Comparing Adaptation and Demolition & New Build for office buildings in the newly developed ADNB Indicator

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First mentor: Hilde Remøy
Second mentor: Peter de Jong
Content

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• Research design
• Research
• ADNB Indicator
• Conclusion & Recommendations
• Reflection
Introduction
Problem analysis

Impact of Built Environment on Climate change

Energy
- 1/3 global energy use within buildings
- Manufacturing building materials is another 10%

Carbon Emissions
- Built environment single largest contributor to climate change
- 30-40% of total Greenhouse Gas Emissions

Materials
- 40-50% of raw materials in global economy used for manufacturing building products and worldwide

Water
- 12% of water use in buildings
- Significantly more due to production demand for building materials and construction

Waste
- Building construction and demolition waste is 40% of solid waste streams
Problem analysis

Office vacancy

- Long-term vacancy is very unfavourable
  - Continuing energy use and maintenance
- Office vacancy main driver for adaptation in the Netherlands
- Sustainable development main driver in international research for adaptation

Src: DTZ Zadelhoff, 2015
Problem statement

- Impact of Built environment on climate change needs to be tempered
- Office vacancy needs to be reduced
- Adaptation or Demolition & New Build both possible sustainable solutions
- Both strategies can reduce vacancy
- No existing models that support in comparing the two strategies on suitability

Combination of environmental problem and office vacancy as starting point for this research
Main research question

How can the environmental sustainability of Adaptation and Demolition & New Build be compared as a strategy for a specific office building with the use of a Step-by-Step Decision Support Plan?
Intended end product

**Step-by-Step Decision Support Plan** that can help actors in the built environment to determine whether it is more suitable for a certain office building to adapt or demolish and construct a new building as a strategy when considering environmental sustainability.

- Should not require high level of expertise to use it.
- For actors in the built environment that are in search for a new environmentally sustainable strategy for an office building.
- Office building as starting point, followed by steps and ends at the result for each solution.
Research design
Research design

Making the existing building stock more sustainable with the use of adaptive reuse

Literature research: Background information about adaptive reuse and sustainability

Conceptual model with all variables

Formulate research question and sub-questions

Research design and methods

P1

P2

Adaptive reuse
- Literature study
- Case studies
- Output

Step-by-Step Decision Support Plan
- Literature study
- Interviews
- Output

Demolition & New Build
- Literature study
- Simulation
- Output

P3

P4

Validation

P5

Finishing touch
Research design

Making the existing building stock more sustainable with the use of adaptive reuse

Literature research: Background information about adaptive reuse and sustainability

P1

Conceptual model with all variables

Formulate research question and sub-questions

Research design and methods
Research design

P2

Adaptive reuse
- Literature study
- Case studies
- Output

Step-by-Step Decision Support Plan
- Literature study
- Interviews
- Output

Demolition & New Build
- Literature study
- Simulation
- Output

P3

P4

Validation
Research
Research method: Literature study

- Theoretical input for entire research
- Summarize relevant literature
- Acquire better understanding of
  - Environmental sustainability in the Built environment
  - Assessment of sustainability
  - Adaptation
  - Demolition
  - Existing decision support model
Literature study – Sustainability

- PEOPLE
- PLANET
- PROFIT
Literature study – Sustainability
## Literature study – Sustainability assessment

