Master thesis

Research into a framework to make stakeholder values explicit during assessment processes in construction projects

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Preface

This report concludes the final phase of my study programme at the Delft University of Technology. The topic of interest is related to the field of 'Construction Management and Engineering' and covers a research into how stakeholder values can be made explicit and if so, how a framework could contribute to more meaningful assessment processes between stakeholders in construction projects.

During the past 1.5 years I have performed this research for the TU Delft in collaboration with Dutch Process Innovators (DPI), a management consultancy firm. The outcome of this master thesis serves as a guideline for many practitioners who are involved in assessment processes in which values form a decisive factor in communication and alignment of interests. Furthermore, the outcomes serve as an academic foundation for further research on this topic.

The practical study of this research was performed within Bouwteam 'Sewage Treatment Plant Terwolde'. The group of respondents provided me with a useful test environment. I would like to thank this group of people in advance for their devotion and cooperation. This helped me to get a unique view of how stakeholders in Bouwteams collaborate and how applicable the framework is to make values explicit during assessment processes.

I have passed and undergone many personal obstacles during my research. Without the infinite support that my supervisors have provided me with, I would not have been able to overcome these obstacles. Therefore, I would like to thank my first and second supervisor – Ir. L.P.I.M. Hombergen and Dr. Ir. A. Straub – in particular for their trust and dedication to support me during this process. Furthermore, I would like to express many thanks to my external supervisor Philine Goldbohm. We went through some challenging times in which her support enabled me to rationalize the graduation process. Philine made me feel being heard and understood. DPI have provided me with a more than welcome heart and provided me with all necessary support to make this research a success.

There have been one person who was mostly involved in my personal process who I would like to shed light upon. Marleen Vos – my dearest and most beloved friend – have helped me through the biggest personal obstacles and brought me the courage, dedication and perseverance to finalize my studies successfully. Without her intense support I would not have been able to provide you with the report that lays in front of you today.

I hope you enjoy your reading.

Vincent Ligthart

Delft, August 13, 2021

Executive Summary

Introduction

Humans are confronted with trade-offs on a daily basis. The choices that we make are guided by the principles which shape our behaviour: Values (Rokeach, 1973). In construction projects – characterized as a temporary endeavour – values seem to have an effect on how stakeholders, such as clients, contractors and end-users estimate project success (Hjelmbrekke & Klakegg, 2013).

A successful construction project does not just rely upon the condition of the final deliverable. Success is subjective and is a result of the sequence of justifiable choices that stakeholders have made during the design process (Martinsuo, Klakegg, & Marrewijk, 2019). To make justified design choices, stakeholders have to align their interpretations of values which seems to be crucial to deal with the divergence that exists (Bos- de Vos, 2020).

Ideally – to facilitate a meaningful assessment process – this divergence about interpretations of values should be part of the conversation. However, the difficulty that emerges when doing so is formed by inefficiency in the process. Many conversations lead to endless discussion about what is right or wrong. The aim of this research is to find a methodology which helps to make values explicit and assist in a meaningful assessment process.

This research provides an answer to the following research question:

How can stakeholder values be made explicit to support assessment processes in construction projects?

Methodology

The approach to answer the research question consists of a qualitative study in which a literature review and case study research have been performed. The first part of literature aims to provide the reader with an understanding of how values are defined. The second part of literature is devoted to a description of possible methods which are used nowadays to make values explicit. The final part of literature provides insights into why making values explicit is such a difficult undertaking.

The researcher then selected a method which could be of help in overcoming the difficulties to make values explicit during assessment processes. The Analytic Hierarchy Process (AHP) was executed in a single case study project. The researcher used a manual AHP-module to facilitate an assessment process concerned with the design of the commercial building within Bouwteam project 'Sewage Treatment Plant Terwolde'. Three steps were executed sequentially:

1. Formulation of the assessment context;
2. Participant judgement of criteria and alternatives;
3. Group discussion about the outcomes.

The outcomes of the group discussion and corresponding process that followed from steps 1 and 2 were analysed by the researcher to provide an understanding of the applicability and meaningfulness of the AHP-method for assessment processes.

Literature findings

The literature study provided insights into how to define values. Generally, one can distinguish values as 'qualities with worth' (Bowman & Ambrosini, 2000; Laursen & Svejvig, 2016) and 'ideals and beliefs' (Friedman et al., 2013). Ideals and beliefs determine the behaviour of individuals, groups and organisations. Furthermore, they influence strategic decision making (Rindova & Martins, 2017). Stakeholders within organisations translate ideals into prospective goals which are concretized in the mission and vision that the organisation propagates.

Abstract concepts on a strategic level have to be translated into measurable units to make sure that ambitions and prospective goals will be achieved. To do so, stakeholders assign performance criteria to an object. Since lots of performance criteria exists, a categorization can be made (Vos- de Bos, 2020). A distinction can be made between performance criteria concerned with the use value (the realized utility), social value (impact on people), economic value (generated income or expenses) and ecological value (impact on the environment).

Prioritization of performance criteria requires knowhow and experience about the consequences or effects of a choice. Existing theoretical methods provide ways to make explicit what the effects or impacts of certain design options or alternatives are, such as the Cost-Benefit Analysis (MKBA, n.d.). Other methods are used to help in identifying functions and help to deviate between primary and secondary objectives to get an understanding of what design aspects are considered as indispensable, such as Value Engineering techniques.

The bottom line that is found from studying multiple methods is that these methods require specific skills and knowhow of the user. Cost-Benefit Analysis requires understanding of welfare effects and economics, whilst Value Engineering techniques require a very good understanding of systems, subsystems and components (Systems Engineering). Since multiple stakeholders with diverging backgrounds are involved in construction projects, the researcher aimed to search for a method which is accessible, transparent and easy-to-use for stakeholders with diverging backgrounds and interests.

The Analytic Hierarchy Process (AHP) seemed to be suitable for this context. The Analytic Hierarchy Process is a Multi-Criteria Decision Making Method (MCDM-method) which makes use of subjectivity in assessment processes. AHP is able to prioritize both quantitative and qualitative trade-off aspects which makes the tool suitable to compare apples with pears.

Practical findings

1. Formulation of the assessment context

The literature findings have shown that values are ambitious and are usually measured by translating ambitions and goals into functions and performance 'standards'. However, literature does not provide a certain prescribed methodology which helps to simplify value assessment and can aid the dialogue between stakeholders. Therefore, the researcher searched for an assessment context in which it would be possible to explore a new approach by the Analytic Hierarchy Process.

The case study project 'Bouwteam Terwolde' offered a unique test environment for the researcher. After several meetings with the project managers from client and contractor, an assessment process was identified which was concerned with the realization of the commercial building of the sewage treatment plant. The Analytic Hierarchy Process was applied by making use of a web-based application (https://bpmsg.com/ahp/ahp-calc.php).

To formalize the assessment context, the researcher used the categorisation of performance criteria according to literature (Vos- de Bos, 2020). At the time of execution of the web application, two design alternatives were on the table: Renovation of the existing commercial building and Rebuilding at a different location. Eleven respondents were asked to prioritize their interests. The researcher selected stakeholders which were closely involved and had a mandate to make decisions. The group was formed by the 'core team' and core team + (expert panel).

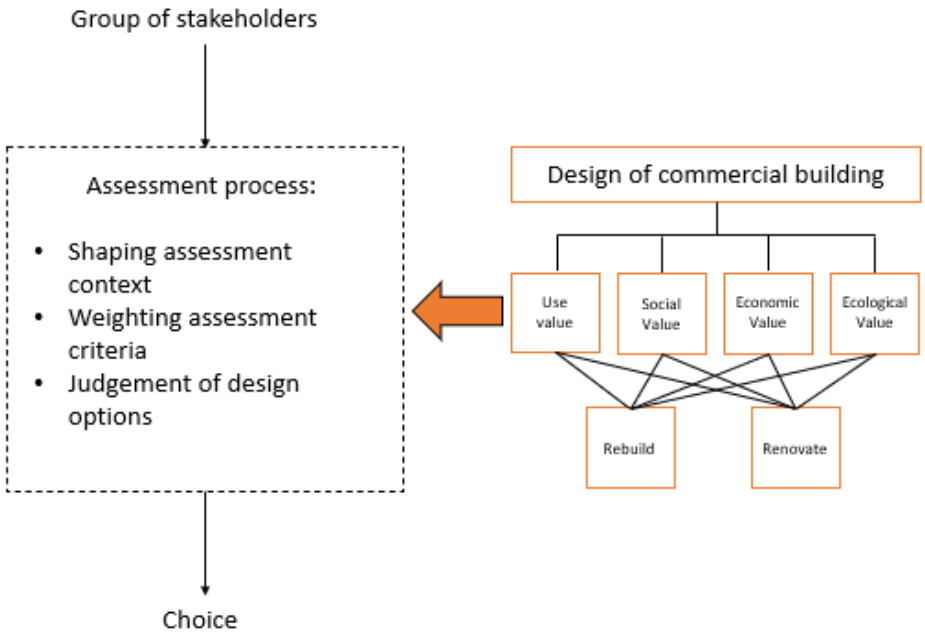


Figure 1: Composition of the Analytic Hierarchy Process (orange) and a schematic overview of the assessment process – conceptual framework. Source: Own image.

2. *Judgement of criteria and alternatives*

The participants had to prioritize two 'levels' in the assessment hierarchy. First, an assessment was made in which the four criteria were prioritized in pairs (Figure 2, left). Second, both design options (rebuild and renovate) were judged against each individual criteria (Figure 2, right). An overview of the steps that were necessary to facilitate the judgement procedure can be found in Appendix A: Process steps AHP web application.

Participant	Use value	Social Value	Econ. Value	Ecol. Value	CR_{max}
Group result	44.0%	29.0%	15.6%	11.3%	6.9%
USER 1	69.1%	19.8%	8.3%	2.8%	37.3%
USER 2	62.7%	23.9%	9.5%	3.8%	28.7%
PROJECT MANAGER 1	44.7%	21.6%	4.2%	29.5%	9.1%
PROCESS MANAGER	66.5%	7.1%	22.8%	3.6%	25.3%
SUSTAINABILITY MANAGER	30.9%	30.9%	14.2%	24.1%	5.7%
TECHNICAL MANAGER 1	62.1%	22.3%	11.8%	3.8%	25.9%
CONTRACT MANAGER	44.2%	45.5%	5.1%	5.2%	0.1%
COST EXPERT	8.3%	3.1%	67.1%	21.5%	35.4%
PROJECT MANAGER 2	3.7%	41.2%	10.6%	44.4%	18.7%
TECHNICAL MANAGER 2	27.8%	57.0%	10.9%	4.3%	3.7%
ENVIRONMENTAL MANAGER	53.4%	27.4%	12.4%	6.8%	16.3%

Participant	RENOVATE	REBUILD	CR_{max}
Group result	45.7%	54.3%	0.0%
TECHNICAL MANAGER 1	53.0%	47.0%	0.0%
USER 1	32.7%	67.3%	0.0%
SUSTAINABILITY MANAGER	57.4%	42.6%	0.0%
CONTRACT MANAGER	44.2%	55.8%	0.0%
TECHNICAL MANAGER 2	44.1%	55.9%	0.0%
ENVIRONMENTAL MANAGER	49.1%	50.9%	0.0%
COST EXPERT	30.1%	69.9%	0.0%
PROJECT MANAGER 2	65.5%	34.5%	0.0%

Figure 2: Overview of distribution of interests (left) and preferred design option (right). Source: Own image.

3. Group discussion about the outcomes

The outcome of all judgements made by the participants was used in a group discussion to find out if the AHP-module outcomes made sense for the participants. The researcher had the advantage to steer the conversation by starting with the outcomes of the assessment process. Clearly, the project manager (indicated by project manager 2 in Figure 2) took a different point of view and had a clear preference to renovate the commercial building. In addition to some general questions, the researcher had the opportunity to ask the project manager some specific questions about this 'diverging' point of view.

Four questions have been asked, for which the answers form the most essential results of this thesis research:

Question 1: Does the prioritization according to Figure 2 make sense to you [open question to the group]

- **The respondents recognized themselves in the outcomes of the AHP-module regardless of the fact that they argued about the interpretation of criteria;**
- **Decisive in the prioritization of both design options were sustainability considerations.**

Question 2: "Project manager 2, did you expect this result?" &

Question 3: "How did you get to this allocation of preferences?"

- **The project manager gave himself a 'license to diverge' from the rest of the group and positioned himself as an outlier;**
- **The project manager identified a disbalance in the allocation of criteria and expressed his concerns about the consequences for future assessment processes.**

Question 4: "Would you fill in the tool assessment differently based on the precede discussion?" [open question to the group]

- **Some participants stressed the importance that assessment of criteria according to professional values may lead to different results than by following personal values;**

Besides the answers on the four questions that were asked during the group discussion, the researcher had found some important remarks:

A. To get an understanding of the assessment context, it is important to involve the technical manager as early as possible.
B. Organize for two separate AHP sessions to make explicit if there are differences to be observed between a person's gut feeling and 'knowhow'.

Conclusion

The outcomes of the practical application of the Analytic Hierarchy Process shows that the AHP-module can be successfully integrated in an assessment process to make values explicit. The biggest advantage that the AHP-module offers is that multiple stakeholders can follow a very transparent and justifiable judgement process, since the potential outliers in the process can be identified.

The questions addressed during the group discussion were useful to find that the method does not just make values explicit but can also provide an understanding of the group dynamics in a Bouwteam project.

Discussion

The outcome of this thesis research brings some discussion points which are further elaborated in Chapter 7. The main discussion points have to do with:

- The implications that follow from the observed differences between personal and professional values;
- The use of the AHP module to clarify if differences in values can be bridged;
- The importance of the 'Use value' of an object and the way in which other categories (Social value, economic value and ecologic value) are worthwhile to consider during assessment conversations;

Recommendations

- The results of this research clearly illustrate that the participants are curious about the additional possibilities that this framework generates, including:
    - The use of the framework to visualise role authenticity;
    - The use of the framework to relate project team values with parent organisational values;
    - The use of this framework to measure and manage the 'alignment' between different stakeholder groups, such as client, contractors and users.
    - The use of this framework to measure whether values converge during the course of the Bouwteam phase.
    - The use of this framework to measure the 'alignment' of the project team with the user's desires.
- Furthermore, the researcher suggests further research into the role of the AHP model as a value engineering/ value management technique. This may suggest to integrate life cycle costs and decision scenarios to measure, identify and solve critical value contributing factors during the building process.
- This research has shown that values play an important role in the decision making processes. The composition of project members is of significant influence. Members should be 'progressive' and transparent where mutual trust is key for a successful project. An interesting topic for further research is stakeholder composition and the effects of that composition on implicit and explicit decision making. The optimal team composition perhaps contributes to a more integral design and optimal value for stakeholders.

Managementsamenvatting

Introductie

Dagelijks worden wij geconfronteerd met het maken van afwegingen. De keuzes die we maken worden gedragen door de principes die ten grondslag liggen aan ons gedrag: Waarden (Rokeach, 1973). Binnen een bouwproject – gekenmerkt als een tijdelijke 'onderneming' – blijkt dat deze waarden effect hebben op de manier waarop stakeholders als opdrachtnemer, opdrachtgever en gebruiker het project beoordelen (Hjelmbrekke & Klakegg, 2013).

Een bouwproject wordt als succesvol ervaren als de betrokkenen zich gehoord en gedragen voelen bij keuzes die zijn gemaakt (Martinsuo, Klakegg, & Marrewijk, 2019). De opvatting dat een succesvol bouwproject kan worden beoordeelt op het 'eindproduct' is daarmee achterhaalt. Om te verantwoorde keuzes te maken zullen betrokkenen hun waarden moeten uitlijnen. Juist om de diversiteit die bestaat in interpretaties van waarde(n) het hoofd te kunnen bieden (Bos- de Vos, 2020).

Idealiter moeten deze interpretatieverschillen dan besproken worden. Echter, de moeilijkheid in het bespreekbaar maken van waarde(n) zit in de inefficiëntie van het gesprek. In de praktijk leiden gesprekken over waarden vaak tot oneindige discussie. Het doel van dit onderzoek was om een instrument te ontwikkelen dat helpt bij het expliciet maken van waarden en tegelijkertijd ondersteuning kan bieden aan een betekenisvoller afwegingsproces.

Dit onderzoek geeft antwoord op de volgende hoofdvraag:

Hoe kan het expliciet maken van stakeholder waarden ondersteuning bieden aan afwegingsprocessen in bouwprojecten?

Methodologie

De aanpak die gehanteerd is voor dit onderzoek bestaat uit een kwalitatieve studie onderverdeeld in een literatuurstudie en praktijk casus onderzoek. Het eerste deel van de literatuur geeft de lezer een beeld van hoe waarden gedefinieerd worden. Het tweede deel van de literatuur is toegewijd aan een beschrijving van mogelijke methoden die hedendaags gebruikt worden om waarden expliciet te maken. Het derde en tevens laatste deel van de literatuur geeft inzicht in de moeilijkheid in het expliciet maken van waarden.

Op basis van de literatuurbevindingen heeft de onderzoeker een passende methodiek gekozen die in de praktijk is getoetst. Het Analytisch Hiërarchisch Process (hierna: AHP) is uitgevoerd in een enkelvoudige casus opstelling. De onderzoeker heeft een conceptueel raamwerk (module) gebruikt om een afwegingsproces te faciliteren binnen bouwproject 'Rioolwaterzuiveringsinstallatie Terwolde'. Het afwegingsproces was gericht op het maken van een gedragen ontwerpkeuze voor het bedrijfsgebouw.

De onderzoeker heeft daarbij drie stappen uitgevoerd, te weten:

1. Formaliseren van het afwegingskader;
2. Ondersteunen bij het wegen van criteria en beoordelen van varianten door de participanten;
3. Gefaciliteerde groepsdiscussie over de bevindingen uit stap 2.

De uitkomsten van de groepsdiscussie (stap 3) en het proces dat daaraan voorafging (stap 1 en 2) zijn geanalyseerd door de onderzoeker om te bepalen of de AHP module toepasbaar en betekenisvol is voor het beoogde gebruik binnen afwegingsprocessen in bouwprojecten.

Literatuur bevindingen

De literatuurstudie heeft een overzicht geboden in hoe waarden kunnen worden gedefinieerd. Een onderscheid kan worden gemaakt tussen waarden als 'kwaliteiten met een bepaald nut' (Bowman & Ambrosini, 2000; Laursen & Svejvig, 2016) en 'idealen en overtuigingen' (Friedman et al., 2013). Idealen en overtuigingen bepalen het gedrag van een individu, groep of organisatie. Daarnaast beïnvloeden deze strategische besluitvorming (Rindova & Martins, 2017). Organisaties vertalen overtuigingen in toekomstige doelstellingen welke concreet zijn gemaakt in de missie en visie die de organisatie uitstraalt.

Doelstellingen zijn op een strategisch niveau vaak abstract geformuleerd en zullen daarom binnen bouwprojecten concreet 'meetbaar' moeten worden gemaakt om te kunnen worden behaald. Hiervoor kennen betrokkenen binnen een bouwproject prestatiecriteria toe aan het object. Omdat een veelvoud van mogelijke prestatiecriteria bestaan kan een categorisatie worden gemaakt (Vos- de Bos, 2020). Een onderscheid kan worden gemaakt tussen prestatiecriteria die van doen hebben met de gebruikswaarde (de utiliteit), de sociale waarde (impact op mensen), de economische waarde (gegenereerde inkomsten of uitgaven) en de ecologische waarde (impact op de natuur).

Het prioriteren van prestatiecriteria vraagt om de nodige kennis en kunde met betrekking tot de effecten (gevolgen) van een keuze. Huidige methodieken bieden manieren om expliciet te maken wat de effecten van bepaalde keuzes zijn, zoals de (Sociale) Kosten-baten analyse (MKBA, n.d.). Andere methodieken worden gebruikt om functies van een object te identificeren en een onderscheid te maken tussen primaire en secundaire functies van een object, zoals 'Value Engineering' technieken.

Alle methodieken vragen om een specifiek deskundigheidsgebied. Zo vraagt de Kosten-Baten analyse om een inschatting te kunnen maken van de welvaartseffecten van een keuze (vanuit economisch perspectief). 'Value Engineering' methodieken vergen deskundigheid op het gebed van systemen en de verhouding tussen subsystemen en componenten (vanuit Systems Engineering perspectief). De onderzoeker is daarom op zoek gegaan naar een methodiek om op een toegankelijke en transparante manier de waarden expliciet te kunnen maken zonder dat daar specifieke kennis voor nodig is.

Het Analytisch Hiërarchisch Proces bleek een uiterst geschikte methodiek. De methodiek staat bekend als een Multi-criteria besluitvormings-methode welke gebruik kan maken van de subjectiviteit in afwegingsprocessen. AHP kan zowel kwalitatieve als kwantitatieve factoren paarsgewijs vergelijken waarmee de tool het mogelijk maakt om op basis va onderbuikgevoel een eerste indruk te krijgen van de uitlijning van waarden tussen betrokkenen.

Praktische bevindingen

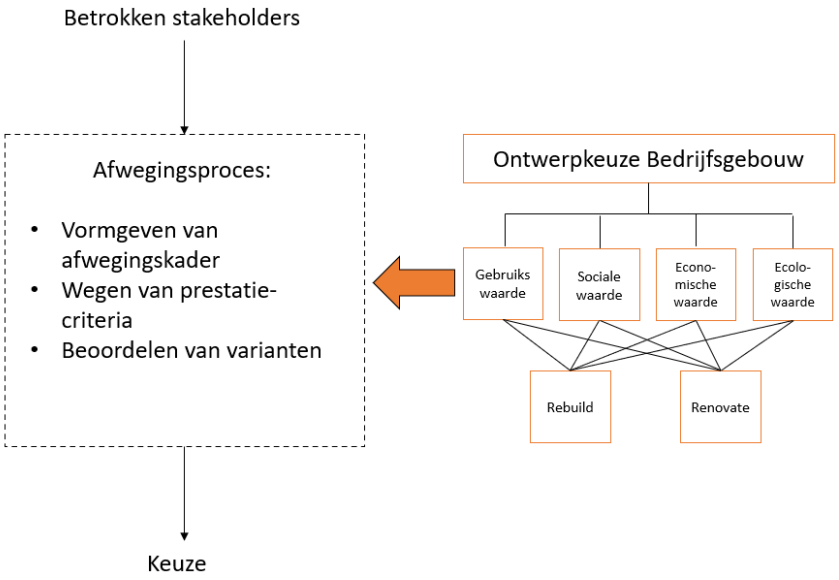
1. Formuleren van het afwegingskader

De literatuurbevindingen bieden inzicht in het ambitieuze karakter van waarden. Waarden kunnen klaarblijkelijk worden gemeten door ambities te vertalen in doelen, functies en prestatie standaarden. De literatuur biedt echter geen kant-en-klare methodologie die helpt om de afweging van waarden te vereenvoudigen en daarmee de dialoog tussen betrokkenen betekenisvol in te richten. Daarom is de AHP methodiek toegepast om op zoek te gaan naar een manier om hiermee om te gaan.

De methodiek is toegepast in een Bouwteam samenwerking. Een Bouwteam is een nieuwe vorm van samenwerken waarbij de opdrachtnemer in het bouwproject als expert de nodige uitvoeringskennis inbrengt in het ontwerpproces. Het doel hiervan is dat in een vroeg stadium de nodige risico's en verantwoordelijkheden kunnen worden afgevangen. De onderzoeker heeft binnen het Bouwteam

'RWZI- Terwolde' de toepassing van een online web module van het Analytisch Hiërarchisch Proces getoetst (zie https://bpmsg.com/ahp/ahp-calc.php).

