Attractive, Acceptable and Affordable deep Renovation by a consumers orientated and performance evidence based approach

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</tbody>
</table>

Table of content

Revision and history chart: ........................................................................................................... 2
Table of content..................................................................................................................................... 2
List of figures......................................................................................................................................... 3
Glossary of terms...................................................................................................................................... 4
1. Introduction........................................................................................................................................ 5
2. Method development......................................................................................................................... 6
   2.1 What currently exists.................................................................................................................... 6
      2.1.1 Verbeterjehuis ......................................................................................................................... 6
      2.1.2 Bleeve ..................................................................................................................................... 7
      2.1.3 Duurzaam bouwloket ............................................................................................................... 8
      2.1.4 Woonconnect .......................................................................................................................... 9
      2.1.5 Bausoft Winwatt Optimum module ......................................................................................... 10
   2.2 Creating concepts.......................................................................................................................... 12
3. Results ............................................................................................................................................... 13
   3.1 Consumer drafts ............................................................................................................................ 13
      3.1.1 Visual driven selection............................................................................................................. 14
      3.1.2 List driven selection ............................................................................................................... 15
      3.1.3 Morphological list selection ................................................................................................... 16
      3.1.4 Alternative design .................................................................................................................. 17
   3.2 Architect ....................................................................................................................................... 18
   3.3 Link to the database ..................................................................................................................... 19

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List of figures

Figure 1 Visual representative of the ‘Verbeterjehuis’ web toolkit Source: Verbeterjehuis.nl ........................................ 6
Figure 2 Visual representative of the ‘Bleeve’ web toolkit Source: Greenhome.nl ......................................................... 7
Figure 3 Visual representative of the ‘Duurzaam bouwloket’ web toolkit Source: Duurzaambouwloket.nl ... 8
Figure 4 Visual representative of the ‘Woonconnect’ web toolkit Source: Woonconnect.nl ........................................ 9
Figure 5 Visual representative of optimal renovation of building structures in “WinWatt Optimum module”
Source: http://www.bausoft.hu/ww_optimum.htm ........................................................................................................ 10
Figure 6 Visual representative of searching the optimal renovation package in “WinWatt Optimum module”
Source: http://www.bausoft.hu/ww_optimum.htm ........................................................................................................ 11
Figure 7 Morphological design designed in task 3.1 ...................................................................................................... 13
Figure 8 Visual driven selection design ..................................................................................................................... 14
Figure 9 List driven selection design ......................................................................................................................... 15
Figure 10 Morphological list selection design ........................................................................................................... 16
Figure 11 Alternative design ........................................................................................................................................ 17
Figure 12 Architect concept .......................................................................................................................................... 18
Figure 13 Database link ................................................................................................................................................. 19
Glossary of terms

**Architect**
The professional end user of the tool. They are able to aid the end-user with the use of the tool, can give advice on how/what to renovate and form the linking pin between the end-user and the renovation companies.

**Concept**
A concept is a collection of measures that fit the renovation strategy and the building.

**End-user**
The end user, also the consumer, occupant or building owner, is the person who will use the final product, with or without aid of someone with knowledge of building(services).

**Measure**
A measure is a product or solution that is part of the renovation of the building.

**Morphological design**
Morphological design is a method to generate concepts by first collecting all the possible solutions for the different problems. All the possible solutions for each renovation step are collected, which allow a more complete set of concepts. When you have all the solutions ready, you can choose which option best fits your wishes or problem. This allows the best solution(s) for the end user, by leaving nothing out.

**nZEB**
Nearly Zero Energy Building. The general definition of nearly zero energy building (nZEB) was introduced in the Directive 2010/31/EU of the European Parliament and of the Council (EPBD recast) on 19 May 2010. According to the Article 2 of the EPBD recast, the nearly zero energy building means a building that has a very high energy performance, and the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from on-site or nearby renewable sources. Beyond the general definition of nZEB, every Member State has its own, more precise definition for nZEB. Practically, it can be stated that the energy performance of nZEB is lower than the cost-optimal levels (nZEB is more energy efficient than cost-optimal building), and the differential Global Cost ($\Delta GC$) is negative, so that nZEB is cost effective.