<table>
<thead>
<tr>
<th></th>
<th>BREEAM-NL</th>
<th>GreenCalc+</th>
<th>GPR Gebouw</th>
<th>LEED</th>
<th>Green Star</th>
<th>Sustainability Index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimated Service Life</strong></td>
<td>Standardised in the method; 50 years for offices and 75 years for mixed-use</td>
<td>With the use of LCA</td>
<td>Standardised in the method; 50 years for offices and 75 years for residential</td>
<td>With the use of LCA</td>
<td>?</td>
<td>Not included</td>
</tr>
<tr>
<td><strong>Energy Use</strong></td>
<td>EPC Calculation</td>
<td>EPC Calculation</td>
<td>EPC Calculation</td>
<td>Points awarded for % reduced energy use</td>
<td>Points awarded for reduced energy use and GGE</td>
<td>Embodied energy and operational energy</td>
</tr>
<tr>
<td><strong>Embodied Energy</strong></td>
<td>Ratio of remaining estimated service life / estimated service life</td>
<td>Remaining building parts / materials are part of calculation for environmental performance</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Part of energy use</td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td>Reuse is taken into account, demolition materials are not</td>
<td>Select materials from catalogue for every part of the building</td>
<td>Select materials from catalogue for every part of the building</td>
<td>Reuse is taken into account to achieve points</td>
<td>Points awarded for LCA, responsible material use and sustainable products</td>
<td>No</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td>Only as achievements, not in calculation</td>
<td>No</td>
<td>Only as future achievements</td>
<td>Points awarded for diverting materials and achieving material streams</td>
<td>% of materials</td>
<td>No</td>
</tr>
<tr>
<td><strong>Model simplicity</strong></td>
<td>Average, Checklist system is simple, but determination of scores is difficult</td>
<td>Bit difficult, a lot of information to enter</td>
<td>Bit difficult, a lot of information to enter</td>
<td>Checklist system is simple, but determination of scores is difficult</td>
<td>Checklist system is simple, but determination of scores is difficult</td>
<td>Average, based on one calculation</td>
</tr>
<tr>
<td><strong>Weighting</strong></td>
<td>Determined in agreement, not scientifically, same as BREEAM International</td>
<td>Equal for each aspect</td>
<td>The 5 themes have an equal amount of achievable points in total, but within each theme there is a weighting</td>
<td>Equal for each aspect</td>
<td>Equal for each aspect</td>
<td>Can be determined per aspect or alternative</td>
</tr>
</tbody>
</table>
Literature study – Sustainability assessment

• Different weightings for each aspect
• Determine minimum for each aspect
• Use of statements to assess possibilities

Differences to incorporate:

• Model simplicity, no expert knowledge required
• Adjustable weighting of aspects to user preference
• Comparison between two strategies
Literature study – Adaptation

Within use

Across use

‘Any intervention to adjust, reuse, or upgrade a building to suit new conditions or requirements’. (Douglas, 2006)
Literature study – Adaptation

- 6 Layers of Brand (1995)
- Important principle for adaptive capacity

- ‘All characteristics that make it possible for a building to maintain its function in a sustainable and economic feasible manner during its technical service life when demands and circumstances change’ (Hermans et al., 2014)

- Indicators for adaptation possibilities
Literature study – Demolition & New Build

Demolition
The process of disassembling a building with the use of sustainable management of demolition waste and therefore providing in recycling possibilities of the materials involved.

New Build
A sustainable construction process where materials from demolition projects can be reused to construct the new building.
Interviews: Experts from practise

- Acquire insights in experience, expertise, and opinions

- Reuse of materials mentioned by all experts
- Functionality of the building
- Multiple location aspects were mentioned
Research method: Case studies

- Find aspects of adaptation that influence environmental impact
- Office-to-office adaptation
- Construction date between ‘70-’80
- Old energy label between E-G
- New energy label minimum of A
- Facade replacement
- Difference in energy use
- Embodied energy
- Materials
- Analysis of GPR calculation
• Changing the facade has major impact on energy use and thermal comfort
• Maintaining, adding, and removing materials have a major influence on the end result
• Maintaining 94% of the building resulted in an overall low environmental impact
• Maintaining 92% of the building without adjusting the facade, does not lead to large reductions in energy use and an overall low environmental impact
Research method: Simulation study

- Environmental impact of Demolition & New Build
- Design of the adaptation case input for the simulation study

- ‘Slim Slopen’ tool of BREEAM for environmental impact calculations
- Two types of demolition: traditional and demountable demolition.
  - Based on demolition documents from Faes (2015)
  - Transport distance, the type of machines and working hours of the machines

- ‘Materials’ tool of BREEAM for new build construction
- Complete Environmental impact = ‘Slim Slopen’ + ‘Materials’

- Environmental impact of the simulation study is presented in the Global Warming Potential in kg CO₂ eq.
Simulation Demolition & New Build

- Small difference between the traditional demolition and the demountable demolition processes for both cases.
- For both demolition processes the influence of the materials is more than 90% on the total GWP
- Influence of machines is only minor