Het afwegingskader is vormgegeven door de onderzoeker door gebruik te maken van de categorisatie zoals omschreven in het framework dat opgezet is door Vos- de Bos (2020). Tijdens de uitvoering van de webapplicatie lagen twee ontwerpkeuzes op tafel binnen het bouwteam: Renovatie van het huidige bedrijfsgebouw en nieuwbouw op een andere locatie. Elf respondenten werden uitgenodigd om een prestatiecriteria te wegen en ontwerpvarianten te beoordelen in twee afzonderlijke sessies. De groep werd gevormd door participanten uit het kernteam en kernteam +.



Figuur 1: Opzet van het Analytisch Hiërarchisch Process (oranje) en een schematisch overzicht van het afwegingsproces - samen het conceptuele framework

2. Ondersteunen bij het wegen van criteria en beoordelen van varianten door de participanten

De participanten werden gevraagd om in twee niveaus van de afwegings-hiërarchie een prioritering toe te kennen. De eerste ronde bestond uit een paarsgewijze vergelijking tussen de vier prestatiecriteria (categorieën). Hierna werden beide ontwerpvarianten paarsgewijs afgezet tegen ieder afzonderlijk criteria. Een overzicht van de stappen die nodig waren om het ontwerpproces te faciliteren kunnen worden teruggevonden in Appendix A: Process steps AHP web application.

Participant	Use value	Social Value	Econ. Value	Ecol. Value	CR_{max}
Group result	44.0%	29.0%	15.6%	11.3%	6.9%
USER 1	69.1%	19.8%	8.3%	2.8%	37.3%
USER 2	62.7%	23.9%	9.5%	3.8%	28.7%
PROJECT MANAGER 1	44.7%	21.6%	4.2%	29.5%	9.1%
PROCESS MANAGER	66.5%	7.1%	22.8%	3.6%	25.3%
SUSTAINABILITY MANAGER	30.9%	30.9%	14.2%	24.1%	5.7%
TECHNICAL MANAGER 1	62.1%	22.3%	11.8%	3.8%	25.9%
CONTRACT MANAGER	44.2%	45.5%	5.1%	5.2%	0.1%
COST EXPERT	8.3%	3.1%	67.1%	21.5%	35.4%
PROJECT MANAGER 2	3.7%	41.2%	10.6%	44.4%	18.7%
TECHNICAL MANAGER 2	27.8%	57.0%	10.9%	4.3%	3.7%
ENVIRONMENTAL MANAGER	53.4%	27.4%	12.4%	6.8%	16.3%

Participant	RENOVATE	REBUILD	CR_{max}
Group result	45.7%	54.3%	0.0%
TECHNICAL MANAGER 1	53.0%	47.0%	0.0%
USER 1	32.7%	67.3%	0.0%
SUSTAINABILITY MANAGER	57.4%	42.6%	0.0%
CONTRACT MANAGER	44.2%	55.8%	0.0%
TECHNICAL MANAGER 2	44.1%	55.9%	0.0%
ENVIRONMENTAL MANAGER	49.1%	50.9%	0.0%
COST EXPERT	30.1%	69.9%	0.0%
PROJECT MANAGER 2	65.5%	34.5%	0.0%

Figuur 2: Overzicht van de belangenverdeling (links) en het voorkeursalternatief (rechts)

3. Gefaciliteerde groepsdiscussie over de bevindingen van stap 2

De uitkomst van alle toegekende wegingen van de participanten is gebruikt in een groepsdiscussie om uit te zoeken of de AHP-module een 'juiste' vertegenwoordiging bood en nuttig was voor de participanten. De onderzoeker bezat het voordeel om het gesprek te sturen vanuit de verdeling van voorkeursalternatieven. Vanuit het resultaat van de projectmanager (project manager 2, Figuur 2) identificeerde de onderzoeker duidelijk divergerend belang t.o.v. de rest van de groep. Daarom heeft de onderzoeker ervoor gekozen om de projectmanager hierover wat vragen te stellen.

Gedurende de groepsdiscussie zijn een viertal vragen gesteld, het antwoord en de beleving van deze groepsdiscussie vormen de belangrijkste bevindingen van dit onderzoek.

Vraag 1: Maakt de verdeling zoals inzichtelijk gemaakt in Figuur 2 sense? [open vraag naar de groep]

- **De respondenten erkende zichzelf in de uitkomsten van de AHP-module. Grootste punt van aandacht was de onduidelijkheid in definities van de vier prestatiecriteria.**
- **Duurzaamheidsoverwegingen vormden de belangrijkste drijfveren van de respondenten voor het voorkeursalternatief.**

Vraag 2: "Project manager 2, verwachtte jij dit resultaat?" &

Vraag 3: "Hoe ben jij tot deze weging gekomen?"

- **De project manager gaf zichzelf een duidelijke licentie om te divergeren van de groep. Hij positioneerde zichzelf daarmee als potentiële 'outlier' binnen de groep.**
- **De project manager identificeerde een disbalans in de uitkomst van allocatie van criteria en gaf te kennen dat het belangrijk is om in toekomstige afwegingen deze disbalans in het achterhoofd te houden.**

Vraag 4: "Zouden jullie deze wegingen/beoordeling anders uitvoeren na dit gesprek?" [open vraag naar de groep]

- **Een aantal participanten gaven aan dat op basis van professionele waarden wellicht andere voorkeuren zouden toekennen dan vanuit hun persoonlijke waardenbeeld.**

Naast het antwoord op deze vier vragen zijn de volgende belangrijke notities op te merken door de onderzoeker:

A. Om een goed beeld te krijgen van het afwegingskader is het belangrijk om zo vroeg mogelijk in het afwegingsproces de technisch manager te betrekken;
B. Organiseer twee verschillende AHP sessies waarin expliciet kan worden gemaakt of op basis van onderbuikgevoel een andere weging tot stand komt dan op basis van een vooraf samengesteld afwegingskader met prestatie indicatoren.

Conclusie

De uitkomsten van de praktische toepassing van het Analytisch Hiërarchisch Proces laten zien dat de AHP-module succesvol kan worden geïntegreerd in het afwegingsproces om waarden expliciet te maken. Het grootste voordeel van deze methodiek is dat diverse betrokkenen een transparant en te verantwoorden afwegingsproces kunnen doorlopen doordat de potentiële 'outliers' kunnen worden geïdentificeerd.

De applicatie heeft daarnaast zijn vruchten afgeworpen voor verdere toepassing binnen het casus project 'RWZI-Terwolde'. Daaruit is gebleken dat met de bevindingen van dit onderzoek het AHP proces ook betekenisvol toe te passen is binnen afwegingsprocessen met een vooraf duidelijk geformuleerd afwegingskader.

Discussie

De uitkomsten van dit onderzoek heeft geresulteerd in een aantal discussiepunten. Deze zijn terug te vinden in Hoofdstuk 7 van dit rapport. De belangrijkste discussiepunten zijn gericht op:

- De implicaties die het onderzoek meebrengt om te kunnen identificeren dat er verschil zit tussen persoonlijke en professionele waarden;
- De manier waarop de tool bruikbaar is om te identificeren of conflicterende belangen/waarden te overbruggen zijn;
- Het belang van de gebruikswaarde en de noodzaak om uit te zoeken hoe deze categorie zich verhoudt tot de andere categorieën;

Aanbevelingen

- De resultaten van dit onderzoek laten duidelijk zien dat de participanten benieuwd zijn naar de volgende mogelijkheden die de tool kan bieden:
    - Gebruik van de tool om rol authenticiteit bloot te leggen, het gesprek hierover aan te gaan en mogelijk de juiste mensen te selecteren op de juiste posities binnen het bouwproject;
    - Het gebruik van de tool om de waarden van een project team te vergelijken met de waarden van de moederorganisatie(s);
    - Het gebruik van deze tool om te meten en te managen of er een convergentie of divergentie zit in waarden tussen verschillende stakeholder groepen zoals opdrachtgever, opdrachtnemer en gebruiker;
    - Het gebruik van deze tool om te meten of waarden convergeren over de fasen in een bouwteam;
    - Het gebruik van deze tool om uitlijning te vinden tussen het project team en de beheerder.
- Daarnaast suggereert de onderzoeker om onderzoek te doen naar welke rol AHP kan vervullen binnen Value Engineering processen, bijvoorbeeld bij het bepalen van primaire en secundaire functies van objecten. Hierbij rekening houdend met de integratie van LCC (total life-cycle cost) en scenario's om te identificeren, meten en oplossen van waarde bepalende factoren in het bouwproces;
- Het onderzoek laat zien dat waarden een belangrijke rol vormen in afwegingsprocessen. De compositie van projectleden heeft een significante invloed hierop. Progressie en transparantie is belangrijk om een succesvol project te realiseren. Een interessant onderzoeksveld is om te kijken naar diverse teams en de impact van deze teams op het gezamenlijk waardebeeld. Daarnaast kan worden gekeken of teams met gelijke waardebeelden ook impliciet dezelfde waarden dragen. Een optimale samenstelling van het project team zou mogelijk besluitvorming versimpelen en leiden tot een integrale projectuitkomst.

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1. Introduction

1.1. Research Context

Construction projects can be seen as driving vehicles for defining, creating and delivering value (Laursen & Svejvig, 2016). A construction project is a temporary affair in which the involvement of three stakeholder groups can be identified: Client, contractor and user. A construction project delivers optimal value and is considered successful if the project meets the value perspectives of the three stakeholder groups. Hjelmbrekke & Klakegg (2013) provide a simple definition of these perspectives: The client requires return on investment, the contractor needs to obtain results that maintain the long-term uphold and the user requires some sort of use value.

The deliverable of a construction project – a tangible product – is developed during a cooperation period between contractor and client. The form of collaboration between these parties determines the level (or degree) of involvement of the contractor in the design process. In a Bouwteam – a relative new form of collaboration in the construction industry – the contractor takes the role of advisor during the design stage. A reason to construct this form of collaboration is a lack of internal expertise by the client on the practicality of the design.

Assessing the value of a design option asks for the input of both client, contractor and user. Value assessment is a continuous effort – throughout a project's lifetime – in which decision makers measure benefits with costs and value in comparison to the initial value expectations of stakeholders (Martinsuo, Klakegg, & Marrewijk, 2019; Artto, Ahola, & Vartiainen, 2016). Value expectations are expressed by ambitions and goals, reflected in the project's delivery model, business model and the organization's portfolio of projects.

During assessment processes in the design stage of a construction project, each design option is mirrored against the project objectives. The design option which best reflects the project objectives is selected by a decision team with a mandate to take decisions. Within these assessment processes, the benefits, costs and value of design options are assessed by quantitative performance measurements. The remaining qualitative aspects are merged with the quantitative outcomes in a trade-off (decision) matrix. The outcomes of these matrices are often used as leading instruments in the final choice of the decision team.

1.2. Problem Definition

Although it seems that engineers have found a meaningful way to measure value, there are many ways that lead to Rome – as indicated by the picture on the cover of this report. Still, construction projects seem to fail in delivering value to both the client, contractor and user. Partly, this problem is solved by the introduction of contracts, regulations and oversight structures. However, values are emergent and competing (Koppenjan et al., 2008). Particularly in Bouwteam projects – with an early involvement of the contractor – different interpretations of project objectives lead too often into misunderstanding and conflict which hampers the progress of the project and leads to dissatisfied stakeholders.

The 'soft' factors in assessment processes have to do with values (plural). Values relate to the expectations and experiences of people (Koops, Coman, Bosch-Rekveldt, Hertogh, & Bakker, 2015). Values can have different meanings, perceptions and definitions (Hjelmbrekke & Klakegg, 2013). Values are in way intangible (Koppenjan et al., 2008). Although actors have very accurate instruments to measure and quantify values, the conversation about the outcomes of these instruments are susceptible to interpretation differences (Mouter, 2012).

The value co-creation process – designing for values in a group context – is complex, not only within a firm but even more in inter-organizational projects (Hjelmbrekke & Klakegg, 2013). Especially when there are both private and public actors involved (Van Marrewijk, Clegg, Pitsis, & Veenswijk, 2008). Public and private actors assess the value of projects differently. For public organizations, the socio-political environment plays a major role in decision-making and behavior which shapes the institutional value system (Kuitert, Volker, & Hermans, 2019).

An alternative methodology which helps to make values explicit during the design stage of construction projects is found necessary to meaningfully address values (plural). Clarity about motives and lines of reasoning of participants during a assessment process is found of primary concern, particularly in the collaborative context of a Bouwteam collaboration. The question that remains is how to incorporate these motives and interests of stakeholders in a meaningful way during an assessment process.

1.3. Research Objective

Although existing methodologies to make values explicit are criticized in this research, the researcher does not suggest to throw current methods in the garbage bin. The objective of this research is to find a unique and alternative way to make subjectivity tangible during assessment processes in construction projects.

This research does not consider values as being good or wrong, but helps to understand the reasoning behind decisions and grasps the underlying motives and rationale of stakeholders that form the driver of their preferences. The final product of this research is a tangible methodology which can be used to identify both diverging and converging interests of stakeholders and helps to steer conversations about values.

1.4. Personal motivation

The personal goal of this thesis is to understand the considerations that people (un)consciously make during decision processes within construction projects. This provides the researcher with new insights that could be of use throughout the researcher's future career as an engineer or consultant. For scientific purposes, the researcher aims to contribute in providing a useful foundation for further research on the topic of value(s) and explication of values during assessment processes.

1.5. Research Object

1.5.1. The Dutch construction industry

The research addresses projects that are part of the *Dutch construction industry*. The construction industry plays a crucial role in the build environment and is concerned with the production and management of physical objects. These physical objects can vary from large infrastructure works to small road maintenance. Construction works are executed by building contractors in a contractual agreement with a client. This research focusses on (semi-) public clients in the public domain.

1.5.2. Bouwteam collaboration

This research particularly targets '*Bouwteam*' collaborations. A (traditional) Bouwteam is a form of collaboration within the construction industry in which the contractor is involved in the design stage of the construction project. The contractor provides expert knowledge about practical aspects of the design. Bouwteams are part of two-phase contracts. A two-phase contract consists of a separate design phase (Bouwteam) and realisation phase..

During a Bouwteam collaboration, the administrative rules of the 'The New Rules' apply (BNA, 2011). The goal of a Bouwteam is to compose a work description including the final design which offers a full description of how to realize the work. The contractor which is involved in the design stage has the privilege to propose the first price offer to the client. The collaboration in a Bouwteam is based on trust and bilateral relationship between contractor and client.

1.5.3. Assessment processes

During Bouwteams, stakeholders seek for the most suitable design solution. This is usually performed during an assessment process. This practical study covers an *assessment process* in Bouwteams, concerned with the assessment of design options.

1.6. Research Questions

The research problem was answered by following a sequence of sub questions. By doing so, an answer was then formulated on the main research question of this research, which is:

RQ: "How can stakeholder values be made explicit to support assessment processes in construction projects?

SQ1: What is the definition of values?
SQ2: What characterises an assessment process?
SQ3: Which instruments (methods) can be used to make values explicit?
SQ4: Which aspects make it difficult to make values explicit during assessment processes?
SQ5: Which instrument is preferred, considering the difficulties in making values explicit and the intended use?
SQ6: How can this instrument be used in practise to make values explicit?

1.7. Research Scope

The research will focus on assessment processes in construction projects. The relative 'novelty' of Bouwteam collaborations provide an interesting field to discover and address stakeholder values.

The researcher chose to search for useful theoretically proved and practical methods which could assist in making values explicit during assessment processes. The researcher used a holistic approach, aiming at cost-benefit analysis, multi-criteria decision making methods, value engineering techniques and value sensitive design methods – including both simple basic principles and comprehensive methods. The researcher aimed to search for a broad description and understanding of value(s) under the domain of 'Value Theory'.

The research addresses assessment processes in which multiple values have to be interpreted, prioritized and discussed. Conflicts in assessment processes can be a consequence of different interpretations of stakeholders about a single value as well as problems that follow from the alignment of multiple values. This research specifically focusses on the alignment of multiple values.

The research is performed under guidance of the company DPI – Dutch Process Innovators – and the Delft University of Technology.

1.8. Research Outline

This thesis report consist of seven chapters, including this introduction. Chapter 2 describes the research methodology. Chapter 3 provides an extensive literature review. Chapter 4 provides the conceptual framework which is formed by literature input and assumptions. Chapter 5 describes the outcomes of the empirical study by providing an overview of results. The last two chapters were devoted to the interpretation and analysis of the results. Chapter 6 provides the general conclusion and sub-conclusions. Chapter 7 provides discussion points and recommendations for further research.

The reader can find the literature sources in the Bibliography at the end of this report. The report consists of three appendices – A, B and C.

2. Methodology

2.1. Introduction

The aim of this research is to provide a framework that can support in making values explicit during assessment processes within Bouwteam projects. The framework should provide both scientists and practitioners with a useful methodology that is able to make subjectivity tangible by focussing on underlying motives and rationale of stakeholders.

In order to fulfil this objective and provide a grounded answer to all sub-questions of this research, this methodology has been elaborated and is divided into four sections. Section 2.2 describes the general approach of this study. Section 2.3 provides the preparations of the research. Section 2.4 provides the data gathering method. Section 2.5 elaborates on the data analysis. Finally, section 2.6 describes the intended results. This methodology is executed according to a structured approach by Verschuren & Doorewaard (2010).

2.2. General approach

This thesis is a qualitative research. The research consists of a theoretical and empirical part. The theoretical part covers the answers to sub-question 1-5. The empirical part particularly focusses on the answer of sub-question 6. Four stages can be identified: Preparations, Data gathering, Data analysis and results.

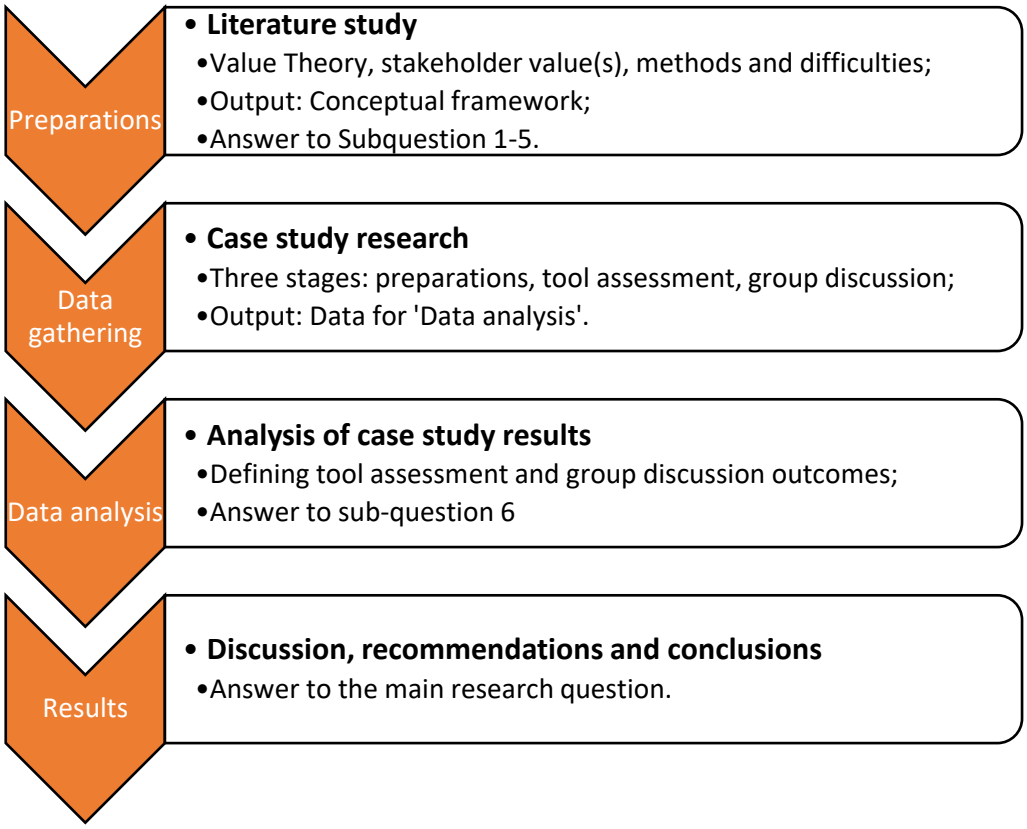

Figure 3: Research overview – General approach.

2.3. Preparations: Literature review

2.3.1. Aim of literature review

The aim of the literature review was to provide the researcher and reader with an understanding of how value(s) are defined and what role they have in the context of assessment processes. The outcome of the literature review is a conceptual framework. The preparation phase was performed to provide an answer to sub-questions 1-5.

2.3.2. Covered scientific domains

This research covers a few domains of literature. An important and at the same time comprehensive domain is 'Value Theory'. The domain of 'Value Theory' covered during this thesis research consists of Value Management principles, Value Engineering methodologies and Value(s) definitions according to management scholars active in the domains of economics and social sciences.

Besides a thorough research on values and the role of values in assessment processes, different methods have been analysed based on their capabilities of supporting the identification, structuring and evaluation of values during assessment processes. Research performed by post-graduate Goldbohm (2016) has provided fruitful insights into the incorporation of values into the management of, particularly, inner-city quay walls. This research extends on this point of view, aiming at the practical application of the Analytic Hierarchy Process to make gut-feeling and stakeholder experiences tangible.

In addition to a comprehensive study on values, a study has been performed on existing methods that can be used to make values explicit during assessment processes. A comprehensive research was performed on the domain of Multi-Criteria Decision Making, Cost-Benefit Analysis, Value Sensitive Design and Value Engineering/Management techniques.

2.4. Data gathering: Case study research

2.4.1. Aim of case study research

The case study research aimed to test and evaluate the conceptual framework with practitioners in an existing Bouwteam project. The intended outcome of the case study research was to test if the conceptual framework would be useful in the assessment process. The case study research consists of three stages: Preparation, Tool assessment and Group discussion. Together, these three stages were elaborated to provide an answer to sub question 6.

2.4.2. Case project description

The empirical research was performed within project 'Circular Sewage Treatment Plant Terwolde'. The project is concerned with the renovation of a sewage treatment plant (STP). The STP is located in Terwolde, a small village located in Voorst, the Netherlands. The STP is located in a remote area. The goal of the project was to renovate the STP with maximum attention to circularity and modularity. The goal was in line with the ambitions and vision of the client of the project, who aimed to implement the principles of the circular economy within the organization – people's minds and work protocols – before 2030 (Waterschap V&V, 2018). The client in this project is water authority 'Vallei and Veluwe'.

The contractor which is selected to perform the works consists of a consortium between four parties. The combination, 'Lokaal circulair', consists of Pannekoek GWW B.V., ADS Groep, Moekotte and Witteveen+Bos. Each firm within this combination brings in expert knowledge on different aspects of the STP. The preparation phase of the project has started in December 2020. The empirical study was performed in March and April 2021, during the early conceptual design stage of the project.

The juridical framework in which the realization of the works is performed follows the rules and guidelines of the UAC-IC 2005.

Figure 4: Sewage Treatment Plant Terwolde - overview of the project location. Source: https://www.voorsternieuws.nl/algemeen/terwolde-krijgt-nieuwe-circulaire-rioolwaterzuivering

2.4.3. Preparations

2.4.3.1. Focus area

The preparations of the case study research were concerned with the formulation of the assessment process and associated design choice and a selection of participants who were invited to join the tool assessment- and group discussion stages.

The tool assessment and group discussion focused on a specific design trade-off. This design trade-off covered the renovation of the commercial building of the sewage treatment plant. At the time this research took place, two options were conceptually developed. The options were: Renovation of the building on the current spot or full demolition and rebuilding at a different location.

2.4.3.2. Group of participants

The researcher invited the core team and core team+ members, consisting of a group of 11 participants. The core team was mandated to take decisions, supported by expert knowledge derived from the core team+ members. The core team consist of five participants. In addition, new/additional insights were gathered from four core-team+ members, including process manager, technical manager, sustainability manager, cost expert. Two additional members were involved, which were involved in the daily business of the STP.