**Proven measures carousel**
A carousel consisting of energetic or sustaining measures and concepts created with these measures. That have been proven in practice. For example, a concept to renovate and sustain a pitched roof including the integration of PV. In that concept the measures are roof isolation, roof airtightness and solar PV integration, which have been tested in practice and thus function as proven measures.
1. Introduction

TripleA-reno is developing an easy to use digital tool to create nZEB renovation concepts based on morphological design methods. One of the steps towards this goal was to define measures/concepts (D3.1) and another step is how people or consumers interact with them. These interactions have to be achieved on an easy to understand level, so that everyone, from consumers to architects, can use the morphological design tool.

This deliverable contains the functional design with special focus on the visual aspects of the digital tool (co-design app). This tool will be used to create nZEB concepts based on morphological design methods (visually selecting measures, instead of selecting measures textually described). In this functionality the proven measures in the carrousel are used for the creation of customized renovation concepts/approaches.

Based on this deliverable the IT-team of TripleA-reno will develop, in dialogue with the WP3 team, the technical specifications of the TripleA-reno platform.
2. Method development

The first step of development a functional design was to take stock of what’s already available on the market. Followed by a brainstorm session to create concepts based on what currently exists and the goal of TripleA-reno.

2.1 What currently exists

There are several other tools on the market that address parts of the TripleA-reno vision. Several of these tools are shown and explained below.

2.1.1 Verbeterjehuis

This tool gathers background information about the building, the city and the residents. Followed by already made improvements to the building. These steps coincide with the TripleA-reno approach. After these steps an advice is given on which improvements are still available for the home on both building and buildings services level. This tool only gives general advice, such as: Improve windows, insulate the walls, install a better heating system, etc. It is mostly text based and doesn’t discern whether an improvements would really be an improvement, for instance it advises to install a heat pump in an uninsulated home.

![Image of Verbeterjehuis tool]

Figure 1 Visual representative of the ‘Verbeterjehuis’ web toolkit Source: Verbeterjehuis.nl
2.1.2 Bleeve

‘Bleeve’ is a similar to the ‘Verbeter je huis’ tool. The tool also gathers the same background information from the user and the building. However, instead of giving general advice, this tool gives more home specific advice. For instance it says that a heat pump isn’t possible in an old uninsulated home and that it’s better to insulate an old home and add solar panels. Meaning this tool is a lot more advice driven.

Another aspect of the tool is that it gives some general information on the advised measures. For instance, the cost estimation, yearly savings, payback time and efficiency. It does this for all measures and places the most fitting measure at the top of the list.

![Figure 2 Visual representative of the “Bleeve” web toolkit Source: Greenhome.nl](image-url)
2.1.3 Duurzaam bouwloket

This toolkit consists of step-by-step advice. In each step they advise on different parts of the building:

1. Small general saving tips
2. Insulating your building
3. Good ventilation
4. Generating your own energy
5. Sustainable heating and cooling

Each step gives information of different types of measures for the corresponding subject. It gives information on why, how and what types of solutions are available for the measure. This is not user-fitted advise, only general information.

Figure 3 Visual representative of the ‘Duurzaam bouwloket’ web toolkit Source: Duurzaambouwloket.nl
2.1.4 Woonconnect

This online toolkit is for housing associations, municipalities and provinces. It creates 3D visualisations of the building and allows the users to interact with it, to add the measures they want and see the impact on their lives/homes. It creates awareness through energy modules to aid the user in their choices.

Figure 4 Visual representative of the ‘Woonconnect’ web toolkit Source: Woonconnect.nl
2.1.5 Bausoft WinWatt Optimum module

Bausoft WinWatt is Hungarian software which is made for professionals, especially for building service engineers and architects. The building energy module of the toolkit is able to make building energy calculations according to the Hungarian legislation. Furthermore, the software has an “Optimum module”, which is based on the building energy module. When using the Optimum module, the professional is able to analyse the impact of different interventions on the energy use of the building and find the optimal solution.