<table>
<thead>
<tr>
<th></th>
<th>RHDHV Traditional</th>
<th>RHDHV Demountable</th>
<th>MT Traditional</th>
<th>MT Demountable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition</td>
<td>36.144.031</td>
<td>37.438.177</td>
<td>5.870.392</td>
<td>6.649.136</td>
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<tr>
<td>Total GWP</td>
<td>41.344.393</td>
<td>42.638.539</td>
<td>8.667.683</td>
<td>9.446.427</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>CASE 1: RHDHV</th>
<th>CASE 2: MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptation (GWP/m²)</td>
<td>31,5</td>
<td>55,7</td>
</tr>
<tr>
<td>Traditional Demolition &amp; New Build (GWP/m²)</td>
<td>2.153,4</td>
<td>810,5</td>
</tr>
<tr>
<td>Demountable Demolition &amp; New Build (GWP/m²)</td>
<td>2.220,8</td>
<td>883,3</td>
</tr>
</tbody>
</table>
Interviews: Transformation Lab

- Step-by-Step Decision Support Plan is clear, logical, and well organized
- Building design ranked highest by most students
- Location ranked in top 3 by all students
- Ranking of other aspects is more diverse
- Weighting remained difficult issue, opinions were diverse
- Step-by-Step Decision Support Plan has potential for practice

<table>
<thead>
<tr>
<th></th>
<th>Sanaz</th>
<th>Alicia</th>
<th>Jan</th>
<th>Lisanne</th>
<th>Yvette</th>
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<tbody>
<tr>
<td>1</td>
<td>Location</td>
<td>B. Design</td>
<td>B. Design</td>
<td>B. Design</td>
<td>B. Design</td>
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<tr>
<td>2</td>
<td>B. Design</td>
<td>Location</td>
<td>Services</td>
<td>Location</td>
<td>Material</td>
</tr>
<tr>
<td>3</td>
<td>Energy</td>
<td>Material</td>
<td>Location</td>
<td>Energy</td>
<td>Location</td>
</tr>
<tr>
<td>4</td>
<td>Services</td>
<td>Energy</td>
<td>Material</td>
<td>Material</td>
<td>Energy</td>
</tr>
<tr>
<td>5</td>
<td>Material</td>
<td>Services</td>
<td>Energy</td>
<td>Services</td>
<td>Services</td>
</tr>
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</table>
ADNB Indicator
ADNB Indicator

**Objective**: help actors in the built environment to determine whether it is more suitable for an office building to adapt it or to demolish and build a new office building when considering environmental sustainability.

**Strategies**: Adaptation versus Demolition & New Build

**Target group**: All actors in the built environment that deal with sustainable strategy decisions for a vacant office building or an office building that does not meet the current demands anymore.
ADNB Indicator

*Phase*: Mainly during the initiate phase and near the end of the usage phase.

*Requirements next to the ADNB Indicator*
- Information about location, such as demand and characteristics
- Information about building characteristics
- Information about future energy use after possible adjustment
ADNB Indicator

- (vacant) Office building that requires a new strategy as input.
- Step 1. The first step entails a Veto checklist
- Step 2. Determine weighting for the five aspects
- Step 3. Filling in the score card with statements per aspect
- Step 4. Result is Adaptation score and a Demolition & New Build (DNB) score.

This is the final step in the ADNB Indicator.

- After the presented result from the ADNB Indicator it is possible to continue with the S3 model from Jansz (2012)
- Greencalc+ calculates the difference in sustainability between the chosen strategies
- Remaining environmental load will be calculated with the use of the lifespan model.
- Estimated Service Life of the building can be determined for the chosen strategy
ADNB Indicator

Score card

- 5 aspects with statements
- Statements answered with yes / no.
- Number of statements with yes determines the score
  - Maximum score is 1
  - 5 statements, 3 answered with yes, the score will be 3/5 and therefore 0.6
- Score is multiplied with adjustable weighting = Adaptation score per aspect
- Total of all scores = final Adaptation score.
- Demolition & New Build (DNB) score = 100% - Adaptation

<table>
<thead>
<tr>
<th></th>
<th>Y / N</th>
<th>Score</th>
<th>Weighting</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION</td>
<td></td>
<td></td>
<td>25 %</td>
<td></td>
</tr>
<tr>
<td>Statement 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement ..</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUILDING DESIGN</td>
<td>Y / N</td>
<td></td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>Statement 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement ..</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATERIAL USE</td>
<td>Y / N</td>
<td></td>
<td>20 %</td>
<td></td>
</tr>
<tr>
<td>Statement 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement ..</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENERGY</td>
<td>Y / N</td>
<td></td>
<td>15 %</td>
<td></td>
</tr>
<tr>
<td>Statement 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement ..</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SERVICES</td>
<td>Y / N</td>
<td></td>
<td>5 %</td>
<td></td>
</tr>
<tr>
<td>Statement 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement ..</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Score Adaptation</td>
<td></td>
<td></td>
<td>..%</td>
<td></td>
</tr>
<tr>
<td>Total Score DNB</td>
<td></td>
<td></td>
<td>..%</td>
<td></td>
</tr>
</tbody>
</table>
Validation