Core team members:

Project manager – Water Board
Contract manager – Water Board
Technical manager – Contractor
Project manager – Contractor
Technical manager – Water Board

Core team+ members:

Manager environment – Water Board
Sustainability manager – Contractor
Process manager – Contractor
Cost expert – Contractor

Additional members:

Supervisor operations – Water Board
Manager operations – Water board

2.4.3.3. Case study document analysis

To fully understand the focus area, a document analysis has been performed. The identification of ambitions, project objectives and stakeholder point of views within the assessment process has been performed by studying the following documents:

- The Plan of Action of the contracting team;
- Documents retrieved from the project Start-Up meeting, these include:
  - Overview of project participants;
  - Overview of ambitions and expectations;
- The project's contract;
- Outcomes of an ambition-web session.

2.4.4. Tool assessment

The second stage of the case study research focused on a tool assessment. An open-source web application of the Analytic Hierarchy Process was used during the case study research to identify stakeholder interests within the assessment process of the design of the commercial building.

Practitioners were asked to run the web application twice. During the first assessment, participants were invited to prioritize value typologies with regards to the goal of the decision process, whilst during the second assessment the participants were invited to prioritize design option 1 and 2 (renovation and rebuilding of the commercial building) with regards to the value typologies. The results that followed from the two sessions have been analysed with participants in a group discussion meeting.

2.4.5. Group discussion

The third stage of the case study research was an interactive (discussion) session with the case study participants regarding the tool assessment outcomes. The researcher took the role of observant and facilitator. During the group discussion session, the researcher asked some very specific questions regarding the outcomes of the tool assessment stage. These questions can be found in section 5.4. Generally, the following subjects were treated:

- Verification of the web application outcomes;
- Discussion about the interpretations of the content;
- Discussion about possible points of improvement.

2.5. Data analysis, Verification, Validation & Processing

The outcomes generated from both the tool assessment and group discussion with participants were analysed based on a comparison between the outcomes of the tool and the reflection of this outcomes by the group of participants. The outcomes have been elaborated in a transcription, which can be found in Appendix B.

The Analytic Hierarchy Process provides an overview of distribution of interests amongst the participants on multiple levels in a decision hierarchy. The researcher interpreted these outcomes based on a oral validation with some of the participants. The second supervisor was involved in the empirical study to validate results proposed by the researcher.

2.6. Results

The results of this research are based upon a discussion and conclusion which form the results from the data analysis phase. The discussion reflects upon the general remarks that have been made during the group discussion with participants. The discussion describes the generalizability of the outcomes and the application of the AHP web application for similar/other case project contexts.

Finally, a conclusion is drawn which provides an answer to the main research question of this thesis research. The conclusion describes if the research was successful and if so, how values can be made explicit to support assessment processes in construction projects.

The limitations of this research have been described at the end of this report, see section 7.4.

3. Literature review

3.1. Introduction

The first stage of this research covers a literature review. This chapter is divided into four sections. Each section covers a sub question of this research. Section 3.2 provides the reader with insights about the ambiguity that exists in literature with regards to how values can be defined. Section 3.3 particularly aims at assessment processes and provides the essential characteristics. Then, the researcher took a more holistic view to find out which methods exist to make values explicit, section 3.4, 3.5, 3.6 provide some of the most relevant methods. To find out which method is preferred to make values explicit in the context of this research, the researcher provides the difficulty of making values explicit in section 3.7.

3.2. The definition of values

3.2.1. Value Theory

Value theory encompasses evaluative aspects of different philosophies, such as moral, social and political philosophies. Value theory describes *how*, *why* and *to what degree* persons value an object or subject (Smelser & Baltes, 2001). An object or subject could be an idea, project, service or anything similar. From a traditional point of view, research focused on the concept of "the good" to find ways to clarify human behaviour (Stanford Encyclopedia of Philosophy, 2016). Latest value theory principles address multiple domains, which helps to understand why people value things in the context of psychology, sociology and economics (Detmer, 1988).

3.2.2. Perspectives on values

Latest value theory principles cover two different perspectives on values. The plural form – values – can be considered as guiding principles: The ideals and beliefs of actors[1] (Rokeach, 1973). Values represent criteria or guiding principles that actors use to evaluate and select their behaviour (Friedman et al., 2013). On the other hand, values can be considered as qualities with worth, referred to as the singular form of value (Bowman & Ambrosini, 2000; Laursen & Svejvig, 2016). From this perspectives, value can be seen as qualities inherently related to tangible subject that represent a certain worth to actors. This worth can be either monetary (for example the generated income) as well as non-monetary (for example the achieved competitive advantage).

Figure 5: The relation between values and value, subtracted from work by Bos- de Vos (2020).

[1] This thesis regards actors as the people involved in a construction project.

3.2.3. Value categorisation

The two perspectives on value(s) presented in Figure 5 can be categorized. Values – considered as guiding principles – can be divided into human values, cultural values and professional values. Whereas human values relate to pleasure, achievement and status of an individual, the cultural values relate to values associated to a team, organisation, sector or nation. Examples of cultural values are equality, authority, and respect for tradition. Professional value got increased attention by scientists as a new classification of values (Bos- de Vos, Wamelink & Volker, 2016). Professional value relates to how individuals or groups act according to the principles of their profession.

Value – qualities with worth – can be expressed by the four categories explained below. The four categories can best be understood by the triple bottom line: Worthiness for people, planet and prosperity.

3.2.3.1. Use value

The term 'use value' is employed by classical economists and strategic management scholars and describes that a commodity – a tradeable object – has tangible features which can satisfy the wish, need or requirement of a group or individual and serves a useful purpose (Bowman & Ambrosini, 2000). The use value is the utility or quality that an object generates for people concerned with the object.

3.2.3.2. Social value

A different way of acquiring worth is to regard value as a non-economic benefit. The social value of, for example, an object could be to generate benefits for human health. Other examples of social value are safety and maximizing opportunity for workers. Social value can relate to different dimensions of people: For instance a single person, a group of persons or the society.

3.2.3.3. Economic value

'Economic value' is the worthiness of a certain product, service, or idea in both monetary as non-monetary terms (Bowman & Ambrosini, 2000). Examples of monetary economic value are income and profit. Examples of non-monetary economic value are reputation and competitive advantage. Economic value does not only focus on the pursuit of monetary worth by commercial firms but also on individual and societal pursuit (Bos- de Vos, 2020).

3.2.3.4. Ecological/environmental value

The fourth category is Ecological value. Ecological value can be understood as the worthiness created for the physical environment. This typology relates, in contrast to the other typologies, to the value that an object generates for the planet.

3.2.4. The definition of value

An ambitious definition of value which, according to the researcher, provides a logic and meaningful description is:

$$\text{Value} = \alpha \ \frac{\text{Satisfaction of needs}}{\text{Consumption of resources}}$$

This definition is retrieved from the NEN-EN 12973 regarding 'Value management' within construction projects (NEN, 2020). The equation considers value as the effective and efficient use of resources in defining, prioritizing and delivering needs. Value is a useful principle that describes how to achieve a balance between contributions which arise from an artifact and the sum of consumed resources and the impacts of their provision (NEN, 2020).

This definition addresses both the desired output or outcome – a level of satisfaction – and the required effort to achieve the outcome – the consumption of resources. Since output is dynamic and measurable, latest insights on the topic of 'Value management' contributes to the understanding of this concept.

3.2.5. Value management

3.2.5.1. Stages

The domain of 'Value management' contains methodologies which provide a structured approach to define and agree upon a perceived need (Connaughton & Green, 2006). In construction projects, a perceived need is expressed by project objectives. A successful value management process includes three phases (Figure 6).

The first phase is value planning. During this stage, briefings and brainstorm methods support in identifying the key objectives of a project. Afterwards, these objectives are analysed extensively by value engineering methodologies to structure, prioritize and evaluate upon the project objectives and translate objectives into plans. Value engineering is a time consuming process. The final phase of the value management process is the value analysis phase. The value analysis phase covers feedback and monitoring processes to determine whether a planned value has been turned into tangible and achievable tasks in the value engineering process. The analysis phase contain methods which validate if the associated tasks have been executed accordingly. Value management can be seen as a continuous endeavour throughout a project.

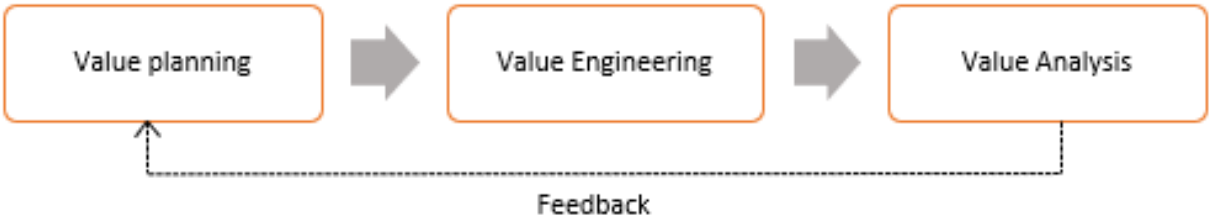

Figure 6: The simplest form of the value management process (Institution of Civil Engineers, 1996).

Value Engineering is, besides a stage in the value management process, observable as a stand-alone process. Value Engineering can be seen as a discipline within the construction industry carried out by value engineers in the role of consultants. Value engineers are concerned with translating ambitious project objectives into unambitious objectives. Value Engineering supports in reaching objectives in a cost- effective way by considering multiple scenarios.

Functions fulfil an important role within Value Engineering methods. The value of a tangible product (or object) is related to its function and cost. Objects can fulfil multiple functions. A product is considered valuable if the total sum of functions deliver added value. Added value is acquired when the total benefits exceed the total effort. The function of an object is expressed by a verb and adjective.

Examples of functions are maximizing efficiency or minimizing CO2- emissions. A structured way of assessing functions is usually performed by function analysis (Figure 7).

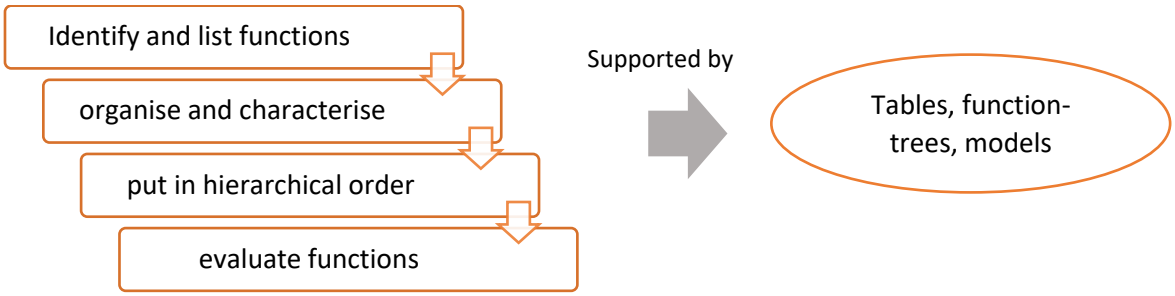

Figure 7: A typical function analysis approach (NEN, 2020).

3.2.5.2. *Value for Money*

The aim of value management in practice is to support actors in determination of the real value of a project. A way to consider the real value of a project is to identify the Value for Money (VfM). VfM refers to how a person or group of actors allocates resources to certain desires. Since desires in construction projects are translated into project objectives, the easiest way to measure VfM is to identify how much effort a participant is willing to assign to the achievement of that objective.

Figure 8: A schematic overview of the process towards Value for Money. Source: Own image.

VfM is expressed by four key principles:

- Develop **e**conomically → achieving a relevant level of quality.
- Develop **e**fficiently → realize the relevant level of quality in the most optimal way.
- Develop **e**ffectively → fit for purpose.
- Develop **e**quitable → distribute relevant level of quality amongst all actors.

3.2.6. Defining quality

Quality is something that is related to satisfaction: quality is subjective. The worth that an object, process or anything else represents for a project stakeholder depends on who you ask to assess this quality. A definition which is closely related to the definition of value according to the NEN 12973:2020 (NEN, 2020) is:

"Quality is defined as the summation of the affective evaluations by each customer of each attitude object that creates customer satisfaction." - (Wicks & Roethlein, 2009)

Quality is often related to fitness for purpose or use. Fitness for purpose means that inputs are efficiently used in such a way that output satisfies the mission and objectives of the customer (Vlãsceanu et al., 2007).

3.3. Characteristics of assessment processes

The previous section shows that values can be defined as the ideals and beliefs of actors. Ideals and beliefs however, do not carry the same weight or level of importance to stakeholders in a construction project. During assessment processes, ideals and beliefs have to be aligned and communicated. This is a crucial step in the value management process.

Construction projects are concerned with temporary collaboration between a group of stakeholders. This section provides the reader with an understanding of what these stakeholder groups really stand for and what roles can be identified. Additionally, an overview is provided of the steps in an assessment process.

3.3.1. Involved stakeholders

3.3.1.1. The client

Within construction projects, the term client refers to a variety of stakeholders. A client can be an experienced client, unexperienced client, public or private client, short term client (developer) and long term client (owner). Each client has a personal view on a project, having beliefs and ideals to strive for both from a personal but also professional and cultural point of view. A client may consist of legislators, end-users, funders and the client is likely to be represented by a business case team and experts for temporary affairs such as projects.

This thesis focusses on projects that involve (semi-)public clients. Public clients serve in the needs and desires of society. Beside public clients, semi-public organizations can be distinguished. Semi-public clients serve the public interest and are publicly financed. Hermans & Eisma (2015) identified the following sectors in the public and semi-public domain:

- Central government;
- Local government: Municipalities and provinces;
- Water boards;
- Housing Associations;
- Universities and colleges;
- Primary and secondary schools;
- Hospitals.

During construction projects, the (semi-)public organisation is held accountable to end-users – though internal commissioning – and market parties – through external commissioning. A professional public organisation should succeed to collaborate with market parties in such a way that the collaboration contributes to the organizational goals of the public organisation, the expectations of end-users and a solid accountability to societal and political expectations (Hermans, Veldhuis & Van Zoest, 2018). A few out of many roles carried out by (semi-)public actors are:

- Procurement advisors;
- Legislators;
- Contract managers;
- Managers maintenance and operations;
- Project developer(s)/leader/initiator(s);
- Risk managers;

- Funders.

Bertelsen & Emmitt (2005) relate clients to complex systems. The client conventionally includes users. This system adds to the complexity of construction projects. Stakeholders are autonomous (may act on their own), having non-linear relations with non-uniform parts: Stakeholders and roles can rotate.

3.3.1.2. The Contractor

The contactor is a body – consisting of either a single organisation or an alliance of multiple organizations – which is concerned with the design and execution of a construction project during a collaborative agreement with the client. The competitive advantage of a contractor has long been assigned to productivity, however the changing role of the contractor in the construction project leads to new viewpoints. Increasing customer value nowadays is an important building block in order to obtain the long-term uphold that is strived for (Hjelmbrekke & Klakegg, 2013).

The contractor is privately financed. The contractor acts in a private circuit, dealing with manufacturers – under the umbrella of subcontractor(s) – which deliver the required tangible resources in case the contractor does not possess these resources himself. Obviously, the contractor interprets the success of a project from the point of view of the production system. This is contrary to the position of the client, which interprets the success of a project from the asset point of view. An asset is a tangible possession which serves multiple needs and interests over a specific time span.

3.3.2. Assessment of public and private values

The differences between (semi-) public clients and contractors can be understood by the two types of values that characterize the culture of these stakeholder groups. Public values are values such as safety, quality of the built environment and sustainability. Stakeholders can perceive public values differently and this subjectivity can lead to trade-offs and competing public values (Koppenjan, Charles, & Ryan, 2008). The public organization is seen as a protector of public values. These values are embedded in the organizational culture. The socio-political environment of the organization shapes the institutional value system (Kuitert, Volker, & Hermans, 2019). Public values have an important role in the strategic behaviour of the public organization.

Private values relate to profitability, competitiveness and market share. Contractors are internally criticized and judged based on income and profits and driven by a different type of business model than the business model of a (semi-public) organization.

3.3.3. The context of assessment processes

Values – whether public or private – play an important role in the assessment processes of design choices. Decision processes can be characterized by three stages. Firstly, a particular subject – a trade-off – is identified which can be seen as the value proposition. Secondly, a co-creation phase takes place in which actors interact and discuss to give substance to the value proposition. Finally, the actors decide upon the design choice and agree upon responsibilities and resource allocation. This process is comparable to the Value management approach, described in section 3.2.5.1.

During a decision process, multiple factors are considered. Technical regulations and legislation take part in the process (V_T). Moreover, the user has a certain value proposition (V_U), other stakeholders that flow in and out of the project have their values (V_{OS}) and the one in control of the design has values (V_D). The aimed outcome of a design process is a tangible product which reflect this variety of values (Figure 9) in the most optimal way.

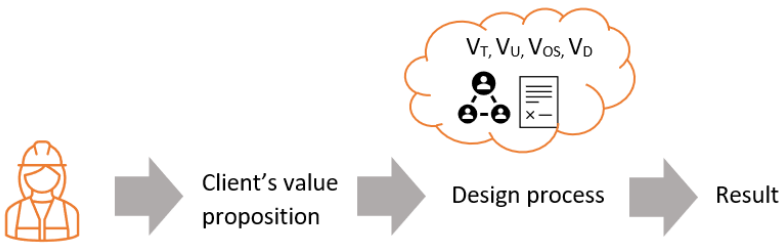

Figure 9: Values in a design process (Vermaas, Hekkert, Manders-Huits, & Tromp, 2015)

3.3.4. Values and Bouwteams

The design process as presented in Figure 9 is reflected in any design stage of construction projects, but the concept is particularly interesting in the case of Bouwteam projects. A Bouwteam is a form of collaboration in which client and contractor share a joint responsibility for the design. Bouwteam projects provide the opportunity for contractors to share expertise on the practicality of the design which at the same time provides a unique chance to execute the project when the Bouwteam goals have been achieved. The actors within a Bouwteam project have been selected based on collaborative principles, reflected in the Model Agreement of Bouwteams (Duurzaam Gebouwd, 2020).

In a Bouwteam project, the particular demarcation between the role of contractor and client may disappear as the design process tends to be a joint endeavour with common interests. The understanding of the public client and associated public values is crucial for the contractor to provide meaningful expertise regarding design choices. Moreover, a fully integrated client and contractor provide a fruitful basis for the continuation of the ongoing collaboration.

3.3.5. Process steps

A value management process is a continuous endeavour throughout the lifecycle of a project. Assessment processes can be seen as individual value management processes. An assessment process usually entails the evaluation of alternatives and criteria in which importance assessment takes place.

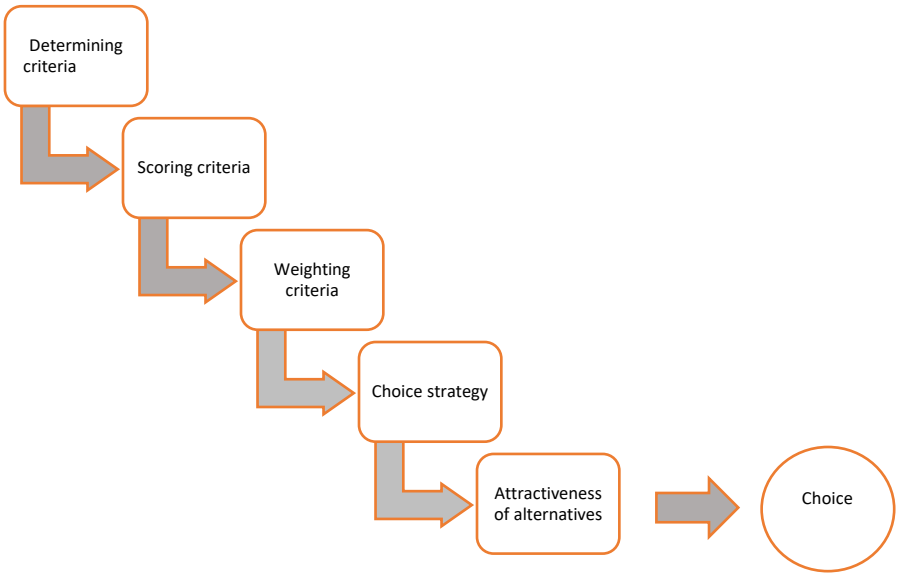

Figure 10: The steps in an assessment process, own image.

3.4. Multi-Criteria Decision Making

The previous two section have provided a definition of values and describe the characteristics of assessment processes. To support an assessment process, values have to monetarized or in some way be made measurable to compare. Various methods exist which help to communicate, formulate and integrate values. The following subsections provide a glance of some of the commonly used methods to make values explicit.

3.4.1. Basic principles

Multi-criteria decision making (MCDM) is a scientific domain that is concerned with complex decisions. MCDM-methods are used to structure and evaluate quantitative and qualitative factors and help in creative problem solving contexts (Čančer & Mulej, 2013). Many different MCDM techniques exist, aiming at either synthesizing or outranking 'subjective' preferences (De Montis et al., 2005). MCDM is recognized within the fields of construction and project management (Mardani et al., 2015).

MCDM methods can deal with a variety of information types. Information could be determined exactly or fuzzy (De Montis et al., 2005). The most common problem with MCDM techniques is caused by the aggregation of components: More components could lead to a better understanding of the decision problem at hand, but may also increase the overall complexity of the technique (Triantaphyllou, 2000).

First, an overview of basic principles of multi-criteria decision making are provided, which were subtracted from an extended client guide by Connaughton and Green (2006).

3.4.1.1. Value Hierarchy

A value hierarchy helps to establish a shared perception of the objective and associated attributes of the objective within a decision making process. A value hierarchy consists of a breakdown structure (Figure 11). Attributes are subdivided by making use of a 'means-ends' analysis. For example, a smooth connection to a bridge is a means to the primary objective of accessibility. A value hierarchy is an iterative process. The process is complete if all participants accept the 'tree' as a fair representation of the order of attributes that contribute in achieving the objective.

A value hierarchy may be restructured when an alternation of project objectives occur. Usually, value hierarchies are optimized during multiple iteration sessions to reach a simplified form.

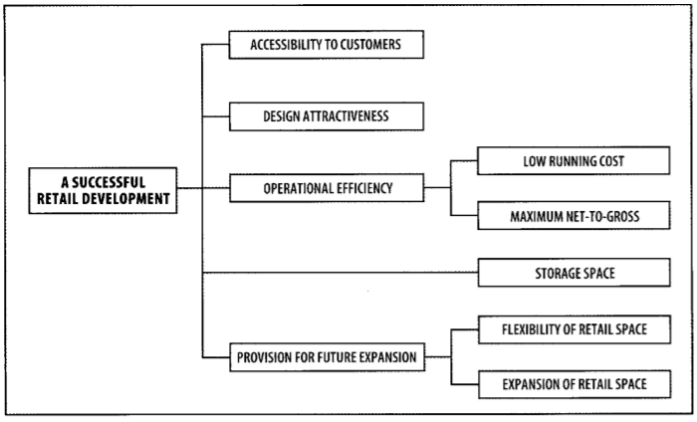

Figure 11: An example of a simple horizontal hierarchy (Connaughton & Green, 2006)

3.4.1.2. Criteria importance weighting

Value hierarchies can be used in twofold. Firstly, hierarchies can contribute in providing structure to a decision process. Secondly, hierarchies can be used to help in selecting a design solution. In case of the latter, the decision maker can assign weights to the attributes. Different type of weights can be assigned to attributes, examples are percentages, points or scales. The total weight of each 'row' within the hierarchy should add up to a certain maximum (accountable) number. The most obvious numbers are 100 or 1. The scores are often translated into ratio's. The ratio provides an overview of the weighting of an attribute in relation to the total sum of weights assigned. An example of assigned weights to the hierarchy presented in Figure 11, can be found in Figure 12.

