

## 5. Interactions in the renovation process

From previous research (LEHR - [www.lehr.be](http://www.lehr.be) [2]), it became clear that 'in the field' or on the renovation site better communication and cooperation is needed. Especially in striving for nearly zero energy buildings, aspects such as: air tightness, thermal bridges, correct dimensioning of ventilation and heating are very important. When executing a certain task, it is possible that it disturbs work already done; for example destroying the air tightness layer. On the other hand, certain tasks may lead to problems further on (not foreseeing future connections) or can already during their execution facilitate future renovation tasks.

This means that every activity executed during the renovation process should take into account the work already executed and the current situation on the one hand, and also keep in mind tasks that will be executed later on in the process. All tasks should fit into an integrated, global concept.

In order to deal with these challenges, the different points of attention and interactions between the different professionals in the renovation project were mapped. In first instance a methodology to create this list of 'potential problems' or rather 'interactions' was established. The elaborated list of points of interest then served as a basis for solution development.

### 5.1 Objectives

The first application of the 'interactions map' is the improvement of communication and creation of more awareness amongst contractors and other renovation professionals. By calling the problems 'by name', they become debatable, and clear agreements on responsibilities and ways of execution can be made. Too often, a contractor performing a small task in an overall house renovation, striving for a low energy consumption, global approach is unaware of the influence his work can have on the work of others. He only takes responsibility for his own work, while neglecting the connection with other parts of the work. In order to have a basis for discussion and mutual agreement between the different executing actors, the information is presented in an accessible way. This allows to link directly to existing guidance on good execution techniques (e.g. Technical Recommendations of BBRI, examples from the demonstration projects, ...) in order to improve the practical knowledge and skills of the contractors.

Another important aspect is the development or implementation of new, innovative solutions for some of the potential interactions. More and more European product developers and manufacturers come up with new solutions in order to improve the current building and renovation practice. This can help in improving performance of the products or creating totally new solutions, but in the view of the aspects focused on in this part of the project, more interesting are the 'integrated product' solutions, that allow for execution of different tasks at once or a better execution of a certain technique.

Finally, application of the 'interactions mapping' is in quality control or assurance. The basis of quality is of course the good execution of the tasks on their own (knowledge, skills, procedures, on-site workmanship), but as explained, a good project ensures that the 'overlaps' between the tasks are well managed and executed as well.

## 5.2 Methodology

In order to map the interactions in the deep renovation process, the following steps were undertaken.

The main part of the work consisted in the creation of a 'matrix'. This matrix contains in both directions (horizontal & vertical) the different 'actions' to be undertaken in a thorough renovation process, structured by 'building components': foundations, floors, external walls, windows & doors, roof, installations; each one split up in more detailed renovation tasks (not shown on the figure). This is an exercise that can be done for actual projects as well: starting from the 'big picture' (= the desired end result), the different tasks and works can be listed, preferentially but not necessary in chronological order.

This results in a map or matrix, where all renovation tasks can be connected to each other, in two directions. The theoretical process is explained in Figure 1. Point A shows the situation where the new windows and doors are installed before the facade is renovated (let's say 'insulated'). In this case we look at the (horizontal) line 'windows' and look forward to the work listed in the columns (eg. external wall - facade insulation): when installing the windows, one should think ahead of the connections with the future insulation. When insulating the facade, it is clear that there are connections with the already installed windows and doors. We look at the column 'facade insulation' (vertical) to 'check the current situation'. Point B can be interpreted following the same logic: when insulating the roof and installing the air tightness layer, one should give consideration to potential future installations that will need a pass through the layers (eg. ventilation, solar installations), in the other direction, when placing installations, the contractor should be aware of the insulation and the airtight layer in place, and respect them during execution of his work.

		Future tasks				
		...	External wall	Roof	Windows & doors	Installation
Past tasks	...					
	External wall					
	Roof					B
	Windows & doors		A			
	Installation					

Figure 1 MATRIX TO MAP INTERACTIONS IN RENOVATION

Figure 2 and Figure 3 show an example of attention points for installing roof insulation with respect to the existing situation and the future works.