*Expert validation*

- Individual sessions
- Feedback on definitions and the workflow of the model
- Feedback on practical use
- Presentation of ADNB Indicator with Excel and Validation Handbook

*Experts for the validation were:*

Maarten Dansen  
Dutch Green Building Council – Sustainability assessment

Gert Jan de Gier  
Oranje BV – Sustainable Demolition in practice

Kees Faes  
Search BV – Adaptation and Demolition in practice

Sascha Jansz  
University of Alberta - Estimated Service Life

Arne Balvers  
bbn adviseurs – Strategic decision making building and areas

Anne-Marie Rakhorst  
Duurzaamheid.nl - Sustainability in the built environment
Validation

Design of the ADNB Indicator
• Good and logical workflow
• Strength lies in its simplicity.
• Veto checklist considered as positive start
• Clear and relevant statements, strongly related to the office function

Applicability in practise
• Possible to use in practise, easy in use
• Positive that it provides an indication of the suitability of a strategy
• Always difficult to get investors to work with this type of methods
• Environmental sustainability is smallest part in decision-making processes when it comes to accommodation strategies

Compared to existing models
• Strongly connected to the user and primary processes of the function
• Focus on suitability of a strategy versus most sustainable option
• Implementation of current market trends
Application ADNB Indicator

**Royal HaskoningDHV**
- 94% of the building maintained
- Building proved to be suitable for adaptation
- Results ADNB Indicator also in favour of adaptation

**Provinciekantoor Haarlem**
- Building proved to be suitable for adaptation
- Results ADNB Indicator also in favour of adaptation
Conclusion & Recommendations
Conclusion

How can the environmental sustainability of Adaptation and Demolition & New Build be compared as a strategy for a specific office building with the use of a Step-by-Step Decision Support Plan?

- Office building in question as input
- Veto criteria to check for fitness of method
- Five aspects related to Adaptation, Demolition & New Build, and environmental sustainability
- Statements defined to assess options
- Result shows score for both strategies

To reach outside the scope of this research with the ADNB Indicator as a result, more research is necessary.
ADNB Indicator in Excel

ADNB Indicator Manual

The flowchart for the ADNB Indicator is shown in the figure right. The starting input is the (vacant) office building that requires a new strategy.

1. The first step entails a Veto checklist, which consists of a couple of criteria that will help determine whether this is the suitable model to support in the decision-making process of the user. When this Veto checklist is not passed, other decision support models are better suitable for the project in question.

2. When the Veto checklist is passed, the importance for the five aspects needs to be determined by adjusting the weighting to user preference but within the determined bandwidth.

3. After the weighting is determined for each aspect, the score card needs to be filled in.

4. After filling in the score card, both an Adaptation score and a Demolition & New Build (DNB) score are provided as a result. The higher the score, the more suitable the strategy is for the chosen office building. This is the final step in the ADNB Indicator.

After the presented result from the ADNB Indicator it is possible to continue with the S3 model from Jansz (2012).

First Greencalc+ is used to calculate the difference in sustainability between the chosen strategies, which requires a building specific input. The input consists of the used materials in the building during construction and the energy use during the exploitation phase.

Then the remaining environmental load will be calculated with the use of the lifespan model.

Finally the Estimated Service Life of the building can be determined for the chosen strategy.

Requirements next to the ADNB Indicator

To be able to use the ADNB Indicator, it is necessary to have certain information at hand:
- Information about location, such as demand and characteristics
- Information about building characteristics, such as plans and construction information
- Information about future energy use after possible adjustment, which can be acquired from suppliers
## ADNB Indicator in Excel

<table>
<thead>
<tr>
<th>Veto Criteria</th>
<th>Y/N</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is local demand for the function</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>The new desired function is in accordance with the ‘Omgevingswet’</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>The new desired function is in accordance with governmental policies and laws</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>The building is free from the Monumental Act</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>The desired function for the office building in question is offices</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Total score</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