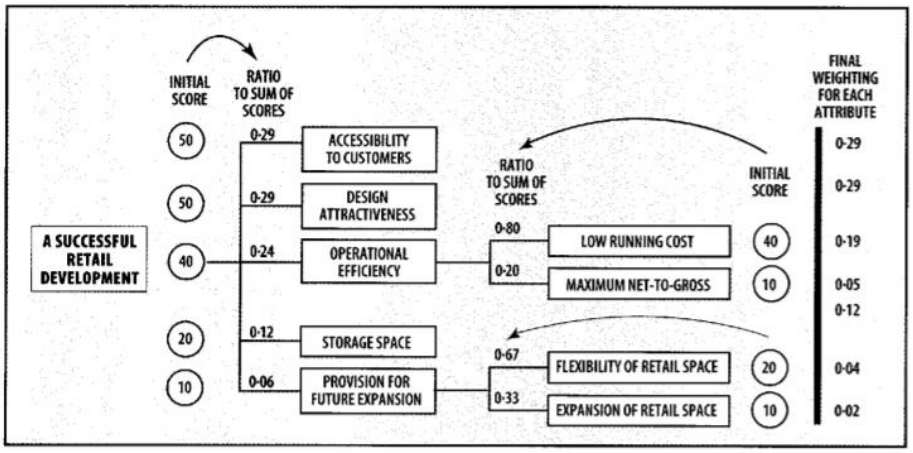

Figure 12: Example of a decision hierarchy with weights assigned to the attributes of the hierarchy (Connaughton & Green, 2006).

3.4.1.3. Matrix analysis

After performing the criteria (here attributes) performance weighting, all weights can be added to a simple matrix to realize a trade-off instrument (Figure 13). This trade-off instrument can help in deciding upon a design option. Since every option can be assigned a score with regards to every single attribute, the summation of scores provides the best scoring alternative. In case of this example, design option B is the preferred alternative, having a final score of 68.2.

ASSESSMENT ATTRIBUTES	ACCESSIBILITY TO CUSTOMERS	DESIGN ATTRACTIVENESS	LOW RUNNING COST	MAXIMUM NET-TO-GROSS	STORAGE SPACE	FLEXIBILITY OF RETAIL SPACE	EXPANSION OF RETAIL SPACE	
WEIGHT OF IMPORTANCE (0–1)	0·29	0·29	0·19	0·05	0·12	0·04	0·02	TOTAL
DESIGN OPTION A	70 20	20 5·8	10 1·9	20 1·0	40 4·8	60 2·4	30 0·6	36·5
DESIGN OPTION B	90 26	80 23	20 3·8	60 3·0	70 8·4	60 2·4	80 1·6	68·2
DESIGN OPTION C	50 15	50 15	80 15	40 2·0	10 1·2	40 1·6	40 0·8	50·6
etc.								

Figure 13: A simple decision making instrument to decide upon three design options A,B and C (Connaughton and Green, 2006).

3.4.2. Overview of methods

Literature regarding multi-criteria decision making (MCDM) methods is rather ambitious. The theory on MCDM distinguishes two classes: Multiple Attribute Decision Making and Multiple Objectives Decision Making. Both classes use different ways to support decision making processes. Practically seen, MODM is mend to guide decision processes with non-predetermined alternative solutions, whereas MADM guides processes with predetermined alternative solutions.

Table 1: MODM versus MADM-methods. Retrieved from video: https://www.youtube.com/watch?v=9SC5vWd8rHE&ab_channel=EricDelmelle

	MODM	MADM
Objectives defined	Explicit	Implicit
Attributes defined	Implicit	Explicit
Constraints defined	Explicit	Implicit
Alternatives defined	Implicit	Explicit
# of alternatives	Infinite	Finite
Decision-maker control	Significant	Limited
Decision modelling paradigm	Process-oriented	Outcome oriented

Since the empirical study - as part of this research - addresses a decision process in which design alternatives have been predetermined, no further extension of MODM methods is provided. An overview of popular MADM-methods is provided to simplify the ambiguity in literature and to provide the reader with a glance of possible MADM methods available (Table 2). Additionally, the researcher attempted to find useful ingredients of each method applicable for this research, found in the rightmost column. Three types of methods can be distinguished: Synthesis, descriptive and outranking methods.

Table 2: Overview of popular MADM methods, derived from Allah Bukhsh et al. (2018), Bouyssou et al. (2016), De Montis (2005) and Triantaphyllou (2000).

Overview of popular MADM-methods				
MADM-method	Pros	Cons	Type of method	Useful ingredient(s)
Multi-attribute utility theory – MAUT	• Considers uncertainty • Can be combined with other MCDM methods • Widely used method	• Complex and very data intensive • Strong assumptions required at each attribute level • Does not allow for interdependence	Synthesis, analytical, discrete	Considers risk-attitude of decision maker
Analytical Hierarchy Process (AHP)	• Pair-wise comparisons considers interdependence • Ease of use • Can process a lot of data • Used in political-strategy and corporate policy contexts	• Inconsistency in estimations • Cannot assess a single attribute in isolation • Rank reversal	Synthesis, analytical: deterministic, discrete	Linear hierarchical structure Consistency check Available online tool Pair-wise comparisons of attributes (priority scale) Applied in early stages of construction projects.

Fuzzy Set Theory	• Can cope with uncertain and imprecise data • Covers the evaluation of data	• Complex to compile: lots of connections • Simulations necessary before use: time consuming	Synthesis, analytical, fuzzy, continuous	Evaluation of uncertain data
Case Based Theory	• Can improve over time	• Used for big data • Sensible to inconsistency	Descriptive	May be useful for the explanation behind a ranking
Data Envelopment Analysis	• Used to determine efficiency of alternatives	• All data must be known	Descriptive	May be useful for the explanation behind a ranking
Simple Multi Attribute Rating Technique (SMART)	• Easy to use • Can make use of different ranking methods	• Utility independence • Preference independence	Synthesis, discrete, performance measures	Incorporation of different weighting techniques
Goal Programming	• Can handle infinite alternatives • Handles huge decision problems	• Does not assign weights	Elementary	Not found
ELECTRE	• Outranks alternatives • Takes uncertainty and vagueness into account • Easy to use	• Hard to express the outcomes in common language • Lowest performing alternatives are not visualized	Outranking, discrete, quantitative,	Simplifies decision problem by outranking: thresholds
PROMETHEE	• Outranking method • Easy to use • No assumptions with regards to proportionality needed	• Does not propose a method for weighting	Outranking, discrete, quantitative	Not found
SAW	• Can compensate between criteria • Intuitive	• Results may be unsound/ not logical	?	Not found
TOPSIS	• Simple process, amount of iteration steps remains constant • Identification of alternative closest to ideal solution	• Hard to determine correlation or assign weights. Consistency problems	Synthesis, quantitative	Not found

3.4.3. The Analytic Hierarchy Process

One of many, but most commonly used (Mardani et al., 2015) multi- criteria decision making techniques is the Analytic Hierarchy Process (AHP). AHP is developed independently from other MCDM techniques and uses pair-wise comparisons and numerical analysis to evaluate performance criteria. AHP relies on the judgement of experts to derive priority scales (Saaty, 2008) and can be used as a group decision making tool. A simple representation of AHP can be found in Figure 14.

3.4.3.1. Composition of the method

The Analytic Hierarchy Process consists of multiple levels. In a group decision context, these levels have to be defined by the participants of the group decision. The top box of the hierarchy represents the goal of the decision at hand. The second level consist of criteria, these criteria have to be selected by participants and determine which criteria participants use to judge the goal. A simple example: The goal of a particular client is to select the right contractor for a random construction project. The client group consists of 5 participants in the group decision process which judge the selection of this contractor on Collaboration, Past performance, Risk management and Time schedule. These four criterion are represented by the yellow boxes. The group can choose between three contractors: 1,2 and 3, represented in the hierarchy by the pink boxes. After mutual agreement on the hierarchy, the participants perform two steps:

1. The participants, whether individually or together, allocate weights to the criteria 1-4 with respect to the goal;
2. The participants, whether individually or together, allocate weights to the alternatives 1-3 with respect to the criteria 1-4.

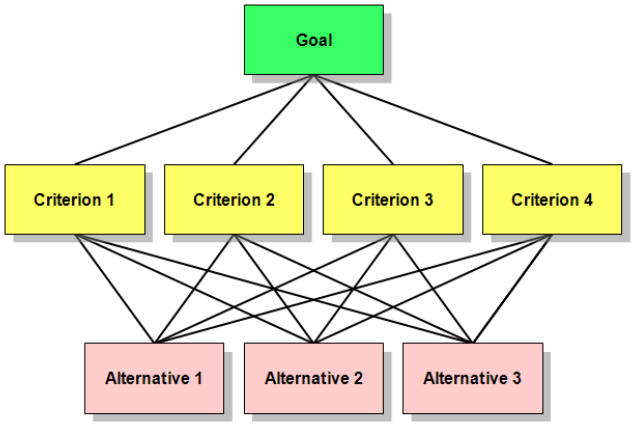

Figure 14: Simple representation of the Analytic Hierarchy Process. Found at https://digital-geography.com/ahp-arcgis-10-x-using-python/

2.4.3.2. Advantages

The benefit that the AHP generates follows directly from the pairwise comparison methodology. The AHP asks the user – which can be any person related to the subject in question – to prioritize an attribute in the hierarchy in contrast to another attribute on the same level in the hierarchy, and asks which of both attributes contributes most in achieving the parent objective – consecutive by executing steps 1 and 2.

The user is asked to repeat these comparisons for every possible pairs of attributes. This contributes to the outcome of the AHP methodology: AHP does not solely provide information about the best-fit alternative, but can also be used to find out how a person allocated needs or desires over the collection of attributes and design solutions. This provides additional advantages, such as:

- Identification of the determining attribute(s) that have led to the outcome of the best suitable alternative solution;
- Identification of the attributes which merely function as side-issues regarding a specific decision;

- A means to incorporate non- monetizable criteria or attributes;
- Room for discussion about the priority scales allocated by individuals on specific levels within the decision hierarchy and associated individual interpretations.

2.4.3.3. Disadvantages

Besides, AHP is characterized by some common disadvantages:

Firstly, The AHP method is particularly hard to use when the participants are confronted with a very complex decision problem (Hartwich, 1999). This leads to complexity in defining the analytic hierarchy and limits the feasibility of pairwise comparisons. The limitation of pairwise comparisons lies in the capability of the human brain to make sound comparisons in a restricted period of time. As a rule of thumb, most humans can make 6-7 consistent pairwise comparisons.

Secondly, humans may compose the hierarchy differently, leading to contrasting results (Adelmann et al., 1986). Therefore, composing the hierarchy in a group is a time consuming occupation.

Thirdly, the aggregation of opinions is determinative for the outcome of the AHP. The amount of participants affects this aggregation. The outcomes of AHP can be achieved either compensatory or non-compensatory among the group of participants (Arrington et al., 1982). Merging the individual estimations can either be carried out before running AHP or after running AHP. The latter uses geometric means to arrive at a group outcome. Additional complexity of the AHP method is achieved when different experts rate different levels in the hierarchy. The approach depends on scope, type and purpose of the study.

Finally, rank reversal may occur. Rank reversal is a phenomenon in which an emergent alternative or removal of an alternative affects the ranking order of the initial alternatives and thus the consistency of the result. Whether rank reversal is undesirable is a debatable issue within decision making theory. The important question here is how people are able to decide whether rank reversal indicates that something is wrong and whether it does not conflict with rational decision making. A well-defined problem may lead to the elimination of rank reversal issues.

2.4.3.4. Complex decision-making

The AHP method is particularly hard to use when the participants are confronted with a very complex decision problem (Hartwich, 1999). This leads to complexity in defining the analytic hierarchy and limits the feasibility of pairwise comparisons. The limitation of pairwise comparisons lies in the capability of the human brain to make sound comparisons in a restricted period of time. As a rule of thumb, most humans can make 6-7 consistent pairwise comparisons.

The human brain can make 6-7 pairwise comparisons without getting caught in the complexity of relations. 6-7 pairwise comparisons relate to 4 criteria (combination 1-2, 1-3, 1-4, 2-3, 2-4 and 3-4). An extra criteria (5) results in 10 pair-wise comparisons. The limits of AHP are also represented in the bandwidth. The used scale is 1 - 9, which reflects in a 46% bandwidth (maximum-minimum = 53%-6%). The most important lesson from the limits of AHP is the relevance of a certain criteria. Especially when the % is close to the lower limit.

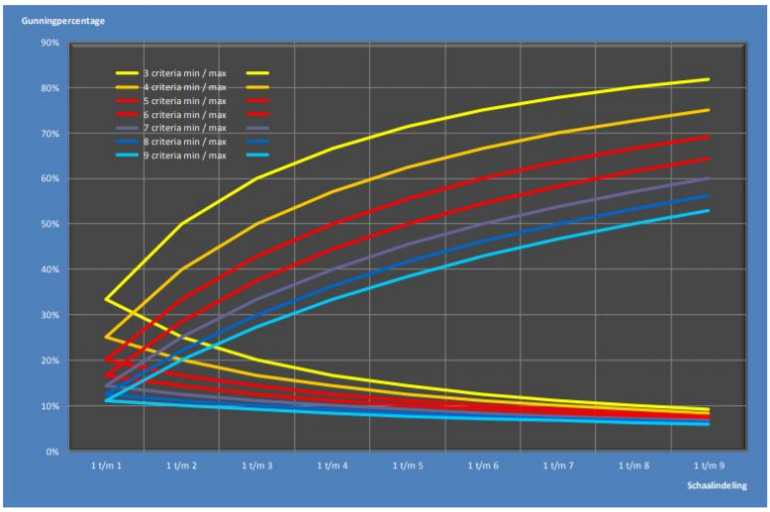

Figure 15: Maximum and minimum weight (%) of quality criteria. On the x-axis the scale of pairwise comparisons (1 t/m 1 means all criteria have an equal importance). The y-axis represents the award-percentage.

The composition of the analytic hierarchy, and thus the problem definition, is a subjective process. The analytic hierarchy is structured composed by different levels and elements on each level. Humans may compose the hierarchy differently, leading to contrasting results (Adelmann et al., 1986).

The aggregation of opinions is determinative for the outcome of the AHP. The amount of participants affects this aggregation. The outcomes of AHP can be achieved either compensatory or non-compensatory among the group of participants (Arrington et al., 1982). Merging the individual estimations can either be carried out before running AHP or after running AHP. The latter uses geometric means to arrive at a group outcome. Additional complexity of the AHP method is achieved when different experts rate different levels in the hierarchy. The approach depends on scope, type and purpose of the study.

3.5. Social Cost-benefit analysis (CBA)

The Cost benefit analysis (CBA) is a tool to analyze decisions (MKBA, n.d.) The benefits of a certain activity are measured against the costs to realize that activity. Most logically this is applicable on subjects which are objectively measurable, thus translated into monetary units. The CBA provides the most feasible approach to achieve maximum benefits while preserving savings.

The benefits of an activity or project are calculated by approximation of the welfare effects on society. The CBA aims to make an objective decision possible for the best alternative option in contrast to the present situation (doing nothing).

3.5.1. Pros of the SCBA-method

The three most important pros of the method are:

- The CBA method provides insights in the welfare effects of a project;
- The CBA methods helps to objectify argumentation;
- The CBA helps in optimization of projects by deleting non profitable activities.

3.5.2. Cons of the SCBA-method

Multiple negative aspects of the Cost-benefit analysis (CBA) exist (Mouter, 2012). The most remarkable are described in this subsection.

1. Not all effects on welfare of a project can be incorporated

Some welfare effects compared to others are hard to measure in a reliable way. Examples of these welfare effects are: the future value of nature, values that are related to 'sustainability', indirect effects from an enhanced city image, the effects of knowledge development during construction, positive effects of innovation projects and effects on other ethical values than those that optimize welfare.

Interesting is the critique on CBA with regards to the principle of 'willingness to pay'. If one person wants to invest for 1 million compared to 10 persons that want to invest 20.000, then still a project can be accepted based on that single person. The capacity to pay is often neglected. Besides, the anthropomorphic perspective of the CBA is criticized: what we take from the planet can't simply be restored. The ethical restriction of the CBA is found in the absence of lifecycle thinking.

Examples of other negative effects of the CBA on the welfare of a country are:

- The effect of a project on the support base of stakeholders.
- Political effects.
- Effects on previously agreed upon agreements.

2. The results and calculations of the CBA are uncertain and debatable

A typical CBA consists of many assumptions. In any case, the CBA tries to incorporate future scenario's which means that assumptions are made with regards to economic and demographic developments. Besides, for every specific project, assumptions are based on key figures. One of the respondents of the study by Mouter reflects on the use of key figures: "In reality, key figures are often context and group specific and therefore soft as butter."

3. The difficulty to quantify/monetarize effects

Some benefits of a project are hard to quantify or monetarize whereas the costs are easily represented. Examples of projects that get a relative low score due to this effect are: investments in spatial projects, non-physical social projects, public transport projects and innovation projects. The consequence of the difficulty to quantify effects is that these effects are out of balance and not properly addressed in the thinking, discussion and decision making processes of a project.

4. The complicated content of the CBA and time restriction

The language in which a CBA report is written is often too complicated for individuals to read, especially when there is a time constraint. The reports are often written in a very complex 'scientific' form. Many decision makers have little time to read and are not familiar with the economic background. The valuable benefits as a result from the CBA may not explicitly be noted in the reports.

5. Strategic use of the CBA results

The results of the CBA may be used in particular circumstances as a tool to trivialize or overstate depending on the desirable outcome. This may prevent an objective result. The outcome of the CBA can be altered to the decisions makers' wishes and desires especially when the CBA provides results that do not fit the decision-makers' personal preferences.

6. Users of the MKBA over- or underestimate the value of a CBA

The overestimation of the MKBA is, according to the respondents of the interviews by Mouter, caused by two reasons: overestimation follows from strategic considerations (see 5. above) and the overestimation takes place because of insufficient knowledge of the downsides of the MKBA (see 4.).

Underestimation of the CBA, according to respondents, is caused by the fact that little value is appointed to the thinking, discussing and decision making process of the project. This can be related to strategic considerations. Too often, a CBA is seen as a "black-box", which may lead to skepticism. The user of the MKBA must be fully committed to the results, meaning that the user has to trust the "black-box".

7. The communication power of the 'CBA-margin' overrules the nuance and content of the report

The communication power of the CBA-margin, being the final result of the CBA, may provide a downside. Respondents in the article describe that the communication power of the CBA-margin results in a neglection of the nuance of the side-effects described in the report. This means that too often, the CBA-margin has such a high communication power to users that this is seen as the absolute truth. Under time limitations, the user of a MKBA often directly focusses on the CBA-margin and forgets to read the whole report.

8. A wrong use of the CBA leads to suboptimal discussions

Respondents of the interviews by Mouter argue that the results of the CBA may lead to better discussion about the utility, essence and design of the project. However, there are also downsides which depends on how the discussion develops. The conversation could end up in infinite discussions about whether the CBA is right or wrong or what value has to be assigned to this CBA, while the discussion about 'how can we improve this project according to this CBA' loses attention. This leads to a delay in decision-making.

9. A wrong use of the CBA leads to suboptimal decision-making

The wrong use of a CBA is often related to the absolute value that users assign to the CBA. Some values or welfare effects which are not incorporated in the CBA can still have drastic impacts on a project. Many innovation projects suffer through the use of CBA, especially because the costs can be defined early, whereas the benefits are generated over the long term.

The inaccessible character of the CBA can lead to bad decision-making. The outcomes of the CBA may be neglected because the information is useless. Besides, in some cases only the end result is used to prevent discussion without a proper study of the background situation.

3.6. Value Sensitive Design (VSD)

A theoretically grounded approach for taking care of values in the design process is Value Sensitive Design (VSD). Contrary to AHP and CBA, the primary focus of VSD is not to compare values but to elicit values. VSD is extensively explored (Friedman et al., 2017). VSD is originally meant to be used within the fields of information systems design and human-computer interaction. However, the tools and methods applied within VSD might also serve other purposes (Friedman et al., 2017). The most useful tools and techniques used to elicit and represent values are summarized.

- Value Source Analysis **Who is the owner of a value?**

Value Source Analysis (VSA) is a VSD method which is typically used to identify the source of a value. VSA distinguishes between: explicitly supported project values, designers' personal values and values according to direct- and indirect stakeholders. Direct stakeholders are people who are daily involved with the project work, indirect stakeholders can be seen as people who are affected by the results of the project.

- Value Scenario **What is the impact of a value?**

Value Scenario is a method that is used to surface the human and technical aspects of technology. The method uses narratives as leading input to find the human and technical aspects. As the word scenario reveals, this method described the impact of a value, the implications for direct- and indirect stakeholders, the related key values and their widespread use, indirect impacts, longer-term use and similar systemic effects.

- Value Sketch **How is the value translated into the product?**

A method to find non-verbal stakeholders' understandings, views and values of the technology by the use of sketching activities.

- Value-oriented Semi-structured Interviews **How and why do people value things?**

To elicit values from stakeholders semi-structured interviews can be used. These interviews may lead to answers on evaluative judgements and their rationale (the 'why').

- Scalable Information Dimensions **How important is a value related to other values?**

The availability of information to stakeholders can be revealed by the use of Scalable Information Dimensions. This method uses questions to find the impact of pervasiveness, proximity and granularity of information. This is regarded as a scalable dimension.

- Value-oriented Mockup, Prototype or Field Deployment **How is a value perceived?**

The use of a prototype, mockup or field deployment may provide insights into how a technology is perceived by stakeholders. These methods emphasize implications for direct and indirect stakeholders, value tensions, and technology situated in human contexts.

- Envisioning Cards **Which values exist and how are they spread across stakeholders?**

A versatile value sensitive envisioning toolkit helps to identify stakeholder values. The Envisioning Cards™ builds on four criteria: stakeholders, time, values and pervasiveness. The Envisioning Cards has multiple use functions: it can be used for co-design, heuristic critique, evaluation and many other purposes.

- Value dams and flows **Which values are worth or not worth considering?**

The function of Value dams and flows method is to filter values at the start of a design process. The value dams are identified which do not or minimally contribute to stakeholder desires. After this consideration, the most important values to be captured with the project are identified.

3.7. The difficulty of making value(s) explicit

The previous section has provided an overview of MCDM-methods to identify, structure and prioritize values. Stakeholder values – defined as ideals and beliefs – can be expressed by allocation of weights to criteria and alternatives during decision-making processes. The outcome of a MCDM method provides a representation of the preferred design option and distribution of interests.

However, to meaningfully apply the MCDM methods during decision-making processes, one has to be aware of the potential limitations. These limitations stem from the difficulties that arise when stakeholder make their values explicit to others. This chapter provides an overview of why making values explicit is such a difficult endeavour.

3.7.1. Measuring and comparing values

3.7.1.1. Economic versus non-economic benefits

From a practical point of view there is no clear demarcation between perceived benefits that are purely economic and benefits that are not (Glendinning, 1988). The boundary is shaped by humans, who estimate or imagine the consequences of an action. In construction projects, consequences are usually measured by defining impacts on welfare (Mouter, 2012). Welfare effects are subjective, depending on the perceived magnitude of the impact of a decision. The perception of a stakeholder about the size of the impact of a decision determines his willingness to allocate resources to minimize or maximize impact.

During a design stage of construction projects, these welfare effects are either imaginary (in case of innovation) or estimated by past experience. Stakeholders judge impacts based on their knowledge and experience. Therefore, a ‘gap’ of knowledge or a ‘gap’ in imagination between stakeholders during conversations about benefits is a logical result. This can lead to misunderstanding and interpretation differences.

3.7.1.2. Subjectivity: Level of satisfaction

In addition to the previous point, people can obtain different levels of satisfaction with exactly the same spendable income. Glendinning (1998) describes this phenomena perfectly. For example: Take a person and give that person $5 and ask him to buy some food. Then, simultaneously give another person $5 and ask that person to buy exactly the same type and amount of food. Although both persons spent $5, their level of satisfaction can be different. The value attached by them by consuming that $5 food can vary considerably: One may eat to live, the other may live to eat. To understand a person's real driver that determines his level of satisfaction, one might have to deep further into the motives and rational of that person.

