a budget cut to facilitate the change. However if the project is nearing the end of phase A and no budget cuts can be found certain points could be labelled as scope change to facilitate continuation of the process. Then there is a shift from added work to scope change. Whether this is happening could be interesting to research.

Chapter 11 Reflection

When concluding a research it is customary to critically look back at the concluded work and point out possible weaknesses and limitations in it. In empirical science two concepts are very important; the reliability and the validity of the research. The applied nature of this research adds a third important criterion, namely the usability of the results. In this chapter these criteria are used to evaluate the research. The chapter concludes with a personal reflection on the subject and the process of the research.

11.1 Reliability

The initial literature study is based on multiple recognized authors in the field and since multiple opinions are combined the results are to be trusted. The choice of how to meld those opinions together, however remains with the researcher and could be different with another approach. Other drawback is the known gap between theorem and practice, especially in the construction sector this gap is often quite large, thus some of the theoretical ideas might end up very different in practice. The conclusions from the literature study often concern the different contract forms in a theoretical vacuum.

The case study in this thesis is based around three completed projects and a project in the start up phase. Due to the limited number of projects, increasing the amount of projects will provided statistically better results. This was impossible since the number of completed projects was very small and the time limits of this research. A quick evaluation of the other projects shows the same signs though. The analyzed materials in the quantitative case study are all factual representations of the projects, so the results based on those are reliable and reproducible.

In the interviews the most information about the contract form as a whole is gathered. For each project multiple parties with different goals have been interviewed to increase the reliability. However due to time constraints certain groups in the contract have not been interviewed. The roles interviewed are chosen with care to provide a correct average of the involved groups but including the left out roles will improve the reliability and add more experiences to base the conclusions on. Especially the end users and the advisors could provide interesting insights into the workings of the method.

Lastly the interviews are worked out based on notes made during the interview, these transcripts are then corrected by the interviewees so the results are quite reliable. The final interpretation of the results is highly dependent on the atmosphere during the interviews and the experience of the researcher and thus less easy to replicate.

11.2 Validity

The number of case study projects that are used both as the baseline and as the study objects are drawn from the archives of Aronsohn Raadgevende ingenieurs. Care is taken to select projects that fall within certain common criteria but the total library of projects was too small to get a large and consist enough sample. Due to the limited time available for this research and the limited amount of projects available only three projects are evaluated in detail.

The data presented about the performance of the Aronsohn contracting vision is derived from three projects and thus has a rather limited statistical value. The results therefore shouldn't be treated as more than an indication of a phenomenon, to statistically prove that the contract form

indeed works a way larger amount of reference projects need to be included, which was impossible. Further complicating is the fact that all projects took a slightly different approach in applying the Aronsohn contracting vision due to progressive insight into the workings of the contract form. The observed trends however are quite distinct and often supported by the interviews which is an indication the data is largely correct.

11.3 Usability

The most important aspect of an applied research is the usability of the results. This thesis had two initial goals based on the two different clients. On the one hand Aronsohn Raadgevende ingenieurs wanted a thorough evaluation of their contract form to prove that it is indeed effective and to find possible optimizations; on the other hand the TU Delft wanted an evaluation of a possible new contract form to be used in the current construction practice.

This research manages to fulfill both goals although the first goal has been fulfilled better. Insight into the opinion of clients and contractors is gained and based on that a number of problems with the method were indentified. A number of the proposed optimizations are already put to good use in a new application of the Aronsohn contracting vision. The results of this thesis can also serve as promotion and the insight gained is valuable for future adaptations. Therefore for Aronsohn Management raadgevende ingenieurs the usability is very high.

The scientific usability of the research is harder to specify. A line up of the currently used contracts is made and a strong comparison presented between them. Based on this comparison and the interviews it is concluded that the Aronsohn contracting vision has its own place between the different contracts and that the general idea could be interesting to explore further. Apart from that the research also saw the theoretical problems regarding forward integration of the contractor into the design process. While not offering the solution this research can serve as a support and starting point for further research into this.

11.4 Reflection

Looking back on the process of a research can be confronting but it nonetheless is essential to find points to improve and look at lessons learned. Looking back however is also dangerous since with the knowledge of now somethings that might look trivial weren't the first time. For me looking back is looking at ways to improve myself and find handholds for future reports and maybe even a promotion research.

Biggest learning experience is once again to make sure that the goals and the scope of the research are set before engaging in any reading. This started out great for this thesis but somewhere in the literature study some dead end roads where taken that lead nowhere.

Another important point for me is the cohesion, the research should build on the results of the previous phases. Trying to run those phases in parallel makes things harder and blends the lines on which conclusion comes from where.

The last thing to comment on is to look beyond the obvious and go over boundaries between the traditional sciences to find answers and analogies that seem important.

Looking back I'm happy with the results of this research but also confronted by a number of things I would like to have done differently or researched more elaborately. Nonetheless the presented results are solid and offer handholds for others to step upon and expand this research.

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List of figures

Delft University of Technology
Faculty Civil Engineering and Geosciences
Stevinweg 1
2628 CN Delft
015-2785440
www.tudelft.nl

Aronsohn Management
raadgevende ingenieurs bv
Lijnbaan 131
Postbus 2401
3000 CK Rotterdam
010-2808080
www.aronsohn.nl