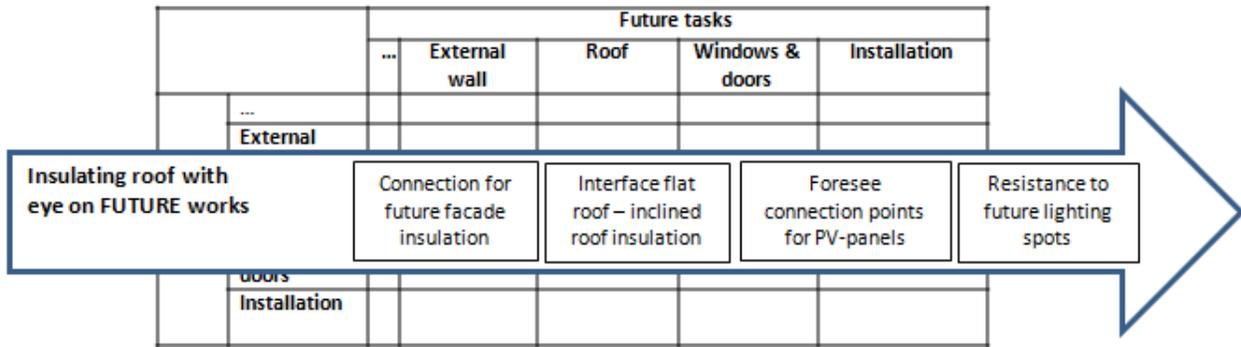


Figure 2 EXAMPLE OF POINTS OF INTEREST FOR INSULATING A ROOF – LOOKING AHEAD

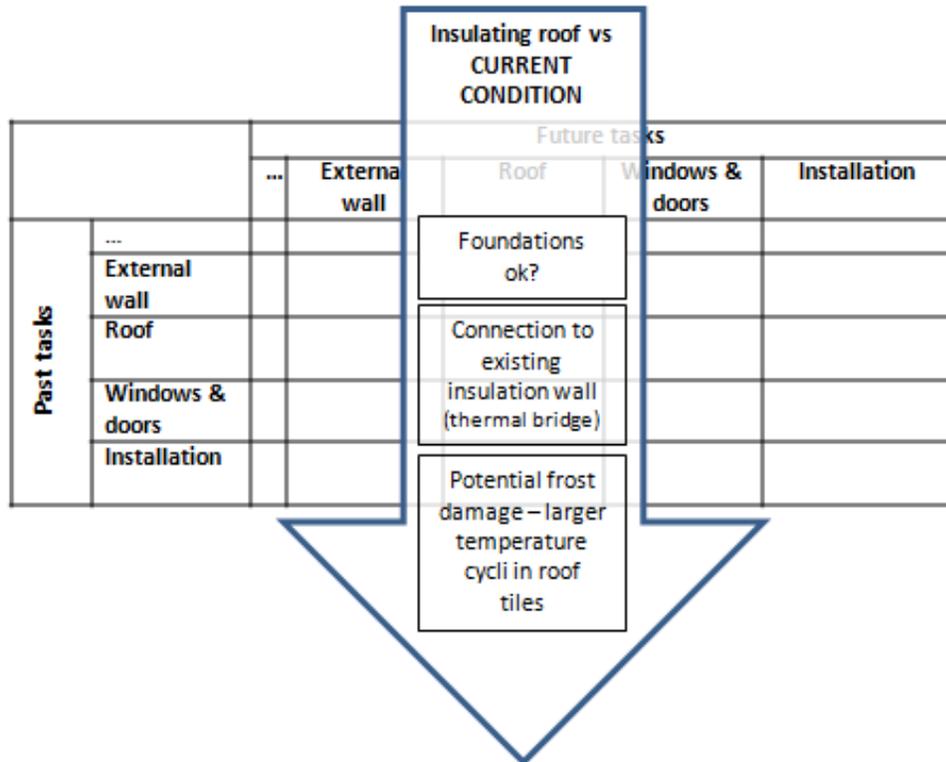


Figure 3 EXAMPLE OF ATTENTION POINTS FOR INSULATING A ROOF - LOOKING BACK

### 5.3 Mapped interactions

This way of working allows to create a theoretical overview of potential interactions and problems during execution of the works. In a second phase, the theoretical basis is checked with the current practice in the context of a house renovation construction site in Belgium.

Therefore, a workshop with contractors and designers was organised in Brussels in November 2011. After a short introduction, the participants were split up per ‘profession’ or ‘activity’. Each group

was assisted by a moderator from the One Stop Shop research team. Each 'profession' had a table with an adapted, empty 'matrix'. The empty matrix (displaying on the rows and columns all the renovation activities that could interfere with the activity of the group in question: foundations, insulation of walls, placing of windows, installations, roof insulation, ...) was filled in using post-its. Per row and column, the exercise was done to answer the questions:

- *"Where comes my work **after** the work of someone else? What are the things to pay attention to in the already existing situation?"*
- *"Where comes my work **before** the work of someone else? What are the things I should foresee so he can do a proper job?"*

In the workshop, a split-up was made between:

- Coordination: General contractors, architects
- Insulation of the envelope: contractors working on roofs, experts in insulation materials, ...
- Openings of the envelope: carpenters, solar protection producers, ...
- Air tightness and finishing: finishing contractors, specialists in air tightness, ...
- Installations: contractors, advising experts, ...