3.7.1.3. Intrinsic and extrinsic value

A distinction can be made between intrinsic and extrinsic value. The intrinsic value of an object is seen as the value that this object has on itself or in complete isolation. Moore (1922) points out that an object does not contains value by itself. According to Moore, an object contains value because people assign value to it.

The difficulty of making values explicit stems particularly from the concept of extrinsic value. This is the value that something has to serve other purposes – as a means to an end. Extrinsic value is often referred to as instrumental value. An example could be money: Money has extrinsic value that can be used to buy products. Extrinsic value could also be attached to public values. For example, take the safety of a road, where the public value is safety. A safe road could serve as a means to reduce future costs: The worth of the victim as the result of a traffic incident on the road can be expressed in monetary terms.

Extrinsic value can be assessed by the use of hierarchies, those that characterize many MCDM-methods. This helps to organize for the different 'layers' of extrinsic value. The problem is that every stakeholder in a project is unique, interpreting hierarchies in different ways. Conversations about the outline of a hierarchy can therefore be a time consuming exercise.

An interesting aspect of intrinsic value is the perceptual source of value (Rice, 1943): A value can become meaningful when experiencing this value, even though this value is not strived for deliberately. This suggests that having conversations about values and differences in stakeholder interests might lead to new interests, which in turn leads to an increased complexity of the decision process. This is regarded as the huge downside of making values explicit.

3.7.1.4. Time dependency of values

Values are time dependent. Perry (1914) distinguishes time dependency by classification of two sorts of values; present values and prospective values. Having discussions about the value of an object at a specific moment in time is probably a waste of effort as the prolongation of the object brings new values and new insights in the near future (prospective values). This implicates that making values explicit should be a continuous process which has already been identified in section 3.2.5.

3.7.1.5. Interpretation of the system boundaries

The context in which an object is situated determines how people valuate this object. The context – understood by the environment of the object – can be small or big depending on the point of view of the person that evaluates the object. This phenomena is illustrated by Hjelmbrekke & Klakegg (2013), who identify a different point of view between contractors and clients in construction projects. The

client regards the project as an asset which serves a function in a greater portfolio. The contractor, in contrary, regards projects as a production system. The context from a client's point of view is therefore much greater.

Illustrated by Aristotle, the value of a whole does not equal the value of its parts. In other words: The value that a person assigns to an object depends on how the system or object can be divided into subsystems or parts. Without a clear shared understanding of the system itself, explication of values is rather ambitious and difficult.

3.7.1.6. Context, environment and integration of values

Defining something as valuable is usually dependent on the context and environment. Although defining an object more valuable than another object can in some cases be defined objectively, a change in context may lead to an alteration of the initial judgement. An interesting part in measuring values is the quote by Aristotle: 'The whole is greater than the sum of its parts', which is also understood in terms of value: "The value of a whole does not equal the sum of the values of its parts". (Moore, 1922). A value is said to be more durable if one could judge the value based on a true or false statement (values can be tested). Moreover, Perry (1914) describes that value may become objective by collective support: fulfilling the interests of the community. Rice (1943) agrees with this viewpoint on value and explains that preferences of interest is dependent on what the environment can supply and what a group can consent. "The challenge is to integrate different interests individually and collectively.

3.7.2. Expressing qualitative values

The statement by Moore about how we judge the combination of individual values as valuable brings forward a complicated issue, formed by the comparison of qualitative and quantitative performance criteria. Qualitative values, for example noise reduction are often hard to express in quantitative measures. The subjective perception of the qualitative performance criteria may lead to a judgement about how to quantify this criteria. This is illustrated by the amount of iteration steps in a value hierarchy. Often, qualitative values are judged by true or false questions.

Prescriptive (value) vs. Descriptive assumptions (https://www.merriam-webster.com/words-at-play/descriptive-vs-prescriptive-defining-lexicography)

Typically, two distinct assumptions can be made with regards to how a person valuates things in life. Prescriptive assumptions are implicit preferences for one value over another value in a particular context. A prescriptive assumption consists of the communicator's value priorities or preferences. The communication of prescriptive assumptions is crucial to compare an individual's preferences with the preferences of others in a group or project context.

A descriptive assumption can be seen as a (unstated) belief of how a person sees the world in the present and in the future. Many qualitative values are judged by descriptive assumptions. A descriptive assumption does not judge a moral status, and does not say anything about what is right or wrong.

Prescriptive assumptions are person dependent and change by the context in which the person finds itself. A prescriptive assumption may also depend on the role that a person fulfils. Prescriptive values bring value conflicts. Sustainability versus cost is an example of such a value conflict. Both descriptive and prescriptive assumptions of persons amplify the difficulty of making values explicit during the lifecycle of a project.

3.7.3. Group composition

Mandates, roles and responsibilities of persons form a driver for persons to make their values explicit to others. Actors in Bouwteam projects have been selected based on character traits. Character traits determine how a person expresses himself, how a person collaborates with others and how a person

handles critique and viewpoints of others. Besides how people act based on their character traits, people tend to express themselves based on the position or role their fulfil in a project. A person's character trait can therefore be contradictory with the role a person fulfils in a particular project. To complicate the matter, group compositions changes during construction projects.

3.7.4. Group behaviour

3.7.4.1. Authority

A specific group of actors in construction projects have a mandate to take decisions. The authoritative appearance or behaviour of these actors might hold back others express their thoughts during decision processes. The convincing attitude of a person might hamper others to share their perceptions and ideas. Especially when a group of people collectively assign weights to criteria and attributes in a group context, as is the case in the application of MCDM methods.

3.7.4.2. Accountability

The final aspect that makes value explication difficult stems from the accountability of a person. A person might have his own values, nevertheless this person can feel accountable to persons which he is mandated to take care for. For example, a technical manager of a project leads a design team which consists of multiple individuals. To make unambitious statements which serve in the interests of many can be very difficult.

3.7.4.3. Commitment

Groups can consist of members which do not fully commit themselves to the decision-making process, simply because these members do not feel the urge to reach a consensus. Commitment in Bouwteam projects is crucial, especially because both contractor and client have mutual wins to gain from a successful Bouwteam phase. In contrary to a decision-making process where politics are involved, for those type of processes there is less or minimum need to find a consensus.

3.8. Conclusions

The literature study have provided insights into how values can be defined, which can best be understood as the ideals that stakeholders have and pursue when undergoing an assessment process. Values are not merely economic, and relate to human factors and organizational factors. To make values explicit during assessment processes, stakeholders prioritize between criteria and judge options or alternatives. Common methods to guide this process are the Cost-benefit analysis, Multi-criteria Decision making methods and Value sensitive design methods. Although all methods can make values explicit in some ways, the CBA is particularly useful when all effects can be monetarized. The non-monetizable factors in a decision context can best be handled by MCA methods. The next section provides the assumptions and input for the selection of the method for the practical research.

4. Conceptual framework

4.1. Introduction

This chapter describes how theoretical insights have led to a practical framework. This framework can be implemented in practise by decision process facilitators and participants in Bouwteam projects. The aim of this framework is to make values explicit in a group decision process. Section 4.2 describes how certain literature findings have been incorporated in the conceptual framework. Section 4.3 describes the choice of the AHP method for the practical study and the composition of the model itself. Moreover, a process description is provided to describe how to use the method in practise and what input variables were considered.

4.2. Literature input and assumptions

- The literature review shows that values and value – in both forms – are rather ambitious and complex concepts. Stakeholders express value by means of performance criteria. Four types of typologies were identified that characterize how a person expresses performance: Use value, Social value, Economic value and Ecological value. These typologies were used in the conceptual framework.
- Values and value are related through functions. A function supports the expression of a person's desires. Usually, evaluating functions in construction projects is performed by the use of Value Engineering methodologies. After an extensive search for mutual consent between stakeholders about feasible design alternatives, the outcomes of Value Engineering methodologies are usually followed-up by Cost-Benefit analyses. Using multiple instruments is time consuming and results in information asymmetry between stakeholders. Therefore, the assumption is made that using a single MCDM-method can optimize the decision process.
- Values are emergent since the design of a project develops over time and satisfaction levels of actors can change during this development. Moreover, construction projects are dynamic systems in which stakeholder composition is not fixed. Therefore, a MCDM-method should be able to secure values across time, so that during future decision processes about particular values decision makers can trace back what is discussed in the past.
- Reaching optimal value between stakeholders in a construction projects might result in infinite discussion about when 'Value for Money' (VfM) has been achieved. Value for Money is a concept which describes how a person allocates resources efficiently, effectively, economically and equitable. In other words, VfM is an indicator of performance. Incorporating the concept of Value for Money in a MCDM-method is useful to determine differences and similarities about how different stakeholders allocate resources over their performance needs.
- Making values explicit in a meaningful way asks for understandable and easy to use methodologies. A huge disadvantage of determining performance by evaluation of functions is the capacity of the human brain to make a distinction between the diversity of functions that characterizes an object. Humans are limited in making fair judgements when there are simply too many ingredients. Therefore, the composition of the framework should be simplified.

4.3. Composition of framework

4.3.1. Selection of MADM-method

AHP – the Analytic Hierarchy Process – is regarded as the most suitable method to be used for making values explicit during group decision processes.

From a theoretical/scientific point of view – the Analytic Hierarchy Process is particularly useful to make values explicit in a meaningful way, because:

- AHP is built upon the concept of Value for Money. This concept enables the identification of diverging interests between particular persons or group of persons and the size of this deviation (expressed in %);
- AHP provides ask users to make pair-wise comparisons which support users in expressing performance needs without the need to perform comprehensive function analysis techniques;
- Although no tailor-made MADM method exists, AHP is the only method from the list of popular MADM-method (Table 2) which enables allocation of relative weights to qualitative and quantitative attributes over multiple levels in decision hierarchies and at the same time provides a complete ranking overview and choice.

AHP is – practically seen – particularly useful, because:

- This open-source web application is regarded as easy to use and understandable for people with various intellectual levels;
- The open-source web application provides users with the option to store values and reassess the state of affairs in the future;
- The researcher has access to an open-source web application of the method;

4.3.2. Decision hierarchy

The following hierarchical structure was used . Level 0, the top part of the hierarchy consists of the goal: 'Design of Commercial Building'. Level 1, the second layer of the hierarchy consists of the four value typologies found during literature review. The design alternatives were: 'Renovation of the commercial building' and 'Rebuilding of the commercial building'.

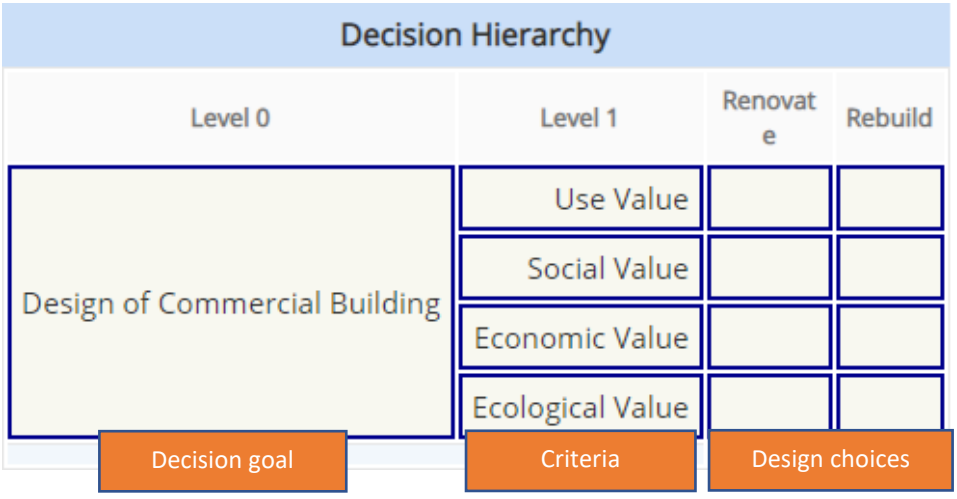

Figure 16: Overview of decision hierarchy applied in practice.

4.3.3. Integration of AHP in decision process

The framework requirements have led to a framework design which can be used in decision processes of Bouwteam projects (Figure 17). The framework consists of five process steps (indicated at the top of the figure). In each step, either the facilitator of the decision process or participants in the decision process have to execute a sequence of actions in a web-application of the Analytical Hierarchy Process.

The framework design presents two different paths or sessions which were executed in practise by the researcher, session A and session B. Both sessions were executed with deviant input characteristics (4.3.4) and process-related aspects (4.3.5). The outcomes of session B were not included in the formulation of the results of this research.

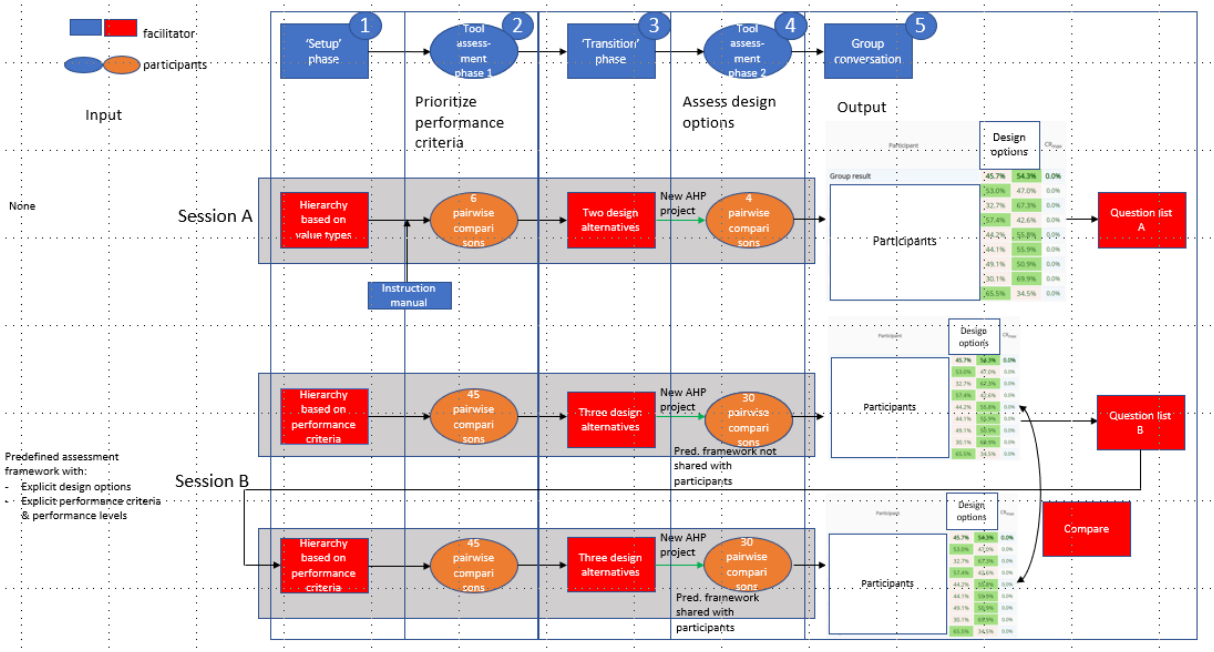

Figure 17: Conceptual framework

4.3.4. Input variables of conceptual framework

To perform session A and B, the following input variables should be used.

Table 3: List of input variables for Session A and B respectively

Session A	Session B
Performance criteria defined by researcher	Performance criteria predefined by participants of decision process
No performance indicators	Performance indicators predefined by participants of decision process
2 Explicitly defined design alternatives	3 Explicitly defined design alternatives
11 Participants from core team and core team +	6 Participants from design team

To successfully execute session A, the facilitator of the decision process should make use of the following definitions for the four value types.

Use value: The tangible characteristics of the commercial building, expressed in quality. Examples are: Functionality, Adaptivity, Accessibility.

Social value: The value that the commercial building offers to the users of the building. For example that users get maximum opportunity to work.

Economic value: The possible costs and expenses that the commercial building yield. This can be expressed in monetary units, but also in non-monetary units. Examples are reputation, competitive advantage or commercial relation.

Ecological value: The value that the commercial building has for the physical environment. This could be reducing CO-2 emissions, re-use of materials or the impact on biodiversity.

To successfully follow the process of session B, the facilitator should use Figure 18 which consists of an overview of predefined performance criteria and performance indicators. These criteria have been developed by the design team in collaboration with product developers and suppliers.

Varianten	Beluchte zand- en vetvang 2 x 1.000 m^3/u + 1 x 400 m^3/u	Zand- en vetvang met lamellenafscheider 2 x 1.200 m^3/u	Centrifugaalzandvang en beluchte vetgoot 1 x 3.150 m^3/u (zand) + 2 x 1.200 m^3/u (vet)
zuiveringsprestatie	- verwijderingsrendement < 90% - vangt zand af tot > 200 µm	- verwijderingsrendement < 95% - vangt zand af tot > 100 µm	- verwijderingsrendement < 90% - vangt zand af tot > 150 µm
beschikbare capaciteit	- max. capaciteit "off-the-shelf" = 1.000 m^3/u	- complete range beschikbaar	- vetvang = special (niet standaard leverbaar) - zandvang complete range beschikbaar
hydraulisch verlies	- ca. 10 - 30 cm drukval	- ca. 20 - 30 cm drukval	- ca. 10 - 30 cm drukval (zelfde als langsgoot)
Verdygo-inpasbaarheid	- hoogte goot = 2,8 m (hoogte schroef = 4,5 m) - kan boven maaiveld worden gebouwd - kan niet compleet per vrachtwagen op transport	- totale hoogte = 2,6 m - kan boven maaiveld worden gebouwd - kan compleet per vrachtwagen op transport	- hoogte goot = 2,8 m - zandvang deels (de conus) onder maaiveld - kan niet compleet per vrachtwagen op transport
bouwgrootte[1]	- 1.000 m^3/u = 23,1 (L) x 2,3 (B) - 400 m^3/u = 11,6 (L) x 2,2 (B) - totale oppervlakte = ca. 131 m2	- 1.200 m^3/u = 5,8 (L) x 1,7 (B) - totale oppervlakte = ca. 20 m3	- vetgoot à 1.200 m^3/u = 23,1 (L) x 2,3 (B) - zandvang à 3.150 m^3/u = 4,8 m (d) - totale oppervlakte = ca. 125 m2
circulariteit (materiaal)	- 2 x 8.500 kg + 1 x 3.800 kg = ± 20.800 kg RVS	- 2 x 2.300 kg = ± 4.600 kg RVS	- 1 x 8.000 kg + 2 x 8.500 kg = ± 25.000 kg RVS
beheer en onderhoud[2]	- positieve beheerervaring op rwzi Epe - verder geen bijzonderheden	- inschatting reinigingsinterval: 2 - 4 keer per jaar; - tijdens onderhoud kan installatie in bedrijf blijven - onderhoud kan uitbesteed worden	- onderhoud aan 2 verschillende installaties - verder geen bijzonderheden
Arbo-omstandigheden	- in te vullen door waterschap	- in te vullen door waterschap	- in te vullen door waterschap
bouwkosten ± 10%[3]	- 2 x 1.000 m3/u = 2 x 175.000 EUR - 1 x 400 m3/u = 1 x 70.000 EUR - budgetprijs totaal = 420.000 EUR excl. BTW	- 2 x 1.200 m3/u = 2 x 105.000 EUR - budgetprijs totaal = 210.000 EUR excl. BTW	- 2 x 1.200 m3/u = 2 x 150.000 EUR (ingeschat[4]) - 1 x 3.150 m3/u = ca. 500.000 EUR (ingeschat[5]) - budgetprijs totaal = 800.000 EUR
referenties	- rwzi Epe à 1.500 m^3/uur	- 3 GritWolf® totaal geïnstalleerd - 55 voorganger GritWolf® geïnstalleerd	- vetvang = special, dus geen referentie. - zandvang = Verdygo (meerdere referenties)

Figure 18: Performance criteria and indicators related to design alternatives.

4.3.5. Process-related variables of conceptual framework

To perform session A and B, the following process-related variables have to be implemented.

Table 4: List of process-related variables for session A and B respectively

Session A	Session B
Single execution of process steps 1-4	Double execution of process steps 1-4 - Based on 'gut feeling' - Based on performance indicators
Session goal: Exploring use of value types	Session goal: Realize assessment framework
Bouwteam- meeting	Technical consultation
Participants execute process during free time	Participants execute process steps during consultation

5. Results

5.1. Introduction

This chapter provides the results of the empirical study. The first section provides an overview of the outcomes of 'Tool assessment phase 1'. The second section provides an overview of the outcomes of 'Tool assessment phase 2'. The third and final section provides the outcomes of the group discussion phase.

5.2. Tool Assessment phase 1

Eleven participants have executed the AHP-model by performing pairwise comparisons between use value, social value, economic value and ecological value regarding the realization of the commercial building. The majority of the participants clearly find the use value of the commercial building most relevant.

Participant	Use value	Social Value	Econ. Value	Ecol. Value	CR_{max}
Group result	44.0%	29.0%	15.6%	11.3%	6.9%
USER 1	69.1%	19.8%	8.3%	2.8%	37.3%
USER 2	62.7%	23.9%	9.5%	3.8%	28.7%
PROJECT MANAGER 1	44.7%	21.6%	4.2%	29.5%	9.1%
PROCESS MANAGER	66.5%	7.1%	22.8%	3.6%	25.3%
SUSTAINABILITY MANAGER	30.9%	30.9%	14.2%	24.1%	5.7%
TECHNICAL MANAGER 1	62.1%	22.3%	11.8%	3.8%	25.9%
CONTRACT MANAGER	44.2%	45.5%	5.1%	5.2%	0.1%
COST EXPERT	8.3%	3.1%	67.1%	21.5%	35.4%
PROJECT MANAGER 2	3.7%	41.2%	10.6%	44.4%	18.7%
TECHNICAL MANAGER 2	27.8%	57.0%	10.9%	4.3%	3.7%
ENVIRONMENTAL MANAGER	53.4%	27.4%	12.4%	6.8%	16.3%

Figure 19: Overview of prioritization results of phase 1

An interesting finding is that only a few stakeholders find the ecological value relevant (the impact of the building on the physical environment). The costs expert is unique in a way that he is regards the economic value of the commercial building as most relevant in this context.

There is clearly some diversity present in the group of participants. The project managers and sustainability manager seem to put more relevance on the ecological value of the commercial building than the other participants.

5.3. Tool Assessment phase 2

The second tool assessment phase provides an overview of the preferred alternative solution per stakeholder. The mathematical consensus is marginal for rebuilding (54.3%). The majority of the group find the option of 'rebuilding' the most preferred solution. Three outliers can be found, which consists of the technical manager (client), sustainability manager (contractor) and project manager (client).

Participant	RENOVATE	REBUILD	CR_{max}
Group result	45.7%	54.3%	0.0%
TECHNICAL MANAGER 1	53.0%	47.0%	0.0%
USER 1	32.7%	67.3%	0.0%
SUSTAINABILITY MANAGER	57.4%	42.6%	0.0%
CONTRACT MANAGER	44.2%	55.8%	0.0%
TECHNICAL MANAGER 2	44.1%	55.9%	0.0%
ENVIRONMENTAL MANAGER	49.1%	50.9%	0.0%
COST EXPERT	30.1%	69.9%	0.0%
PROJECT MANAGER 2	65.5%	34.5%	0.0%

Figure 20: Group results, indicating a marginal group preference for the option 'Rebuild'.

5.4. Group discussion session A

The tool assessment outcomes were discussed during a group discussion session (as described in the methodology of this report). Due to limited time, the researcher was able to ask four questions related to the outcomes of the tool assessment phases.

The full transcription of the group discussion session can be found in Appendix B: Transcription of group discussion – Session A. This section provides the most remarkable results obtained from analysis of the transcription.

First question: "Do the results according to Figure 20 make sense?"

- Technical manager 2 indicated that the results reflect his feelings and directly points out to the diverging interests of Technical manager 1, Sustainability manager and Project manager 2.
- Both Technical manager 2, Technical manager 1 and Sustainability manager relate their feelings (and preferences) with the object (the commercial building).
- Technical manager 2 distinguishes himself from the others.
- The respondents used multiple factors during argumentation about their choice, being: Sustainability, Cost, and Circularity.
- Project manager 1 relates the process with a trade-off matrix.