In the first step of the optimum search, the properties of the structure surrounding the heated space can be specified (e.g. 5 cm thermal insulation, 8 cm thermal insulation, 10 cm thermal insulation on the wall, etc.). Structures surrounding the heated space are listed in a table showing the thermal transmittance of the given structure, its total surface area, and the proportion of \( \Sigma A^*U \). The last feature provides good advice if it is worth it to renovate this type of structure.

Figure 5 Visual representative of optimal renovation of building structures in “WinWatt Optimum module” Source: http://www.bausoft.hu/ww_optimum.htm

A professional is able to give several renovation variations for a structure. When entering a new variation, its expected investment cost with a specific cost per square meter can be specified for the optimization.

The modernization of the HVAC system can also be analysed. Similar to the building structure analysis, several renovation variations can be given on the different HVAC systems: heating, cooling, domestic hot water, ventilation, and lighting systems. When entering a new variation, its expected investment cost has to be specified. The software has some limitation regarding the HVAC system analysis, it is only possible to modify existing systems and it is not possible to specify new systems. For example, if a building does not have a ventilation system, it is not possible to analyse the effect of new ventilation system.

The specific energy costs (HUF/kWh, HUF/m³ gas, etc.) and the specific CO₂ emission factors (g/kWh) of the energy carriers have to be defined.

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After specifying the different measures, the energy prices and CO₂ emission factors, all possible combinations will be analysed by the WinWatt Bausoft Optimum module.

![Figure 6 Visual representative of searching the optimal renovation package in “WinWatt Optimum module” Source: http://www.bausoft.hu/ww_optimum.htm](http://www.bausoft.hu/ww_optimum.htm)

In Figure 6, the left list shows each combination of the measures with the calculation results: investment cost, energy cost saving, payback time, CO₂ saving, primary energy ratio and energy certification category. The variations can be sorted according to the calculation results in order to select the optimal solution. On the right-hand side of the figure the selected variation and the results are detailed.
2.2 Creating concepts

The second part of the creation of the functional requirements was a brainstorm session. All information on how to create a concept came from task 3.1, the way the end-user interacts with this information is created during this step.

The goal of task 3.2 is to create an easy to use co-design app to create nZEB concepts based on morphological design methods. This means visually selecting measures, instead of selecting textually described measures.

During the brainstorm session several key aspects came up that should be included the toolkit:
- Easy to understand visuals, create visual guides that users will recognize without technical knowhow.
- Different styles of visualization based on user needs. For example more technical or schematic visuals for professionals and realistic/photographical for end-users.
- Show only relevant information, impossible measure have to be excluded
- Advice based on realistic and concrete information, creating a perfect fit for the user.
- Show unintended interactions between chosen measures
- Be clear on aspects such as comfort, to be expected disturbances during realization, maintenance and so on.
3. Results
The visual designs have been split between what the architect sees and what the end-user sees. The visual designs for the end-user, with description, are shown first.

3.1 Consumer drafts
The visual design follows the morphological design, where the end user fills in their background first, followed by what they want to renovate. For the complete morphological design, see figure 7.

![Morphological design designed in task 3.1](image-url)
3.1.1 Visual driven selection

Figure 8 shows the first draft. In step 1 ‘User background’ the end-users fill in their background, represented by the different types of houses. In step 2 ‘Renovation strategy’ they choose which strategy they want to use to renovate their home. Step 3 ‘Main screen’ allows them to choose what they want to renovate, as example the figure shows the selection of the roof. In step 4 ‘Measure selection’ they choose what they want to do with their roof, they can choose from insulation, a dormer, photovoltaic panels or a thermal solar collector. The user chooses insulation and goes to step 5 ‘Measure specification’. In this step the end user chooses what type of material they want to use for the insulation. In step 6 ‘Measure outcome’ the impact for the home and the owner is shown. It is also possible to return from the ‘measure outcome’ screen to the ‘main screen’. Everything is presented as visuals, making the tool as accessible as possible.