**Advice**

Use different method
ADNB Indicator in Excel

<table>
<thead>
<tr>
<th>Veto Criteria</th>
<th>Y/N</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is local demand for the function</td>
<td>Y</td>
<td>1</td>
</tr>
<tr>
<td>The new desired function is in accordance with the ‘Omgevingswet’</td>
<td>Y</td>
<td>1</td>
</tr>
<tr>
<td>The new desired function is in accordance with governmental policies and laws</td>
<td>Y</td>
<td>1</td>
</tr>
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<td>1</td>
</tr>
<tr>
<td>The desired function for the office building in question is offices</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total score</strong></td>
<td></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

**Advice**: Continue with Step 2
ADNB Indicator in Excel

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>25%</td>
</tr>
<tr>
<td>Building design</td>
<td>35%</td>
</tr>
<tr>
<td>Material use</td>
<td>20%</td>
</tr>
<tr>
<td>Energy</td>
<td>15%</td>
</tr>
<tr>
<td>Services</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**ADNB Indicator Aspects**

**Location**
Research has shown that most of the time it is more sustainable to maintain a building structure, since the embodied energy will be maintained and can be deducted over the remaining service life of the building. But when an office building is located on a location where there is no local demand for offices and possibly with a high office vacancy rate, it is not sustainable to invest more energy to adapt the building. A better option would be to demolish the building and reuse the retrieved materials on a location where there is demand. Other location characteristics can influence the suitability of the office building, such as accessibility or the neighbourhood, and can therefore influence which strategy is more environmentally sustainable.

**Building design**
Adaptive capacity is related to the design of a building and determines how adaptable an office building is. The more adaptable a building is, the more environmentally sustainable the adaptation can be. Also when the original building design of the office building still meets newly determined demands, the more environmentally sustainable it is to adapt the building.

**Material use**
The focus here is on the type and amount of materials that can be maintained in the office building and if maintaining is not an option, which materials can be reused elsewhere. The main idea is that the more materials can be maintained, the more suitable the building is for adaptation as an environmentally sustainable solution.

**Energy**
This is the most well known aspect that is related to environmental sustainability. This aspects concerns the energy use but also the energy that is necessary to accomplish a strategy.

**Services**
This aspect is mainly focused on the building installations and their functionality. When the installations do not meet current standards, this aspect is focused on whether this can be adapted or not. Important here is the location of the installed pipes and shafts and whether this is according to new demands.
ADNB Indicator in Excel

ADNB Indicator Aspects

Location
Research has shown that most of the time it is more sustainable to maintain a building structure, since the embodied energy will be maintained and can be deducted over the remaining service life of the building. But when an office building is located on a location where there is no local demand for offices and possibly with a high office vacancy rate, it is not sustainable to invest more energy to adapt the building. A better option would be to demolish the building and reuse the retrieved materials on a location where there is demand. Other location characteristics can influence the suitability of the office building, such as accessibility or the neighbourhood, and can therefore influence which strategy is more environmentally sustainable.

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ADNB Indicator in Excel

<table>
<thead>
<tr>
<th>Location</th>
<th>Y/N</th>
<th>Score</th>
<th>Weight</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>The accessibility of the location is suitable for the function</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The special accessibility of the location supports all (primary) processes of the user</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Neighbourhood stability is supported by the zoning plan</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Neighbourhood stability is in favour of the new function</td>
<td>0</td>
<td>25%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>The trends (vacancy, shrinking cities) regarding demography have a positive impact on the location of the building</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The neighbourhood has a positive atmosphere that support the (primary) processes of the user</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The site of the building support the (primary) processes of the function regarding size, shape, corner lots, soil, contour and, excess land</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The location is suitable for the function</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>0.00</td>
<td></td>
<td>0.00</td>
</tr>
</tbody>
</table>

**List of definitions**

*Environmental impact:* Environmental consequences of development actions

*Neighbourhood stability:* This includes the compatibility of land uses and the protection of this compatibility, which generally occurs through the zoning plan. Another factor is the protection from externalities such as crime.