Second question: "Project manager 2, did you expect this result?"

- Project manager 2 relates his preferences with the impact of an action to the environment.
- Project manager 2 points out to the 'Use value'. He addresses his concerns about the fact that 'Use value' stands out in the results with regards to the other 'values'.
- Project manager 2 agrees that he regards himself as an outlier, not particularly in this project but also in other situations.

Third question: "Project manager 2, how did you get to this allocation?"

- Project manager 2 points out that the allocation is based upon his personal preferences, regardless of his role in this project.
- Project manager 2 relates his choices to his interpretation of the project goal: Doing things differently.
- Project manager 2 criticizes current course of events of his employer/business.
- Project manager 2 relates his personal frame of reference to the frame of reference of the business and shows awareness of those differences.
- Project manager 2 indicates that insights in value patterns are particularly useful to understand how conversations take place and help people to understand other people.

Fourth question: "Would you (all participants) now fill in the tool assessment differently based on the precede conversations?"

- Project manager 2 indicates that he would like to perform this tool assessment (phase 1 and 2) another time, then specifically addressing his professional role to make sure that these converge.
- Project manager 2 indicates that based on his interpretation, addressing 'use value' in decision processes within this particular project is important.
- Technical manager 2 indicates that the consistency check of the tool prevented him from staying with his initial preferences.
- Technical manager 2 indicates that he had problems with interpretations of the four value typologies.
- Project manager 2 observes a disbalance between the four value typologies. He indicates that the team should put more effort to balance the four value typologies.
- The results trigger project manager 2 to pay more attention during decision processes.

Possible points of improvements by participants:

1. During tool assessment, participants would like to be able to add alternatives by themselves;
2. Technical manager 1 and 2 indicate that the definitions of the value typologies where rather ambitious and interpretable, besides Technical manager 1 indicates that description of system boundaries in advance would help them making meaningful choices;
3. The sustainability manager proposed a different first question to be used in discussion about values: "What do you find important with regards to the Commercial building?". In other words: Don't start a conversation with a trade-off to steer the conversation to 'values'.
4. According to the participants, the tool should give insights in the allocation of preferences before and after consistency improvements performed by the web application;

5.5. General remarks group discussion

The interesting part about the group discussion was that the stakeholders with diverging interests according to the first assessment phase made their preferences explicit during the group discussion. The sustainability manager and project manager (client) were most committed to the process. The outcomes of the AHP-model helped to gain a deeper understanding of stakeholders' technical considerations. The participants showed a progressive and transparent attitude and converged very early in the process.

5.6. Findings

5.6.1. Session A

For a full transcription of the group discussion phase, see Appendix B: Transcription of group discussion – Session A

Remarks regarding the pros and cons of the web application:

- Participants confirmed that the consistency check of the web application prevents participants to express initial best estimate;
- Participants confirmed that web application is easy to use;
- Participants confirmed that web application does not allow to assign 'no opinion';
- Participants confirmed that web application does not allow to add or modify the project hierarchy without a facilitator;
- Participants confirmed that a participants can see final result and adjust preferences before submitting.

Remarks regarding how the framework helps to overcome barriers in conversations about values:

- The framework is helpful to make subjectivity tangible;
- The framework is helpful to discuss potential outliers in the group;
- The framework helps to identify current 'status' of stakeholder alignment with project objectives;
- The framework helps to identify information asymmetry between participants;
- The framework helps to identify the underlying motives in the behaviour participants. This makes choices explicit and helps in a more robust accountibility.

5.6.2. Session B

For a full transcription of the group discussion phase, see Appendix C: Transcription of group discussion – Session B.

Remarks regarding the pros and cons of the web application:

- Participants confirmed that the consistency check of the web application prevents participants to express initial best estimate;
- Participants confirmed that web application is easy to use;
- Participants confirmed that the amount of pairwise comparisons affect the ability to keep focussed;
- Participants confirmed that the outcomes are useful;

Remarks regarding how the framework helps to overcome barriers in conversations about values:

- The framework is helpful to discuss potential outliers in the group;
- The framework helps in making subjectivity tangible;
- The framework helps to identify information asymmetry between participants;
- The framework provides practitioners with a feeling of being heard during decision processes.

6. Conclusion

The aim of this research was to explore if making values explicit would contribute to assessment processes during construction projects. To achieve this aim, the researcher found an answer to the main research question, formulated as:

How can stakeholder values be made explicit to facilitate meaningful assessment processes in construction projects?

During this research, a framework was developed which incorporates a 'module' of the Analytic Hierarchy Process. The use of this 'module' – in the form of a web-application – supports conversations about values through visualisation and tangible justification of the potential outliers in the decision process. This proves to be helpful in making subjective opinions and desires tangible.

The answer to the main research question was found by providing an answer to a sequence of six sub-questions.

SQ1: What is the definition of values?

Values can be defined as guiding principles which influence the behaviour, expectations and preferences of individuals, groups and organisations.

SQ2: What characterises an assessment process?

A conventional assessment process is part of the decision-making process which consists of five iterative stages: Determination of the decision goal, imagination, judgement, decision-making and evaluation. The aim of decision processes in Bouwteams is to find (mutual) consensus about a preferred design solution.

Since assessment processes aim at physical objects, organisations seek to 'maximize' value (singular form) from an economic point of view by balancing performance (functions) and cost. This process is a continuous endeavour, targeting a range of systems and sub-systems throughout the lifecycle of the project for which each five iterative stages of the decision-making process are applicable.

Usually, three stakeholder groups are involved during assessment processes in Bouwteams. Since this thesis covers the public domain, three groups can be identified: (Semi-) public client, contractor and user. Assessment processes are organized in group-contexts with varying responsibilities and tasks distributed amongst participants. This asks for a careful consideration and allocation of risks amongst contractor and client, depending on the desired performance level and associated costs of the object.

Conventionally, the public client has a decisive role in the selection of the preferred design solution. The assessment process can be organized by appointing a core (decision) team which consists of members from both client and contractor in which the contractor brings expert knowledge about the practicality of the design.

SQ4: Which instruments (methods) can be used to make values explicit?

For large, societal, decisions a (Societal) Cost-Benefit Analysis can be useful to make values explicit to consider the impact of decisions on welfare. A Cost-Benefit Analysis relates the benefits of a design option with the associated costs. The Cost-Benefit Analysis is used in political contexts to express the potential monetary influence of actions.

Multi-Criteria Decision Making methods (MCDM) on the other hand can be particularly useful to organize and structure complex decisions. In contrast to the Cost-Benefit Analysis, MCDM methods incorporate a variety of 'judgement' criteria. MCDM methods help to structure complex decision problems.

In addition to the (Societal) Cost-Benefit Analysis and MCDM methods, the researcher explored the use of Value Sensitive Design (VSD) methods and Value Engineering techniques. VSD is particularly useful to consider ethical considerations (accounting for human values) during the design of technology. Value Engineering is a methodology which is used to address the functionality of a design by optimization of functions over costs. Value Engineering techniques are supportive to understand the drivers and primary functions that an object should contain.

SQ3: Which aspects make it difficult to make values explicit during assessment processes?

Values have a subjective character. Stakeholders in a construction project can have different perceptions and viewpoints upon whether a need or desire has been achieved. Public clients have societal responsibilities, shaped by the social-political context. Contractors work in a private environment, originally led (and judged) by profitability. Balancing both perspectives is complex.

During construction projects, initial goals – the preliminary requirements of the project – and ambitions evolve. Managing values is therefore a time-consuming exercise for project managers. Especially when group composition changes and new values arise. The role of 'value management' has nowadays gotten increased attention in the construction industry.

In a conversation about values, one might have a diverging view upon the system and boundaries of the system which leads to misperceptions. The consequence is that some values remain underexposed. Conventionally, stakeholders tend to monetarize values (expressed in €). However, some qualitative aspects, may not be expressed in any 'tangible' form. An example is the quality of the living environment. Although decision-makers try to make these intangibles measurable, the problem remains that regardless of the effort apples cannot be compared to pears.

SQ5: Which instrument is preferred, considering the difficulties in making values explicit and the intended use?

The wide variety of methods available and the broad context in which these methods are applicable show that considering values is a complex endeavour. The researcher chose to select a Multi-Criteria Decision Making method – the Analytic Hierarchy Process – to be explored in the context of Bouwteam projects. This selection is based upon:

1. Ease-of-use;
2. Executable in the available timespan of this research;
3. Suitability to support integration of qualitative decision aspects;
4. The availability of a facilitating tool/ 'web-application'.

Since no tailor-made MCDM method was found for particular use in the context of Bouwteams, the researcher chose AHP above other MCDM methods based upon its ability to 'synthesize' a decision problem in which a decision goal and constraints of the decision problem are implicitly defined. Moreover, the external supervisor of this thesis provided useful knowledge about the usability of the tool related to personal experiences with the method.

SQ6: How can this instrument be used in practise to make values explicit?

The web-application of the Analytic Hierarchy Process can be used within a decision process in the Bouwteam phase by following a sequence of steps.

1. The 'setup' phase – During this phase, the process manager formulizes the decision problem by creating a hierarchical structure in the webtool application. The hierarchical structure consists of a goal, criteria and design alternatives.
2. Tool assessment phase 1 – The decision team allocates weights to the criteria by following a pairwise prioritization process.
3. The 'transition' phase – The outcomes are integrated and design alternatives are added to the decision hierarchy by the process manager.
4. Tool assessment phase 2 – The decision team assesses the design options by following a pairwise prioritization process in which each design option is compared to the upper level of the hierarchy (criteria).
5. Group conversation – The results of tool assessment phase 2 are discussed in a group conversation.

This sequence of steps has been applied in a single-case study project. The case-study project was concerned with the renovation of a sewage treatment plant in Terwolde, the Netherlands. During this case-study, the AHP 'module' was tested by the researcher and additionally by the external supervisor in the role of process manager. The group conversation (step 5) took place in an online interactive session with the core team members and additional core (+) members in a Bouwteam collaboration.

The outcomes of the group conversation and tool assessment show that participants were able to identify themselves and others as potential outliers in the decision process and multiple great suggestions have been shared with the researcher. The application of value 'types' in the hierarchy of the AHP module seemed to be rather ambitious and indefinable to the practitioners. Nevertheless, the practical applicability of the module did trigger participants to be active in explaining their underlying rationale and motives.

The AHP module provides a distribution of the preferred design solution amongst the participants (Figure 22). Some of the participants recognized their preference. The 'use value' of the commercial building clearly played a dominant role (Figure 22).

Participant	Use value	Social Value	Econ. Value	Ecol. Value	CR_{max}
Group result	44.0%	29.0%	15.6%	11.3%	6.9%
USER 1	69.1%	19.8%	8.3%	2.8%	37.3%
USER 2	62.7%	23.9%	9.5%	3.8%	28.7%
PROJECT MANAGER 1	44.7%	21.6%	4.2%	29.5%	9.1%
PROCESS MANAGER	66.5%	7.1%	22.8%	3.6%	25.3%
SUSTAINABILITY MANAGER	30.9%	30.9%	14.2%	24.1%	5.7%
TECHNICAL MANAGER 1	62.1%	22.3%	11.8%	3.8%	25.9%
CONTRACT MANAGER	44.2%	45.5%	5.1%	5.2%	0.1%
COST EXPERT	8.3%	3.1%	67.1%	21.5%	35.4%
PROJECT MANAGER 2	3.7%	41.2%	10.6%	44.4%	18.7%
TECHNICAL MANAGER 2	27.8%	57.0%	10.9%	4.3%	3.7%
ENVIRONMENTAL MANAGER	53.4%	27.4%	12.4%	6.8%	16.3%

Figure 21: Outcomes of tool assessment phase 1 - criteria weighting

Participant	RENOVATE	REBUILD	CR_{max}
Group result	45.7%	54.3%	0.0%
TECHNICAL MANAGER 1	53.0%	47.0%	0.0%
USER 1	32.7%	67.3%	0.0%
SUSTAINABILITY MANAGER	57.4%	42.6%	0.0%
CONTRACT MANAGER	44.2%	55.8%	0.0%
TECHNICAL MANAGER 2	44.1%	55.9%	0.0%
ENVIRONMENTAL MANAGER	49.1%	50.9%	0.0%
COST EXPERT	30.1%	69.9%	0.0%
PROJECT MANAGER 2	65.5%	34.5%	0.0%

Figure 22: Outcomes of tool assessment phase 2 - design option assessment

7. Discussion & Recommendations

7.1. Introduction

This chapter is devoted to the elaboration of discussion topics that follow from the preparation- (literature), AHP webtool development- and AHP webtool application phases of this research. This chapter consists of three sections. Section 7.2 describes insights that follow from the web-tool outcomes and group discussion outcomes (interpretation of results). Section 7.3 describes opportunities for model development and suggestions for alternative model compositions. Section 7.4 describes the limitations of this research and elaborates upon the possible implications. Finally, section 7.5 provides suggestions for further research.

7.2. Interpretation of results

- The importance of 'use value'
    - The results retrieved from the tool assessment (phase 1) show that a majority of the participants during the empirical study prioritized the 'use value' of the commercial building over the 'ecological value' of the building (Figure 19). This feels contradictory with the main goal and circular ambitions of the case project. However, this result amplifies that the 'use value' fulfils an important primary or perhaps overarching value to stakeholders in a decision process, especially when the decision process is concerned with the selection of the most suitable design option.

      Perhaps, conversations about values should start with the identification of the intended 'use value' that stakeholders derive from an object. The sustainability manager recognized the importance to define and align the interpretations of 'use value', illustrated by the following quote:

      - "Perhaps, you should start a conversation about values by asking participants the question: 'What do you find important about the commercial building?'. This question can prevent that we (engineers) dive into the technical contents of the decision." -

- Role authenticity
    - The outcomes of the AHP model provide fruitful insights about the impact of role authenticity in the prioritization process. Firstly, this phenomena is illustrated by the tool assessment outcomes of the cost expert who prioritized the 'economic value' of the commercial building over the other three types of values. Secondly, the project manager pronounced concerns about the 'disbalance' between different value types. This illustrates that the project manager – devoted to the alignment of needs in a project – clearly triggered his professionality during the group discussion.

      Furthermore, the tool can help to identify that persons with almost similar roles can clearly express different priorities. This is illustrated by the diverging tool assessment outcomes between the technical managers (Figure 19 and Figure 20). The researcher identified that the technical manager of the client clearly focused on technical content, whilst the technical manager of the contracting party was capable of reviewing the decision question from a wider perspective.

A conscious selection of people involved in the decision-making process is clearly important for design choices. Not just technical skills and capacities of people but also their values (what they strive for) play a major role to achieve project success.

- Making potential 'outliers' explicit
    - One of the concerns with the identification of potential 'outliers' in a decision process is that the decision maker is able to ignore this outlier for the sake of the mutual group consent. The AHP web application provides a transparent overview of all participants, but this may come with a price. Especially when the effects of a decision have negative impacts on underexposed values. In this case, participants that were involved in the decision process can blame and point fingers towards decision makers for not paying attention to the potential outliers in the process.

      On the other hand, Bouwteams benefit from a transparent process since stakeholders have been selected on progressive and transparent collaboration principles. Through a simple process that the AHP application offers, conflicts between stakeholders may be solved in a more efficient way.

- Dealing with information asymmetry
    - The researcher observed during the empirical study that the successful use of the AHP model to prioritize values in a decision process depends on information that participants have regarding the development of the object. The facilitator of the prioritization process should be aware of potential developments which affect the scope of the decision.

      However, the tool might also be used to make explicit why this information asymmetry have led to a different viewpoint of a stakeholder. This makes the participants aware of the developments and enables decision makers to determine if this new information would have led to a different group consensus.

- Group commitment
    - The AHP web application is an iterative process which asks a certain commitment of participants in the decision process. The researcher observed that stakeholders with a technical background tend to be more committed to a process with clear and well-defined performance criteria. In contrary, stakeholders with a more strategic role, such as project managers and environmental managers – tend to be more willing to step outside of their comfortable seat.

7.3. Framework development and suggestions

- Group composition
    - The case team that was selected during the empirical study consisted of core team and core team + members in a Bouwteam collaboration, who share the intention to reach an agreement and move on in the building process. Questionable is whether the AHP-model finds a useful application in decision contexts where there is no need to reach consensus. An example of such a decision arena is found in many political contexts.
- The use of performance criteria & performance indicators
    - The second test case (which is added to the appendix of this report) shows that the use of predefined performance criteria and the discussion about performance criteria

contributed to a meaningful conversation in which certain steps in the process could've been left out. This indicates that the AHP model is able to improve the efficiency of the decision process.

7.4. Limitations and implications

- The framework which includes the application of the AHP methodology and group discussion session were tested in a single case study. This case study concerned the decision process of the 'commercial building' within case project RWZI Terwolde;
- No verifications have been performed with multiple case environments, Bouwteam projects, decision processes or varying stakeholder compositions;
- The results are not representative for every type/form of decision processes within Bouwteam projects.
- The research consists of an exploratory character to explore the conversations about values and develop a framework which aims to enable conversations about values in decisions processes of Bouwteams;
- This research forms the basis for further research regarding the role of 'value(s)' in decision processes and the use of methodologies to make values explicit and apply the methodologies to select and prioritize values for selection of the best/most accountable/justifiable design choice.
- This research was limited by COVID19 restrictions and online meetings. Furthermore, the research had to be carried out in a limited time span. Therefore, the researcher choose to develop a accessible and easy to use framework which was tested in an existing decision process within an existing Bouwteam.

7.5. Suggestions for further research

- The goal of this research is to provide insights about how values can be integrated as a topic of conversation within and for decision processes in Bouwteams;
- Until now, the application of making values explicit/topic of conversation within bouwteams was not a clear subject of scientific research. Most of the methodologies that are used to make values explicit are used for societal (large-scale) decision problems. Bouwteam settings and the collaborative (design) considerations that take part in the process retrieve increased attention across the construction industry. As a consequence of the COVID19 pandemic, online meetings have overtaken physical design sessions. The usefulness and necessity of methodologies which support these online sessions has become of greater importance. Further research provides the possibility to develop this framework (including the AHP methodology). This is concerned with the usability (user friendliness) and the use of the results as a substantiated basis to make design decisions.
- The results of this research clearly illustrate that the participants (actors within Bouwteam projects) are curious about the additional possibilities that this framework generates, including:
    - The use of the framework to visualise role authenticity;
    - The use of the framework to relate project team values with parent organisational values;
    - The use of this framework to measure and manage the 'alignment' between different stakeholder groups, such as client, contractors and users.

    - The use of this framework to measure whether values converge during the course of the Bouwteam phase.
    - The use of this framework to measure the 'alignment' of the project team with the user's desires.
- Furthermore, the researcher suggests further research into the role of the AHP model as a value engineering/ value management technique. This may suggest to integrate life cycle costs and decision scenarios to measure, identify and solve critical value contributing factors during the building process.
- This research has shown that values play an important role in the decision making processes. The composition of project members is of significant influence. Members should be 'progressive' and transparent where mutual trust is key for a successful project. An interesting topic for further research is stakeholder composition and the effects of that composition on implicit and explicit decision making. The optimal team composition perhaps contributes to a more integral design and optimal value for stakeholders.

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Appendix A: Process steps AHP web application

1. **'Setup' Phase [Facilitator]**

a. Facilitator opens AHP web application https://bpmsg.com/ahp/

b. Facilitator registers a personal account

c. Facilitator opens 'My AHP projects' after login

d. Facilitator creates a new project

e. Facilitator composes decision hierarchy under empty 'Input Hierarchy ' field

f. Facilitator submits hierarchy

g. Facilitator opens project and shares project link to participants

2. **'Tool assessment phase 1' [Participant]**

a. Participant opens project link in web browser

b. Participants fills in credits and clicks 'check input'

c. Participant clicks on 'go' to proceed

d. Participant clicks on red AHP button under level 0 of decision hierarchy

e. Participant executes pair-wise comparisons. Under left column, participant can check preferred performance criteria and provides priority scale in right column. In case participant has no opinion check 1.

f. Participant finalizes assessment phase by clicking on 'calculate' – 'submit' and 'save judgments' in sequential order.

3. **'Transition phase' [Facilitator]**

a. Facilitator checks if results are complete by checking column 'part' in the overview of personal AHP projects. If part = amount of participants then proceed

b. Facilitator opens project and clicks on 'View result' at the bottom of the page

c. Facilitator clicks on 'define alternatives'

d. Facilitator can now add alternatives by clicking on 'Alternatives' under decision hierarchy

e. Facilitator adds the amount of design alternatives

f. Facilitator submits names of design alternatives and clicks on 'ok'

g. Facilitator now saves project by clicking on 'save as project'

h. Facilitator returns to overview of personal AHP projects

i. Facilitator shares new project link to participants

4. **‘Tool assessment phase 2’ [Participant]**

a. Participant opens project link in web browser

b. Participants fills in credits and clicks ‘check input’

c. Participant clicks on ‘go’ to proceed

d. Participant clicks on red AHP buttons under column ‘compare’ of decision hierarchy

e. Participant executes pair-wise comparisons. Under left column, participant can check preferred design alternative and now needs to provide priority scale in right column. Each pairwise comparison is mend to reflect upon which design alternative is preferred for each performance criteria. In case participant has no opinion check 1.

f. Participant finalizes assessment phase by clicking on ‘calculate’ – ‘submit’ and ‘save judgments’ in sequential order.

5. **‘Group conversation’ [Facilitator]**

a. Facilitator checks if results are complete by checking column ‘part’ in the overview of personal AHP projects. If part = amount of participants then proceed

a. Facilitator opens project related to ‘Tool assessment phase 2’

b. Facilitator clicks on ‘View results’

c. Facilitator shares screen with participants and presents outcome ‘Alternatives by participants’

d. Facilitator starts conversation about presented outcome

Appendix B: Transcription of group discussion – Session A

Datum en tijdsduur van discussie: 15 april 2021, duur van gesprek: +-45min.

Locatie van gesprek: Microsoft teams online omgeving.

Deelnemers:

Vertegenwoordigers namens 'opdrachtgever':	Onderdeel van:
Zeeger van de Koppel – Projectmanager [waterschap V&V]	kernteam
Martin van Zetten – Technisch manager [waterschap V&V]	kernteam
Yvonne Dilling – contractmanager [waterschap V&V]	kernteam
Maaike van Scheppingen – omgevingsmanager [waterschap V&V]	kernteam+
Vertegenwoordigers namens 'opdrachtnemer':	
Wouter van Ee – Projectmanager [hoofdaannemer Pannekoek GWW]	kernteam
Erik Buunck – Technisch manager [ingenieursbureau W+B]	kernteam
Rob Dijcker – Duurzaamheidsaanjager [ingenieursbureau W+B]	kernteam+
Philine Goldbohm – procesmanager [consultancy DPI]	kernteam+

Notitie:

Hierna zullen vertegenwoordigers worden onderscheiden door naam + [functie, OG/ON]

Tijdens de meeting zijn een aantal vragen gesteld. Ter indicatie zijn deze gemarkeerd.

Begin van gesprek

Vincent [afstudeerder, TUD]:

Ik wil jullie allemaal ontzettend bedanken voor jullie bijdrage. Jullie hebben allemaal de invuloefeningen uitgevoerd. Ik begrijp mogelijke irritaties en onduidelijkheden. Daar gaan we vandaag wat dieper op in. De insteek van vandaag is: Bespreken van resultaten invuloefeningen (AHP model). Dit doen wij aan de hand van een aantal vragen. Daarna doorloop ik met Zeeger [projectmanager, OG] zijn individueel resultaat, vraag ik terugkoppeling van Erik B. [technisch manager, ON] en zullen we gezamenlijk terugkoppelen op de uitslagen van de tool.