When in the ‘Main screen’, step 3, the end-user is also able to choose to view the concept they have created so far, step 7 ‘Concept overview’. From this step they can also view the outcome of the concept in step 8 ‘Concept outcome’.

Figure 8 Visual driven selection design
3.1.2 List driven selection

The second concept, shown in figure 9, shows how the end-user can choose from a list, followed by a visual representative of the measure they want. In step 1 ‘User background’ the end-users fill in their background, represented by the different types of houses. In step 2 ‘Renovation strategy’ they choose which strategy they want to use to renovate their home. In step 3 ‘Main screen’ the end-user chooses the measure type they want from a list, after which they are shown the visual of the measure, in step 4 ‘Measure selection’. In step 5 ‘Measure specification’ they choose the type of material or type of device they want. In the last step, step 6 ‘Measure outcome’, the impact for the building and the end-user is shown. It is also possible to return from the ‘measure outcome’ screen to the ‘main screen’.

When in the ‘Main screen’, step 3, the end-user is also able to choose to view the concept they have created so far, step 7 ‘Concept overview’. From this step they can also view the outcome of the concept in step 8 ‘Concept outcome’.

Figure 9 List driven selection design
3.1.3 Morphological list selection

Concept 3, shown in figure 10, shows how the end-user can choose from the morphological design itself. In step 1 ‘User background’ the user fills in their background, represented by the different types of houses. In step 2 ‘Renovation strategy’ they choose which strategy they want to use to renovate their home. In Step 3 ‘Main screen’ the end-user is able to choose which measures they want from the morphological schematic. It gives the user an overview of all possible measures. In step 4 ‘Measure selection’ they define the chosen measure. In step 5 ‘Measure specification’ they choose the type of material or type of device they want. In the last step, step 6 ‘Measure outcome’, the impact for the building and the end-user is shown. It is also possible to return from the ‘measure outcome’ screen to the ‘main screen’.

When in the ‘Main screen’, step 3, the end-user is also able to choose to view the concept they have created so far, step 7 ‘Concept overview’. From this step they can also view the outcome of the concept in step 8 ‘Concept outcome’.

![Figure 10 Morphological list selection design](image-url)
3.1.4 Alternative design

An alternative, shown in figure 11, is for the end user to choose with a menu. Going from step 1 to step 2 allows the user to use the menu, instead of the visual options from step 3 and step 4. All the other interactions are the same as shown in the designs from paragraphs 3.1.1, 3.1.2 and 3.1.3. This merely gives the user an alternative overview of the possibilities.

![Figure 11 Alternative design](image.png)
3.2 Architect

The architect, or the expert user, can work in the same tool as the end-user but is shown in a different level of detail. They will be able to choose from the same options as the designs from paragraphs 3.1.1, 3.1.2 and 3.1.3, but with an added layer of information. This can include technical details, additional options, adding new measures, modifying existing measures, etc.

Figure 12 Architect concept
3.3 Link to the database

The linking pin for the end-user, architect and the database is the tool. The core source of the tool is the concepts and measures database. The database provides all the information and options the end-users need to create their concepts. This means that the tool is the interface to access all the information stored in the database.

There are several important data lines in this model. First, all the information shown in the tool is directly from the database. So all the information the end-user gets to see is stored in the database. But before the user is shown anything, they have to fill in their background, this background is sent back to the database. Inside the database a match is made between the user background and the possible measures he will be able to choose from. These measures are sent back to the tool so that the user can see them.

In the following steps, the user will create his concept. This concept is shared and stored in the Triple-A-reno platform projects database. The minimal amount of data the tool needs to function properly is:

- Measures
- Strategies
- Compatibility lists between the measures and the strategies and measures

The architects form the linking pin between the tool, the renovation site and the end-user. They can give feedback to the end-users through the tool, they form the link between the renovation companies and the end-user and they are able to add/edit measures in the database to make a perfect fit for the end-user.

Delivering this data can be done by a simple one-on-one connection between the measures and concepts database (currently in Excel) or a more advanced API connection (for example with the measures and concepts stored in the ISSO Kennisbank environment). Choices on this will be made in collaboration with the TripleA-reno IT partners.