*Special accessibility:* Or proximity, are the land uses that are of direct interest to the function in question. This in some cases can be more important than general accessibility, which usually is expressed as distance to other urban uses, in determining location decisions. For instance, law firms value face-to-face communication with their clients and therefore tend to locate in central location, while an industrial company values specific transportation and suppliers.
<table>
<thead>
<tr>
<th>Location</th>
<th>Y/N</th>
<th>Score</th>
<th>Weight</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>The accessibility of the location is suitable for the function</td>
<td>Y</td>
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<td></td>
<td></td>
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<tr>
<td>The special accessibility of the location supports all (primary) processes of the user</td>
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<tr>
<td>Neighbourhood stability is supported by the zoning plan</td>
<td>N</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood stability is in favour of the new function</td>
<td>N</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The trends (vacancy, shrinking cities) regarding demography have a positive impact on the location of the building</td>
<td>Y</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>The neighbourhood has a positive atmosphere that support the (primary) processes of the user</td>
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<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The site of the building support the (primary) processes of the function regarding size, shape, corner lots, soil, contour and, excess land</td>
<td>Y</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The location is suitable for the function</td>
<td>Y</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>25%</td>
<td>19%</td>
</tr>
</tbody>
</table>

**Total score**: 0.75
ADNB Indicator in Excel

Total Score Adaptation: 84%
Total Score Demolition & New Build: 16%
Recommendations

Future research

- Financial and social aspects of sustainability
- Other strategies, such as transformation, consolidation, and temporary use into the ADNB Indicator
- Combination of strategies as a new strategy
- Demolition processes
- Decision-making processes
- Scoring methods
- Service life of buildings
- Life Cycle Assessment
- Circular Economy
Reflection
Reflection - Process

**Personal Process**
- Expanded theoretical and practical knowledge
- Difficult to decide when enough theoretical knowledge was obtained
- Interview skills: Anticipate and react to interviewees’ responses
- Transform qualitative data to necessary data
- Scared to take distance from research from time to time

**Research Process**
- Initial research topic changed due to findings
- Difficult to gather case study data
- Prepare while waiting for data
- Most comfortable and most frustrating was literature research
Reflection - Product

- Difficulty acquiring data
- No actual demolition and new build project is analysed, simulation requires assumptions to be made
- Number and type of interviewed experts
- Robustness of research
- Use of weighting and Adjustable weighting
- Implementation of service life and S3 model
Reflection graduation research

Even though it was difficult, it was a great and interesting learning process in how to develop a Step-by-Step Decision Support Plan that could help actors in the built environment with sustainability issues regarding office buildings. Interesting insights were developed by conducting this research and can be applied in future research.
Questions?
Veto Criteria

• There is local demand for the function
• The new desired function is in accordance with the ‘Omgevingswet’
• The new desired function is in accordance with governmental policies and laws
• The building is free from the Monumental Act
• The desired function for the office building in question is offices
Score card: Location

- The accessibility of the location is suitable for the function
- The special accessibility of the location supports all (primary) processes of the user
- Neighbourhood stability is supported by the zoning plan
- Neighbourhood stability is in favour of the new function
- The trends (vacancy, shrinking cities) regarding demography have a positive impact on the location of the building
- The neighbourhood has a positive atmosphere that supports the (primary) processes of the user
- The site of the building supports the (primary) processes of the function regarding size, shape, corner lots, soil, contour, and excess land
- The location is suitable for the function
Score card: Building design

• The structure, skin, services and service plan can be adapted separate from each other
• The load-bearing structure is separate from the infill
• The daylight entry is in accordance with future demands
• The floor-to-ceiling height is suitable for the new function
• The size of the storeys is in accordance with future use
• The available floor area is in accordance with future use
• The shape of the plan is in accordance with future use
• The building structure provides a floor plan with a flexible lay-out
• The elevators and stairs are positioned correctly for future use
• The elevators and stairs have the right dimensions for future use
• The orientation to the sun is correct, regarding positioning of the spaces
Score card: Material use

• The building structure can be maintained
• The service plan can (partly) be maintained in the adaptation
• Removed materials can be reused in the adaptation or other projects that require minimal transport movements of maximum 50 km
• Quality of the used materials is high enough for adaptation
• The new materials that are necessary can be retrieved from local suppliers within 50 km
Score card: Energy & Services

Energy
• With an adaptation the primary energy use can be reduced with at least 40%
• With an adaptation the use of electricity can be reduced with at least 25%
• With an adaptation the energy use for heating can be reduced with at least 60%
• The building performance can be improved with minimal environmental impact

Services
• The installations are adjustable and controllable for future use
• The distribution or modularity of the pipes and shafts is in accordance with future use
• The installations are reusable due to the current technical state and otherwise replaceable
• The main reason that the building is vacant or requires a new strategy is because of the technical state of the building