Vincent opent het dashboard van de tool (via scherm delen), legt uit dat hij overzicht heeft van alle resultaten en dat hij ook individuele resultaten kan inzien. Dan schakelt hij direct door naar de AHP groep consensus, waarin de % verschillen staan tussen deelnemers als het gaat over de twee ontwerpkeuzes.

Zoals jullie zien geeft de tool als uitslag dat er een marginaal verschil is binnen de voorkeuren tussen alternatief renoveren en alternatief slopen & nieuwbouw van het bedrijfsgebouw. Misschien geeft aan dat dit resultaat wellicht nu nog niet zoveel zeggend is.

[Vraag: Hebben jullie het gevoel dat dit resultaat sense maakt? Hebben jullie het gevoel dat dit wat zegt/ wat teweeg brengt bij jullie? Kan iemand van jullie daar terugkoppeling op geven?]

Antwoord Erik B. [technisch manager, ON]:

Ik wil er wel iets van zeggen. Als ik gewoon even bij mezelf kijk: Het is een beetje 50/50 maar de tool geeft een voorkeur voor slopen & nieuwbouw van het bedrijfsgebouw. Dit klopt denk ik wel met mijn

gevoel. Ik twijfel nog wel een beetje, maar dan kunnen zaken gewoon gestructureerd en nieuw gedaan worden en ook duurzaam. Wat ik wel bijzonder vind is dat Martin, Rob en Zeeger voor de renovatie variant kiezen. En dat klopt dan ook wel weer bij hun rol. En ik verwacht dan ook eigenlijk dat jullie dan met name verwachten, Martin en Zeeger, dat het goedkoper en duurzamer is, en je het dus op die manier zou moeten doen. Bij Rob verwacht ik dat zijn overweging ook te maken heeft met duurzaamheid. Dit is mijn indruk, Is dat wat jij van mij verwachtte?

Vincent [afstudeerder, TUD]: Dank Erik, zeker. Jij geeft direct heel inhoudelijk antwoord op mijn vraag. Dat vind ik heel leuk, want dat had ik ook eigenlijk wel verwacht.

[Vraag: Wat vind jij van de verschillen tussen mensen, om dat eens te zien en om daar eens een indruk van te krijgen zonder dat je het gesprek met ze bent aangegaan hierover of wellicht ben je al het gesprek met ze aangegaan. Kun je mij iets meer vertellen? Heb je als je dit ziet een beter beeld bijvoorbeeld van hoe bepaalde mensen in de wedstrijd staan?]

Antwoord Erik B. [technisch manager, ON]:

Vind ik wat lastig te beantwoorden, ik ben technisch manager dus ja ik zit wat meer op de inhoud dus dat heb je goed gezien. Even denken hoe je je vraag precies bedoelt… Ik dacht net al antwoord te geven… en dat koppel ik op inhoud.

Tussenkomst Philine G. [procesmanager, ON]

Even tussendoor, Erik ik denk dat het antwoord dat je gaf o.b.v. de vraag die is gesteld ook lijn der verwachting lag van mij. Uhm Vincent, ik denk dat jij vooral op zoek bent naar het proces van: Wat doet zo'n overzicht nou met je. En mijn voorstel is Vincent om die vraag verderop in het proces nog een keer te stellen.

Vincent [afstudeerder, TUD]: Je hebt gelijk Philine. Ik zie dat Martin zijn 'handje' heeft opgestoken. **[Vraag: Martin, zou jij kunnen terugkoppelen op wat Erik zojuist zei?]**

Antwoord Martin Z. [technisch manager, OG]:

Ja hoor dat wil ik, ik ben ook technisch van aard dus wat dat betreft snap ik Erik. Het is alleen zo, bij het bedrijfsgebouw heb ik misschien een wat ander beeld dan anderen. Ik zie niet alleen het bedrijfsgebouw maar ook de kelder daaronder. Het is een geheel complex dat eigenlijk geheel gerenoveerd of nieuw gebouwd gaat worden. Ik kijk wat integraler, inclusief de kelder. Dus misschien is het verstandig als je dit op gaat zetten om van te voren aan te geven of het gaat om het bedrijfsgebouw met of zonder kelder. Ik ben ervanuit gegaan dat het met kelder is. Qua kosten heb ik niet echt een voorkeur, want we hebben de opdracht vanuit circulariteit en vanuit circulariteitsgedachten heb ik gekeken. Wat eruit komt maakt mij ook niet uit, want beheer gaat erin zitten. Maar ik heb wel een mening: Als we die kelder inderdaad gaan hergebruiken en niet gaan slopen dat mijn voorkeursalternatief meer in de richting zit van renoveren.

Vincent [afstudeerder, TUD]: Oké dankjewel. **[Vraag: Yvonne jij hebt ook je handje opgestoken zie ik, wat vind jij hiervan?]**

Yvonne D. [contractmanager, OG]:

Kunnen jullie mij nu goed horen? Nou: Ik ben ook technisch van aard (grapje). Ik heb de kelder dus niet meegenomen, maar ik denk juist dat door nieuw te bouwen je een veel duurzamer gebouw neer kunt zetten. Dat is eigenlijk wat ik wil meegeven.

Vincent: **[Vraag: Dus als ik het goed begrijp het je dit ook vanuit duurzaamheid ingevuld?]**

Antwoord Yvonne D. [contractmanager, OG]:

Nou ik hoop vanuit alle oogpunten, en daarop heb ik mijn antwoord gebaseerd.

Vincent: Oké, bedankt voor je input. **[Vraag: Rob, jij hebt ook je hand opgestoken?]**

Antwoord Rob D. [duurzaamheidsaanjager, ON]:

Terugkoppeling Rob: Uh… ja, dat klopt. Ik heb even een procesmatige reactie. Voor mij was het wel aardig om dit in te vullen gezien we parallel hieraan ook zelf hier naar hebben gekeken. En een van de eerste inzichten die wij hadden, en dat gaf volgens mij ook Martin aan, dat we dus ook een andere variant hebben. Dus dat we de vloer en fundering van het huidige bedrijfsgebouw weten te behouden – want daar zit de grootste milieu impact – en dat je daar bovenop of ergens anders iets nieuws bouwt. Want dat is in alle factoren de beste variant. En dat inzicht hadden we op het moment dat ik deze tool wilde invullen, dus ik wilde eigenlijk een derde variant hebben/toevoegen, dat is in ieder geval waar ik tegenaan liep.

Vincent [afstudeerder, TUD]: Ik wil hier wel op in gaan. De tool kan dus heel eenvoudig een extra variant toevoegen, gezien de tijd kunnen we dat nu niet doen. Daarom gaan we naar de volgende resultaten, en wil ik Zeeger even meenemen in zijn persoonlijke view hierop. Even kijken, ik kan dus individuele resultaten inzichtelijk maken, en ik 'check' Zeeger en dan kijk ik naar de invulling van Zeeger. Trouwens, dit was niet wat ik gelijk wilde doen, ik zou nog even een intermezzo houden over mijn onderzoek.

Intermezzo Vincent [afstudeerder, TUD]: Stellen jullie je nou eens voor dat jullie gezamenlijk een jas willen kopen die jullie willen toevoegen aan jullie verzameling jassen. En uhm, ik denk dat jullie je allemaal wel kunnen voorstellen dat je met elkaar bespreekbaar maakt welke voorkeuren of verwachtingen jullie hebben om een keuze te kunnen maken voor een jas. Voorkeuren komen voort uit een rugzak die je bij je draagt en is bepalend voor keuzes die je maakt. Bijvoorbeeld, misschien heeft Yvonne wel een jas al eerder heeft gekocht waardoor ze iets weet van het type jas, of heeft Martin hele specifieke kennis over de ritsluiting van de jas. Dus m.a.w. jouw rugzak is bepalend voor de voorkeuren die je hebt, je stelt bepaalde prioriteiten. De vraag is dan: hoe kunnen we nou deze verwachtingen/behoeften bespreekbaar maken en tot een keuze komen zonder teveel te moeten polderen. Laten we het nou eens betekenisvoller of zinvoller (vind ik zelf) invullen. Omdat niet alle prioriteiten hetzelfde wegen, kunnen we gebruik maken van een hiërarchie. Hiërarchie bestaat uit verschillende niveaus, bepaalde zaken zijn nou eenmaal belangrijker dan andere zaken. Of niet, maar dan zetten we het op hetzelfde niveau. We kunnen het ook niet doen, maar dan zijn we niet bezig met innoveren (haha…. Natuurlijk een beetje een flauwe grap) maar ik zie echt potentie in het feit dat we het bespreekbaar maken en waarden borgen en overzichtelijk weergeven en dus bespreekbaar maken omdat het resulteert in succesvollere bouwprojecten en met name in de samenstelling van bouwteams. **[Vraag: Philine jij steekt meteen je handje op?]**

Antwoord Philine G. [procesmanager, ON]:

[Vraag: Ja, want je geeft aan het is niet de waarheid, toch? Of wel?]

Antwoord Vincent [afstudeerder, TUD]:

Nee absoluut, we kunnen dus ook prioriteiten niet bespreekbaar maken of zoals Rob ook al geïnitieerd via duurzaamheidssessies kunnen we heel technisch inhoudelijke invulling hieraan geven. Ik denk dat het vanuit een hogere view, vanuit waarden – heel abstract – van toegevoegde waarde is en wellicht

een andere route is die naar Rome kan leiden. We gaan nu door naar de individuele resultaten van Zeeger.

Opmerking Wouter E. [projectmanager, ON]:

Nog even terugkomen op wat je net zei. Waar ik zelf een beetje mee zat: Waar je ook van te voren een beeld van moet hebben is, wat is de staat van het huidige bedrijfsgebouw. Daar zat ik zelf een beetje mee. Dat bepaald wel heel erg of je gaat renoveren of nieuwbouwen, laat staan de kosten.

Reactie Philine G. [procesmanager, ON]:

Dit komt wel ter sprake nu. Je komt eigenlijk met je behoefte op tafel, voor mij is dit nu belangrijk. Ik kan dat geen plek geven eigenlijk.

Reactie Wouter E. [projectmanager, ON]:

Nee, nu heb je bepaalde aannames gedaan en het zal wel zo zijn, maar exact zit er asbest in of niet, dan vul je deze TOM – of hoe je het ook noemt – anders in dan wanneer je de informatie niet hebt. Althans het kan dat als je meer informatie hebt de afweging iets anders wordt.

Reactie Vincent [afstudeerder, TUD]: Ik zou graag even doorgaan. We kunnen de resultaten van Zeeger er dus even bij pakken, zoals jullie nu zien en tevens wat het mooie is, is dat de hiërarchie terug komt. De hiërarchie is nu horizontaal gericht. Zoals jullie kunnen zien geeft het model een 'global priority' aan.

Reactie Erik B. [technisch manager, ON]

Vincent, je hebt het nu over een kolom global priority, die zie ik niet… oh… nu wel.

Vincent [afstudeerder, TUD]: Oké. Dus wat je hier ziet vinden jullie gebruikswaarde blijkbaar het belangrijkste in jullie overweging voor de keuze van een ontwerp. Laten we meteen eens kijken naar de invulling van de eerste weging van Zeeger. **[Vraag: Yvonne, wil je wat vragen?]**

Antwoord Yvonne D. [contractmanager, OG]:

Ik stel de vraag even tussendoor: Het resultaat dat je net zag was toch alleen van Zeeger dus niet van de groep? Of neemt hij dit automatisch mee?

Reactie Philine G. [procesmanager, ON]:

Dat neemt hij automatisch mee.

Vincent [afstudeerder, TUD]: De globale prioritering die jullie nu zien is dus anders dan de globale prioritering die we hiervoor zagen. Dit is de globale prioritering van Zeeger. De invulling van Zeeger geeft dus wellicht een ander beeld. Ik kan ook kijken naar de wegingen die Zeeger heeft toegekend aan bepaalde waarden. Om daar direct om in te gaan **[Vraag: Zeeger, had jij dit resultaat verwacht?]**.

Antwoord Zeeger K. [projectmanager, OG]:

Ik had wel verwacht dat ik de impact die, nee…dit ga ik anders verwoorden. Dat de impact van iets dat wij doen op onze omgeving, dat ik dat belangrijk vind. Ecologische waarde, dat zie ik ook zo, dat vertaal ik in mijn hoofd op die manier. M.a.w. het resultaat verbaasd mij niet. Ik had alleen niet verwacht dat gebruikswaarde zo ver op afstand zou staan.

Opmerking Philine G. [proces manager, ON]:

Het groepsresultaat wat jullie nu zien heeft dus alleen betrekking op Zeeger. Voor de duidelijkheid.

Opmerking Zeeger K. [projectmanager, OG]:

Vanuit het groepsresultaat vind ik dit resultaat wel prettig.. *Zeeger moet lachen*…

Vincent [afstudeerder, TUD]: Haha. Laat ik de vraag anders stellen **[Vraag: vind je het opmerkelijk dat je anders beoordeelt dan de consensus? Of was dit al de vraag waar je net antwoord op gaf?]**

Antwoord Zeeger K. [projectmanager, OG]:

Laat ik het zo zeggen, het overkomt mij vaker dat ik anders denk dan de groep.

Vincent [afstudeerder, TUD]: **[Vraag: En hoe komt dat, daar ben ik dan wel benieuwd naar?]**

Reactie Philine G. [procesmanager, ON]:

De andere vraag zou ik pakken, die omvat ook deels deze vraag.

Vincent [afstudeerder, TUD]: Oké, dan is de andere vraag **[Vraag: Hoe ben je tot deze weging gekomen?]**

Antwoord Zeeger K. [projectmanager, OG]

Uhm… door heel sec in te vullen en dat te doen op intuïtie. Dus ik heb vooral bij het invullen van de tool niet zo lang nagedacht.

Reactie Philine G. [procesmanager, ON]:

Oké, je hebt niet te lang nagedacht. Maar wel in het niet te snel nagedacht de rol als projectmanager belichaamt voor je gevoel of echt losgelaten?

Reactie Zeeger K. [projectmanager, OG]:

Nee dat heb ik losgelaten, ik heb niet vanuit een bepaalde opdracht geredeneerd, en waarom niet? Omdat één van de doelen van dit project is om zaken ook op een andere manier te doen. En ook circulariteit en ik koppel duurzaamheid er dan ook meteen aan. Als we dan vanuit het bedrijfsstramien blijven werken, komen we ook niet tot een verandering, denk ik. Dus ik heb hier geredeneerd vanuit wat ik denk dat goed is. En ik had ook niet het beeld dat, oh nee… zo heb ik het gedaan, klaar.

Vincent [afstudeerder, TUD]: **[Vraag: En als je het nou wel vanuit je rol als projectmanager dit zou invullen, had je het dan anders ingevuld?]**

Antwoord Zeeger K. [projectmanager, OG]:

Als ik heel eerlijk ben, ik denk het niet. Het doel van dit project is echt om dingen circulairder en duurzamer te doen, en ook volgens mij te leren werken met een wat ander referentiekader dan we als bedrijf hanteren op dit moment. En ik denk dat ik als persoon al een iets ander referentiekader heb.

Reactie Rob D. [duurzaamheidsaanjager, ON]:

Vincent, wat ik mij opeens realiseer door het gesprek wat nu ontstaan is. Zou het voor de volgende keer niet interessant zijn om een vraag te stellen die niet een vraag is wat met een variant vergelijking te maken heeft maar – want volgens mij heeft Zeeger er ook zo veel meer naar gekeken – de vraag stellen: Wat vind ik belangrijk aan het bedrijfsgebouw? Want dat is volgens mij ook het goede

startpunt. Want alle techneuten onder ons wordt meteen een moeilijke vraag gesteld waarin wij afwegingen moeten maken en daar allerlei vragen bij krijgen. En het dus een heel inhoudelijke afweging wordt. Misschien als je begint met waarden zou je niet eens moeten beginnen met deze vraag.

Reactie Philine G. [procesmanager, ON]:

Eens en daar hebben Vincent en ik ook over nagedacht, maar aangezien de tijd en de clustering te moeten doen. Zou daar wel uhm… fijn, bedankt Rob.

Reactie Zeeger K. [projectmanager, OG]:

Uhm Vincent… wat ik nou toch wel leuk zou vinden is op het moment dat onze opdrachtgever dit ook invult, zonder dat je daarbij een toelichting geeft. Waarom? Om inzicht te krijgen in hoe ons waardepatroon in elkaar zit, want dat geeft ook inzicht in waarom sommige gesprekken op een bepaalde manier verlopen. Dat is denk ik heel prettig dat je dat van elkaar weet, dan ben je beter in staat bij elkaar door te vragen. Begrijp je wat ik bedoel?

Vincent [afstudeerder, TUD]: Ja, dat snap ik.

Reactie Philine G. [procesmanager, ON]:

Kijkend naar de tijd, is mijn voorstel af te ronden met je laatste twee vragen. Omdat ik dan denk dat je voldoende reflectie hebt om mee verder te gaan.

Rob heeft een aanvulling gedaan. Je hebt nu iets meer aan context gekregen op basis van waarvan ze bepaalde keuzes wel of niet hebben gemaakt. Bij mij komt de vraag op: Stel je hebt elkaar nu gehoord, zou het resultaat dan anders zijn of zou je andere keuzes maken o.b.v. het gesprek dat je nu hebt gehoord.

Vincent [afstudeerder, TUD]: Oh ja… nu weet ik het weer. **[Vraag: Dus zouden jullie het anders invullen o.b.v. het gesprek van zojuist? O.b.v. de inzichten die je zojuist hebt verkregen?]**

Antwoord Zeeger K. [projectmanager, OG]:

Nou ik zat na te denken om het twee keer in te vullen. Een keer zoals nu, maar ook heel specifiek vanuit mijn rol geredeneerd. Gewoon om te kijken of er verschillen zijn, om er vervolgens ook voor te kunnen zorgen dat beiden goed samen komen. Ik zou dit ook kunnen interpreteren om vanuit mijn rol de gebruikswaarde genoeg mee te nemen vanuit mijn rol als projectmanager. En die anderen zijn al wel geborgd omdat die er vanuit dieper al inzit. Is dat een conclusie die ik zou kunnen trekken op wat ik nu zie? Want dat geeft mij wel dat inzicht.

Antwoord Philine G. [procesmanager, ON]:

Vincent en ik hadden het er ook over, in hoeverre ga je authenticiteit bespreken ook vanuit rol. Je bent met reden een projectmanager voor dit project. Hoe geef je daar invulling aan, dus doe je dit vanuit je persoon of ben je je nog bewust vanuit bepaalde bewuste zaken zoals scope, belangen van opdrachtgever.

Reactie Zeeger K. [projectmanager, OG]:

Ik denk dat dat de combinatie is.

Reactie Erik B. [technisch manager, ON]:

Ik denk niet dat ik het anders in zou vullen eigenlijk, dus dat antwoord is nee. Wat ik wel in mijn hoofd heb zitten, een stukje feedback over de tool. Ik had wat moeite met de definities dus ik heb o.b.v. de titel van het punt gebruikswaarde, sociale waarde etc. zelf een interpretatie te geven. Anders kon ik daar niet echt iets mee. En wat ik wat lastig vond is dat als ik wat invul het computersysteem zegt: No, dit gaat niet, waardoor ik net zo lang moest schuiven tot het 'computer says yes' was. Dus ik kon het niet invullen op basis van mijn eerste reactie. En dat vond ik wel wat lastig.

Vincent [afstudeerder, TUD]: Ik denk over dat tweede, dus wat de tool doet. Gaat niet zozeer over of je goede of slechte keuzes maakt, maar wel bv. ik vind het ene belangrijker dan het andere dan betekent automatisch dat gebruikswaarde belangrijker moet zijn dan de economische waarde. Er zit een bepaalde consistentie in verwerkt.

Reactie Erik B. [technisch manager, ON]:

Ik als techneut begrijp helemaal het consistentie deel. Ik heb achteraf toch iets ingevuld dan dat ik vooraf dacht.

Reactie Philine G. [procesmanager, ON]:

Maar dat zit volgens mij dus ook in die tool Vincent, dus jij zou moeten zien wat de initiële keuze was van Erik.

Reactie Erik B. [technisch manager, ON]:

Ik had het idee dat mijn einduitslag gewoon echt iets anders is dan ik echt bedoeld had. Dat pakte hij niet. Ik begreep dat Rob eenzelfde iets had, en dat hij vast liep in het systeem en daarover een mail had gestuurd.

Reactie Zeeger K. [projectmanager, OG]:

Ik heb nog een andere conclusie, maar even kijken of ik die mag trekken. Als ik kijk naar het waardepatroon van het team, vanuit welke waarden wij werken. Op basis van wat ik nu op dit moment op het scherm zie (de verdeling van participanten over de 4 waarden). Als ik dit goed interpreteer, dan redeneert het gros vanuit de gebruikswaarde terwijl wij ook nog sociale, economische en ecologische waarde hebben. Ik zie dan een disbalans. Als ik dat zo mag constateren, dan is dit ook hele waardevolle informatie voor ons als team dat op het moment dat wij besluiten nemen ook heel nadrukkelijk naast gebruikswaarde de andere 3 waarden beschouwen. Dan moeten wij dus als team iets beter ons best doen om ook op die andere waarden te focussen. Wij zijn een circulair project, wat toekomstbestendig moet zijn waarbij de andere 3 waarden ook een plek moeten krijgen. Ik denk dat wij iets beter ons best moeten doen om dat ik evenwicht te brengen. Kan ik dat zo stellen?

Vincent [Afstudeerder, TUD]: Deels, ja en nee. Ik denk dat het ook heel erg afhangt van de definities die ik vooraf bepaald heb. Ik heb ook het woord kwaliteit in de mond genomen, en ik denk dat kwaliteit ook te maken heeft met ecologische waarde bijvoorbeeld. Dus bepaalde tastbare kwaliteiten heb ik genoemd, dat zou ook met ecologische waarde te maken kunnen hebben. Dus, in dat opzicht niet.

Anderzijds denk ik ja, wellicht wel. Maar dan moet je wel checken bij iedereen of dat zo is. Of dat wel waarheid is. Dus dan moet je eerst het gesprek daarover voeren. Of dat wel waarheid is.

Reactie Philine G. [procesmanager, ON]:

Wat ik interessant vind is, zou zoiets ertoe leiden – in aanvulling op wat Zeeger zegt - we wellicht helemaal geen afwegingen hoeven te maken. Dus als je op een bepaalde manier positioneert, dus dat we blijkbaar vanuit gebruikswaarde alles kunnen beredeneren dan zijn we er ook. Dan zie je wellicht om je heen ontstaan, krijg je misschien reacties van mensen dat het helemaal niet zo is. En dan krijg je ook weer, en dan Zeeger, dan zou je het mee kunnen nemen in het vervolg en daar ook scherp op zijn.

Reactie Martin Z. [technisch manager, ON]:

Ik mag de conclusie trekken? Wat Zeeger zegt, ik snap wat hij zegt. Wat ik wel moeilijk vind bij een bedrijfsgebouw, want je hebt het over een gebouw. Ecologie heb ik een heel ander beeld bij dan het bedrijfsgebouw. Wel waar hij wordt gebouwd en dus de omgeving. Dus dat je goed aangeeft wat de definitie is van ecologie of sociale waarde voor het bedrijfsgebouw, dan kun je er iets meer over zeggen en dan denk ik dat het ook beter in balans komt.

Vincent [afstudeerder, TUD]: **[Vraag: Zijn er nog mensen die iets willen meegeven?]**

Reactie Zeeger K. [projectmanager, OG]:

Ik voel mij wel eenzaam…. (lacht).

Reactie Wouter E. [projectmanager, ON]:

Ja ik was even nieuwsgierig. Bedankt voor je input. Ga jij ook een samenvatting schrijven en wat is je pad voorwaarts? Krijgen wij ook inzicht in de bevindingen die je hieruit hebt gehaald?