Figure 4 – Example of an empty matrix (envelope) for the workshop

This exercise resulted in 6 matrices filled in by the participants. An example is shown below.

INTERACTIES	Handelingen	Behoeften	Visies	Mensen	Ris	Afhankelijk	Verplichtingen en behoeften	Overname	Verplichtingen
Handelingen									
Behoeften									
Visies									
Mensen									
Ris									
Afhankelijk									
Verplichtingen en behoeften									
Overname									
Verplichtingen									

Figure 5 – Completed matrix: windows & solar protection

The first part of the workshop allowed to compliment the theoretical work done by BBRI and fill in additional parts of the existing matrix.

In the second part, a discussion was held on several possible solutions for the identified problems:

- Creation of a new profession – renovation coordinator OR responsibility of the contractor

Creating extra roles and professions are only extra costs, with a limited added value.

It should be the contractor to take the lead in the coordination: planning, designing the practical solutions, taking the right decisions, choosing the right partners for the job.

There is added value in this aspect for the contractor: by showing their expertise, the extra cost can be justified.

Important aspects for a good end result are:

- o Knowledge on interactions and attention points (thus good education)
- o Motivation to do the right thing
- o Persistence in approach: the required level of quality should be the same on all sites. Eventually, this can lead to 'typical solutions' applied on each case.

- Clustering – cooperation of contractors

The relationship between a 'main contractor' and 'subcontractors' is not always considered as 'balanced', so the contractors are a bit reluctant to the idea of 'cooperation' or 'clustering' or 'coordination by another contractor', even if it is the coordinator that creates the extra work & money.

There is some sort of clustering in practice, since some architects usually select the same group of contractors, in which they trust.

- Quality control based on interaction map  
Organising quality control is not easy. Labels and other instruments (to demonstrate good workmanship e.g.) are no solution, since papers do not always reflect the practice. Training and education and attitude should lead to quality. A checklist for internal use can be interesting as a 'grip' for practice.

The matrix contains over 100 cells with one or more attention points or potential overlaps. Looking at the content, the attention points can be grouped in some general categories:

- Air/vapour/water tightness: Where different elements of the envelope come together, the interface between the elements is a critical point, e.g. when installing windows in an insulated facade, or the place where a flat roof construction and a tilted roof construction connect. Once the air tight layer is installed, a second series of potential interactions consists in the installation of heating, ventilation, ... that sometimes requires to 'penetrate' and thus destroy a part of the air/vapour barrier.
- Continuity of the insulation layer: the envelope also performs an insulating function, and in order to avoid thermal bridges, the insulating layer should be continuous or the thermal bridge should be remediated. Attention points here can be the provision of potential connections, e.g. when first insulating the inclined roof, make sure that external facade insulation can be connected to it; or to ensure a correct placement of the windows in an insulated facade.
- Dimensioning of installations in function of the (final) envelope. This is more of a planning and final design issue. For example, when insulating the envelope, it is very important that the heating installation is fit to work in the final conditions. Replacing the heating boiler first, will cause an over dimensioning of the power, when the final situation is not kept in mind. On the other hand, when improving air tightness, it is very important that also controlled ventilation is installed, in order to avoid all kinds of moisture problems.

The matrix also contains other aspects, such as influence on the integrity of the building (placing solar panels on a flat roof can cause structural challenges, and also cause damage to the sealing roofing layer or create a thermal bridge through the insulation), and remediation of moisture problems (in walls) before undertaking insulation or finishing works.

## 5.4 Towards improved practice: solutions

Based on the interactions map, different solutions or improvements can be proposed. First of all, a good execution should be embedded in a good and proper global planning and design. When it is clear that all tasks fit within a holistic project, they can be prepared and executed as such. This also implies a good communication and task description from the architect towards the contractors. Related to the good planning is also the importance of commissioning. When the quality of execution is checked during and after finishing the project, problems can be revealed in an early stage, and can be remediated. The advantage of a 'holistic project concept' is clear: the different aspects and elements can be tuned to fit in the whole building design, and can be controlled as such.

In line with the general objectives of the One Stop Shop project, a more practical representation of the interactions is developed. A more accessible, easy to use interface is created, in order to facilitate communication towards the target audience. A visual house model is used in which all the relevant renovation activities can be selected. When clicking on a task, the model shows the related interactions and potential problems. This way of presenting information allows for a direct approach towards the different contractors with their own speciality, and can form the basis for better communication and better understanding between the actors.