Vincent [afstudeerder, TUD]: Ja, ik ga jullie hier zeker nog op terugkoppelen. Misschien is het een idee om nog kort terug te koppelen met Zeeger en Wouter over wat er tot dusver is besproken. Bedankt voor jullie aandacht!!

Einde van gesprek

Appendix C: Transcription of group discussion – Session B

Datum: 12-05-2021

Philine: Voor degene die er gisteren niet bij waren, welkom ook. Maaike en Rudi. In principe zitten we vandaag om tot een gewogen afwegingskader te komen voor de ontwerpvariant van zand- en vetvang. Het doel van vandaag is niet om te komen tot een daadwerkelijke keuze, maar het dient als input voor de notitie die er momenteel ligt om een advies neer te leggen. Als ik het goed begrijp. Correct me if I'm wrong. En de meekoppelkans is of we op basis van deze sessie ook onze gevolg ontwerpsessies zo kunnen insteken. En op deze manier binnen een bepaalde tijd een efficiency slag kunnen zetten. Daarnaast is het bijeenkomstig vandaag dat we persoonlijke voorkeuren meewegen in onze ontwerpafweging. Maar dat wijst zicht achteraf. Voor ons is het belangrijkste de eerste twee punten.

Hoe ziet vandaag eruit: We hebben ander half uur de tijd. Eerst krijgen jullie een korte toelichting van Jaïr. Dan gaan we even kort in m.b.t. menti-meter op een aantal onderdelen, vervolgens gaan we door op een nulmeting om de tool die we gebruiken te leren kennen en feeling te krijgen. Daarna is er even een brake. Daarna volgt meting 1 en dan bespreken we de resultaten. Wat doen we daar nou mee en wat doet het voor het gevolg. Daarna ga ik jullie vragen om aan het eind feedback te geven op de gehele sessie en of wij het kansrijk zien om dit te gebruiken voor het vervolg.

Maaike: Als ik even naar de samenstelling van de groep kijk ben ik eigenlijk de enige niet 'techneut'. Op het moment dat het ergens technisch naartoe gaat dan wil ik misschien even mezelf afzijdig houden.

Philine: Als het goed is kunnen we dat in de tool gewoon meenemen, dus we kunnen jou elimineren uit de uitkomsten mocht je daar oké mee zijn.

Maaike: Nee zeker, ik ben alleen bang dat ik bepaalde keuzes maak en dat doe op basis van mijn onderbuikgevoel.

Jaïr: De weging is niet technisch dus daar is jouw input sowieso belangrijk voor, voor de scoring zit het misschien wat anders. Maar voor een heel groot deel is het wel relevant en ook nuttig ook voor ons.

Erik: Ik denk dat de mensen van Witteveen en Bos geen mening meer hoeven te geven. Omdat wij dit eigenlijk al hebben gedaan met de eerste weging.

Philine: Ik zie dat anders. Jullie hebben wel voorkennis. Maar ik zou jullie wel willen voorstellen daarmee aan de gang te gaan. Ook om te kijken of dit voor jullie werkt en daarnaast om een vergelijking te maken. Opmerking aan jullie: Mocht het nou niet lopen, ik heb een plan b dus in principe kan ik daar op terugvallen.

Jaïr: Maaike ben je een beetje op de hoogte van de notitie?

Maaike: Ik heb de notitie gelezen dus ik weet wel waar het over gaat.

Jaïr: Er wordt een Verdygo zuivering ontworpen. Daar is al een zandvang module opgenomen, maar het Verdygo stelt geen vetvang voor. Nou is het zo dat we daar zelf voor moeten kiezen. Nou wil het zo dat de vet en zandvang in veel gevallen wordt gecombineerd. Maar als we dat zouden doen zullen we afwijken van het Verdygo handboek. Daarom hebben we deze drie installaties naast elkaar gelegd om te kijken welke we kiezen om te kunnen aangeven waar we afwijken.

Jaïr: Variant 1 is de beluchte zand- en vetvang. Dat is een lange goot waar lucht in wordt geblazen vanaf het begin. Vet drijft op, zand is dan bezonken en met een schroef wordt dat zand dan weggevoerd. Deze variant bestaat uit drie installaties, twee keer van een installatie van 1000m3 per uur en een van …m3 per uur

Variant b is een nieuwe installatie die nog niet is toegepast in Nederland. Met een lamellen scheiding erin. Het is qua werking hetzelfde als de vorige variant. Maar omdat er een lamellenpakket is ingezet kun je de installatie compacter uitvoeren. Praktisch zou deze installatie in twee keer een installatie van 1200m3 /uur.

Volgende, variant met behoud van de Verdygo eis. Dan houden we de Verdygo zandvang van het handboek (centrifugaal), deze kan niet ook vet afvangen. Daarom moet er apart een vetvang worden gebouwd, deze zal dan hetzelfde worden gebouwd als de eerste variant, ook een langsgoot (bijna net zo lang) maar dan zonder een transportschroef aan de onderkant om het zand af te voeren. In de praktijk betekend dit één zandvang van …m3/h en 1 langsgoot van …m3/h dus 3 installaties in totaal. Ik denk voldoende info voor nu.

Martin: Je zei de eerste variant bestaat uit … en … en de tweede variant uit … en ….

Jaïr: Ja dat klopt, dat komt omdat we hebben gekozen voor leverbare varianten. Maar omdat de vetvanger in deze variant sowieso niet bestaat is het beter om twee afhankelijke te kiezen.

Jaïr: Dan hebben we de criteria. We hebben een variant analyse gemaakt. Deze variant hebben we beoordeeld op verschillende criteria. Die hebben we ingevuld samen met productleveranciers en o.b.v. productreferenties. Er zijn er 10 in totaal. Zuiveringsprestatie, beschikbare capaciteit, drukval, Verdygo-inpasbaarheid, bouwgrootte, circulariteit, beheer en onderhoud, Arbo omstandigheden, bouwkosten en praktijkreferenties. Dit zijn ze alle 10, zijn er vragen?

Geen vragen.

Philine: Dan de mentimeter, ik zou jullie willen uitnodigen naar menti.com te gaan en code in te vullen. De vraag is en om in te komen: weeg ieder criterium een weging van helemaal niet belangrijk tot heel belangrijk. Als het goed is hebben jullie een schaal van 0 tot 10 om in te antwoorden. Mijn vraag aan jullie is om hier invulling aan te geven. Dus per criterium een score.

Philine: Menti heeft maar een x aantal criteria die je in kunt vullen. Excuus, ik ga hem even aanpassen.

Als je een cijfer mag geven hoe belangrijk jij de zuiveringsprestatie, is dat dan een 0 een 5 of een 10?
Rudi: 5.
Beschikbare capaciteit: 10
Drukval: 0
Verdygo inpasbaarheid: 5
Bouwgrootte: 5
Beheer en onderhoud: 10
Referenties: Weet je dat vind ik heel lastig. Voor twee vind ik dat niet zo belangrijk en voor 1 wel. 10
Bouwkosten: 0

Dan gaan we naar het vervolg, dan wil ik de anderen ook vragen om deze criteria te wegen.

Philine: Nu heb ik er nog een. Nog een vraag aan jullie: Ik heb een voorkeur voor variant A, B of C. (rudi zucht). Jullie moeten de varianten ‘ranken’. Op het eerste oog is het dus variant B, daar doe ik

nu helemaal niets mee. Dan nog een vervolg stap: ‘Ik kan geen voorkeur geven, want ik heb daarvoor behoefte aan…’.

De constatering die we al doen: In principe hebben jullie de notitie gelezen en daar stond al de nodige informatie. Nu hebben jullie vragen voor je neus gekregen waarbij je direct een antwoord moest geven zonder je daarbij de nodige informatie direct tot je beschikking hebt. Zoals je ziet is die informatie wel belangrijk om enerzijds criteria af te wegen ten opzichte van elkaar en anderzijds een waardering te kunnen geven aan de verschillende varianten. Daartoe is Menti dus niet het middel, dat wordt heel lang en heel uitgebreid. Dus wat ik heb geprobeerd is om het op een andere wijze te doen, door gebruik te maken van een andere tool. Jullie krijgen hiervoor een link. Als het goed is moet je ook kiezen, dat vraag de tool automatisch.

Start gebruik van tool

Jaïr: Ik moet eerst mijn naam opgeven.

Jaïr: Kan ik ook terug klikken als ik te ver ben?

Philine: Ja dat klopt.

Philine: Als het goed is, als jullie naar hetzelfde scherm kijken als ik, dan krijg je (dan zie je) op een lange lijst terecht.

Martin: Ik zie iets anders

Philine: Martin, kun jij je scherm delen dan kunnen we je iets makkelijker helpen.

Daan: Bij mij werkte de link niet omdat ik de link moest kopiëren naar de chat.

Philine: Aan jullie de vraag om in principe paarsgewijze vergelijkingen te doen. Dit is saai maar het is de enige manier om een ‘all-inclusive’ weging te krijgen van de criteria. En daarbij, in principe heb je de mogelijkheid om zuiveringsprestatie af te wegen ten opzichte van beschikbare capaciteit waarin je aangeeft dat je zuiveringsprestatie iets belangrijker of veel belangrijker vind dan beschikbare capaciteit. Je doet dit even op ‘onderbuikgevoel’ dus zonder inhoudelijk informatie. Het voelt ook complex aan maar het gaat er uiteindelijk om dat je de varianten moet afwegen en je loopt spaak als je dit niet doet.

Rudi: Ik kwam op hele rare resultaten dus ik denk dat dat niet goed is. Als ik naar de uitslag kijk zou ik het net andersom willen. Ik heb zegmaar praktijkreferenties op 10 staan, dus er zal wel iets verkeerds uit zijn gekomen. Nu ga ik dus dingen opnoemen, dat is misschien niet verstandig. Maar wat ik anders zou willen zien is dat Beheer en Onderhoud op 1 staan.

Philine: Ja maar als je dus gaat wegen dan kun je Beheer en Onderhoud wegen.

Philine: Martin de resultaten van jou kan ik zien. Het is even een test dat begrijp ik.

Maaike: Ik drukte dus op submit en daarna moest ik nog op save judgements drukken.

Jaïr: Moet ik dan nog een keer op save judgements drukken om te finalizen?

Daan: Ik krijg eerst nog een verzoek om de scores aan te passen om consistentie te verbeteren.

Philine: Ah, dat klopt. Het is wel zo eerlijker als je dat dus niet aanpast. In principe als je je bolletjes aanpast ben je dus in lijn aan het oordelen.

Daan: Dan ben je ergens naartoe aan het werken.

Philine: Normaal gesproken kan je hem aanpassen. Alleen het voelt niet goed (want je bent je bolletjes aan het aanpassen). Feitelijk ben je dan in lijn aan het oordelen. Maaike ik heb die van jou nog niet binnen, klopt dat?

Philine: Hier zie je dus een overzicht van de geconsolideerde resultaten. Waarbij zuiveringsprestatie, beheer en onderhoud en arbo-omstandigheden dus eigenlijk de top 3 zijn. We gaan hier mee door waardoor we een soort van in een routine terecht komen. Nu ga ik jullie opnieuw meenemen.

Philine: Zal ik de link in de mail sturen? Dank voor jullie geduld overigens!

Maaike: Tot over een uurtje he jongens. Laten we maar snel doorklikken. Volgens mij moet je hier ook niet heel lang over nadenken.

Philine: Nee zeker, dit is inderdaad puur op gevoel en niet op kunde of feiten.

Jaïr: Philine, als je kijkt naar die resultaten. Dan krijg je een 1 2 en 3 te zien als je een preview doet. Is dat ook de score in hele getallen? Of gaat hij ook in decimalen werken?

Philine: In decimalen, dus ook hier is de stap save judgements en dat gaat dus op dezelfde manier. Als het goed is kan ik dan op view result klikken.

Maaike: Ik had wel een aantal gewoon gelijk a ingevuld omdat ik er gewoon niets van wist. Dan gaat het gewoon gelijk mee toch in de score?

Philine: Ja en als we straks resultaten bekijken kunnen we ook aangeven jou niet mee te nemen. Een gedeelte is ook kun je op basis van deze methodiek waarde of achterliggende wegingen bespreekbaar maken (dus kun je daar achter komen).

Maaike: Het is echt een wetenschappelijke tool, haha. Als het maar bijdraagt, toch.

Daan: Het is wel veel klikken.

Rudi: Ik vind het toch wel lastig hoor. Er staan gewoon dingen tussen die ik niet ken, dat vind ik moeilijk beoordelen.

Philine: Ja ik heb alles binnen. Dan ga ik direct even door (gezien de tijd). Dat was even de nulmeting, we hebben alles gedaan o.b.v. gevoel. De gevolgmeting, in principe staat er in de notitie een onderbouwing. Jullie zien deze onderbouwing nu op het scherm. Varianten horizontaal en criteria verticaal. Ik wil dit nu nog een keer doen (maar dat is waar onze keuze nu voor staat) maar nu op basis van de informatie die ik hier heb. Mijn vraag aan jullie: Zien jullie het zitten deze hele weging nog een keer te doen.

Maaike: Waar ik wel benieuwd naar ben. Aangezien een aantal mensen dit heel nauwkeurig hebben ingevuld. Misschien is het wel slim om de vraag te stellen aan mensen: Hebben jullie dit nou ingevuld op basis van dit schema in jullie achterhoofd. Ik heb bijvoorbeeld bij kosten een 1 ingevuld omdat ik de kosten niet wist zegmaar. Ik kan me voorstellen dat het redelijk hetzelfde is als iedereen deze informatie in zijn achterhoofd heeft.

Martin: Ik heb wel een ander voorstel. We hebben alles ingeschat. We hebben nu een invulling gedaan en per onderwerp een waardering gegeven. Ik kan mij voorstellen dat je die waardering per onderwerp even tevoorschijn haalt wat het uiteindelijk geworden is en kijken of we het ermee eens zijn o.b.v. wat hier nu op het scherm staat.

Philine: Eens, ik zou jullie willen vragen om de notitie met deze tabel zelf voor jullie te halen dan ga ik de resultaten van de tool met jullie delen.

BESPREKEN VAN RESULTATEN

Philine: Oke, dan ga ik mijn scherm delen. Zien jullie überhaupt iets? In principe zien we hier de weging van de alternatieven, en daarbij zie je dan ook per criterium wat dan de voorkeur heeft (onze voorkeur heeft). Aan de onderkant zien we eigenlijk de consensus waarbij de consensus momenteel staat op A. Alles bij elkaar in ogenschouw nemend.

Als ik kijk naar variant B: ik zie dan twee opvallendheden, Rudi en Maaike. Even los van de percentages. Er is een groot verschil ten opzichte van het gemiddelde. Is daar aanleiding toe?

Rudi, kun jij je hierin vinden dat A jouw voorkeur heeft?

Antwoord: Ja.

En Maaike, kun jij je vinden in dat variant C de voorkeur heeft?

Antwoord: Nou wat mij vooral opvalt is dat je mij hierin niet teveel moet meenemen. Ik zou mij gewoon eruit laten.

Maaike: Ik denk dat als ik naar de criteria ga wel redelijk een beeld heb, maar van de varianten dus niet.

Philine: Maar de vraag Martin, dus op basis hiervan op basis van de notitie (als we die er dan bijpakken), kunnen wij ons dan vinden in het totaal en in de subs? Dus als jullie de varianten erbij pakken (dus de hiërarchie met geconsolideerde voorkeuren) kunnen jullie je dan vinden in het voorkeursalternatief?

Jaïr: Ik heb meer het idee, dat is meedenkend, dat de vraag is. Kunnen wij ons vinden in de weging van die criteria, want voor een groot deel zou de uitkomst dan een objectieve uitkomst moeten zijn. Dan hebben we blijkbaar een aantal varianten op een bepaalde manier en dan scoren de varianten zo. Ik zag dat er per criterium bijvoorbeeld iets stond over hoeveel consensus er dan is in de groep. Dus ik zou het overzicht van de criteria willen weten, dat is een andere vraag als je weet wat ik bedoel.

Philine: Oke dan sla ik hem even terug in kwalitatieve en kwantitatieve criteria. Kwalitatief heb je bijvoorbeeld bouwgrootte. Degene die de minste bouwgrootte heeft verdiend plek nummer 1. Dus wat ik mij kan voorstellen dat je op basis van dit gedachtegoed van de eindresultaten al iets kunt vinden. Als je kijkt naar de kwalitatieve criteria dan is het wel van belang, bv Verdygo inpasbaarheid, beheer en onderhoud en praktijkreferenties volgens mij. En dan even gericht op de varianten is het dan wel van belang hoe is het gewogen bijv.

Dan terug komend op jouw vraag Jaïr, de vraag die centraal staat, in de weging van de criteria. Dat wil zeggen dat de zuiveringsprestatie het aller belangrijkste criteria is.

Martin: Zoals ik het nu zie is het een logisch plaatje, hij moet gewoon presteren, beheersbaar zijn en veilig.

Rudi: Ik vind het wel een beetje lastig hoor, want sommige dingen zijn gewoon cijfers voor he. Wat kost dat apparaat is heel duidelijk. Maar ik heb het gevoel dat ik 3 auto's moet beoordelen, twee auto's heb ik een proefrit in gemaakt en die derde auto moet ik vanuit …. Beoordelen. Ik vind het toch lastig.. Ja uhm… Ik kan twee beoordelingen met gevoel doen en die derde moet ik doen op aannames.

Philine: En welke is dat voor jou, welke is dat dan ?

Rudi: Ik vind dat heel erg jammer want ik sta heel erg open voor nieuwe technieken. Hij scoort gewoon heel slecht voor mij alleen ik weet dus niet of dat terecht is.

Daan: dan kijk je ook echt wel vanuit beheer en onderhoud denk ik toch?

Rudi: Jaaa, tuurlijk. Die prijs dat uhm is ook wel belangrijk maar dat..

Philine: Maar dit is ook iets, uiteindelijk is dit een weging. Is het waarheid, niet zozeer. Je kunt bijvoorbeeld toch kiezen voor variant B wetende van de resultaten en ook dat dat herleidbaar is. Maar dat je er bewust van bent dat dat het punt is waar jij meer behoefte aan hebt. Dus stel men gaat voor advies B, toch, dat kan ook maar dan ben je wel bewust dat ik geen praktijkinformatie heb.

Rudi: Nee precies, maar ik denk dat deze weging ook wel goed is als ik er zo naar kijk. Ja.

Philine: Jaïr ook nog, ingaande op jou. Hoe zit het nou met weging van criteria, dat is de eerste stap die wij zette. Die kan ik er ook helemaal uittrekken. En de uitschieters. Maar dat doe ik bewust nu niet om te verliezen in de percentages, maar dat ga ik wel doen toekomen om dat te verwerken in de notitie. Helaas kon ik ook geen schaal -5 0 en 5 te gebruiken om dat te vergelijken met jullie. Daarnaast was het ook niet het doel van vandaag om een variant te kiezen, maar wel om dit te gebruiken om wegingen en door te vertalen van oke dan is het advies of de top als volgt. Vraag aan jullie: Als ik de resultaten doe toekomen, kunnen jullie hiermee iets mee. Kunnen jullie hiermee uit de voeten voor de notitie?

Jaïr: Als ik zo afga op de criteria dan zie ik wel een aantal verassende scores. En dat is beschikbare capaciteit maar die is niet het grootst. De drukval vind ik opvallend, verdygo inpasbaarheid vind ik het meest opvallend. En dat is het.

Philine: En heeft dat te maken met dat jij weet wat de onderbouwing is?

Jaïr: Ja.

Philine: En ik weet ook dat uiteindelijk de onderbouwing uiteindelijk doorslaggevend is. Dat heb je berekend en in beeld gebracht. Dan is wel de testvraag voor het team. Bijvoorbeeld beschikbare capaciteit: Zou B de voorkeur hebben? Oke. Als ik dus kijk naar de score dan klopt dat wel. Wel echt gering zegmaar.

Jaïr: zou je verdygo kunnen pakken?

Philine: B zou de voorkeur hebben, en hier is het dus A.

Maaike: Als je naar bouwgrootte kijkt dan klopt het wel dat B de kleinste is, als je dan naar A en C kijkt → C is kleiner dan A.

Philine: Dit is wat ik dus wil meegeven, als je deze informatie dus wel had zou je dat wel zo wegen. Ik zou jullie vragen om alsnog deze weging uit te voeren o.b.v. deze onderbouwing. En mij dan een berichtje stuurt van joh ik heb deze uitgevoerd. Dan is het feitelijk dus compleet.

Maaike: Heb jij een overzicht van wat wij hebben ingevuld bij ronde 1?

Philine: Ja dat is dus het lastige, want je kunt niet met terugwerkende kracht deze dingen invullen.

Maaike: Nee maar stel dat jij de resultaten van 1 naar ons opstuurt, dan kunnen we dat heel makkelijk invullen en kan ik de tweede invullen o.b.v. dat tabelletje.

Jaïr: Dit is ook een vraag uit het projectteam. Ik principe kan ik hier wel mee aan de slag voor kwalitatieve criteria. Er waren geen cijfers in de TOM, ik denk dat ik dit wel kan gebruiken in de TOM. Dit hoeft opzich niet opnieuw ingevuld te worden denk ik.

Martin: Ik denk dat het dus nog niet af is. Hetgeen wat er nu staat is op gevoel gedaan, en ik heb dus niet kennis voorhanden. De tweede slag dus als je die kennis naast je hebt, want die is denk ik nodig om toe te splitsen op een beter resultaat. Want sommige dingen zijn gewoon in m2 dus dan kun je wel zeggen dat het een beter is dan B dan moet dat wel gecorrigeerd worden. Kwalitatieve dingen hoeven dus opzich niet opnieuw ingeschat te worden.

Philine: Dan zou ik jullie dus willen doorsturen wat jullie al hadden (een uitreksel), en dat we ons alleen bemoeien met de kwantitatieve criteria. Nee laat ik het zo zeggen, ik zou jullie willen vragen om alles nog een keer in te vullen.

Philine: Zijn jullie vandaag nog in de gelegenheid om dat te doen?

Martin: Bij de afweging van de eerste criteria zou je dus gewoon de afweging van de eerste ronde kunnen gebruiken.

Jaïr: ik heb eigenlijk nog 1 vraag. Voor mij is achteraf het verschil tussen beheer en onderhoud en arbo-omstandigheden niet helemaal duidelijk. We hebben het eigenlijk gehad over beheer en onderhoud vanuit arbo-omstandigheden. Is beheer en onderhoud dus hoe vaak je het moet schoonmaken met jaar etc.? Want dan scoort beheer en onderhoud wel heel zwaar.

Rudi: Ik heb wel informatie gekregen over kosten e.d. dus ik ga het niet meer een tweede keer invullen.

Martin: Je zegt dat bepaalde mensen het bijvoorbeeld niet zint. Probeer je objectieve werk te doen dan komt dat eruit. Dan is dit het gewoon.

Rudi: Het brengt een groot risico met zich me als ik geen keuze kan maken voor de derde installatie omdat ik daar geen kennis over heb.

Voor nu ga ik richting afweging. Jullie krijgen nog een link van mij waar je de varianten kan wegen met de onderbouwing van de notitie t.o.v. de criteria. En Jair: mocht jij dus behoefte hebben om jouw criteria nog input te leveren voor die weging, kom dan even bij mij in de lucht dan stuur ik jou even een andere link. Voor nu nog vragen van jullie kant?

Maaike: Ja ik ga hem ook niet invullen.

Martin: Bedankt voor jouw begeleiding in dit proces. Ik ben er heel blij mee.

Daan: Is het misschien voor de volledigheid om dit nog naar Auke-jan te sturen zodat het complete team het kan invullen? Want ik denk wel dat je op basis van meerdere mensen dus een gezamenlijke weging kan realiseren.

Philine: Ja dat kan ik wel doen, maar dan krijgen jullie dus ook nog een keer dezelfde stap. Het systeem genereert het namelijk niet allemaal door. Als dat wel kan, dat als hij het invult en dat doorgevoerd kan worden laat ik jullie dat weten.

Dank voor jullie aanwezigheid!