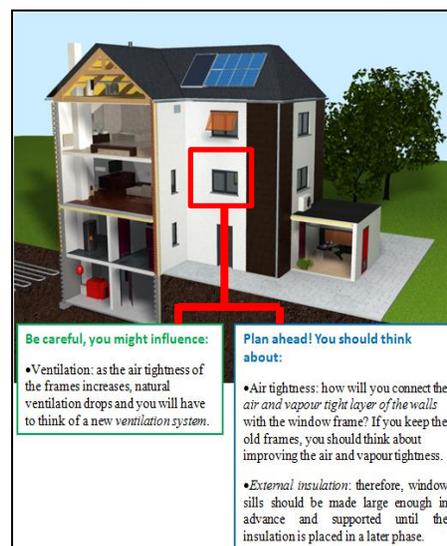


Figure 6 GRAPHICAL INTERFACE OF THE INTERACTIONS MODEL

When the points of interest are shown, as in the Figure 6 above, a logical next step is to provide links to solutions. Three types of solutions can be envisaged:

- Technical solutions: reference to a technical drawing of a detail, ...
- Organisational solutions: adapting the order of the works, or making clear arrangements about responsibilities of the different actors
- Innovative solutions: for some difficult to tackle problems, there can be new solutions, that solve the issue. Reference is made to the catalogue of innovative products.

For each of the ‘typical renovation activities’ or rather professions, an individual list of attention points (on beforehand & afterwards) is created, and solutions for the attention points are listed. For the implementation of the solutions, reference is made to:

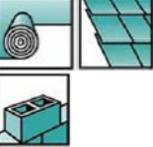
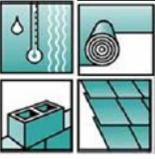
- Existing information on good and best practice solutions, such as:
  - BBRI’s Technical Notes and Technical Fiches
  - Catalogue of thermal bridge solutions
  - Guidelines for better ventilation
  - Best practice examples from the case studies
  - ...
- Exemplary projects (see next chapter)
- Innovative product catalogue and forms (see previous chapter)

This list is created for:

Roofs	Floors	Windows & doors
External Walls	Finishings	Installations

For illustration, 2 screenshots are given below of the DRAFT lists for ‘roofs’ and ‘installations’. The complete lists and model will be available on the BBRI website ([www.bbri.be](http://www.bbri.be)) in Dutch and French. The actual publishing was not feasible within the timeframe of the One Stop Shop project, and is foreseen by the end of 2012.

## MOGELIJKE INTERACTIES BIJ ENERGETISCHE RENOVATIES : DAKEN

Pas op! Houd rekening met bestaande situaties:		
Interactiepunten	Mogelijke oplossingen	
<b>Dakwerken algemeen</b> 		
		<ul style="list-style-type: none"> <li>Bij vervanging van de dakstructuur, plaatsing van dakisolatie en/of vervanging van de dakbedekking, moet worden nagegaan of de bestaande <b>fundering</b> in staat is om de nieuwe last op te vangen.</li> </ul>
		<ul style="list-style-type: none"> <li>Bij vervanging van de dakbedekking (bvb. nieuw groendak) of plaatsing van dakisolatie moet eerst worden nagegaan of de bestaande <b>dakstructuur</b> de nieuwe last kan opnemen.</li> </ul>
<b>Plaatsing van dakisolatie + lucht- en dampdichtheid</b> 		
		<ul style="list-style-type: none"> <li>Het plaatsen van dakisolatie langs binnen zal de <b>temperatuurcyclus in de dakpannen</b> versterken, waardoor (vorst-) schade gemakkelijker kan optreden.</li> </ul>
Plan vooruit! Denk nu al aan de volgende ingrepen:		
Interactiepunten	Mogelijke oplossingen	
<b>Installaties algemeen</b>		
		<ul style="list-style-type: none"> <li>Indien in de toekomst <b>binnenisolatie</b> is voorzien, moeten de <b>leidingen</b> (en kabels) van een nieuwe (verwarmings-) installatie zo geplaatst worden dat ze zich later steeds aan de binnenkant van de isolatie bevinden.</li> </ul>
		<ul style="list-style-type: none"> <li>Om de <b>toegankelijkheid</b> van de muren voor pleister- (en schilder-) werken te verzekeren is het beter om sommige <b>leidingen</b> pas achteraf te plaatsen.</li> </ul>
<b>Verwarming</b>		
		<ul style="list-style-type: none"> <li>Een nieuw <b>verwarmingssysteem</b> moet afgestemd worden op de (geplande) <b>uiteindelijke isolatiegraad</b>. Wanneer dak- of gevelisolatie gepland is, wordt hier rekening mee gehouden bij het dimensioneren van de verwarmingsinstallatie.</li> </ul>
		<ul style="list-style-type: none"> <li>Bij het plaatsen van een nieuwe <b>verwarmingsetel</b> kan al gedacht worden aan latere uitbreidingsmogelijkheden i.v.m. <b>zonne-energie</b> (compatibiliteit van het systeem, dimensionering).</li> </ul>
<b>Ventilatie</b>		