Web Platforms Integrating Supply and Demand for Energy Renovations

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Summary

It is widely acknowledged that the uptake of energy efficiency in renovations has to increase in order to meet the climate challenge and European policy objectives, which means that a market arena for thorough renovation has to be developed. To achieve thorough renovation some major challenges have to be dealt with. The supply side has to be integrated so that enterprises can offer a holistic service, including quality assurance and - preferably also - a cost, maintenance or energy performance guarantee. The concept of thorough renovation must also be well communicated towards owner-occupants. This requires innovation in the supply side, but also in the demand side interfaces.
Within a European Eracobuild-project, this study examines opportunities and barriers of novel communication tools, focusing on web interfaces that integrate demand and supply, to provide solutions in order to stimulate highly energy-efficient renovation of owner-occupied single-family houses.
Knowing that each step in an innovation-decision process can be covered by communication tools, a model is developed to study web sites that integrate supply and demand side innovation for thorough renovation.
The qualitative analysis examines and compares 20 existing web sites from 7 countries that provide an interface between suppliers and owner-occupants. The discussion then reveals opportunities and possible threats for developing novel tools.
The study concludes that the successful emergence of a supply/demand interface requires an integrated approach, in which both enterprises and clients are guided in each step of the decision-making process. Five levels of information and four groups of knowledge are recommended.

Keywords: Buildings; Energy efficiency; Renovation; Innovation; Demand/supply interface.

1. Introduction

It is widely acknowledged that, in order to meet the climate challenge and European policy objectives, the uptake of highly energy-efficient renovations in the existing building stock has to increase [9]. Although tacit knowledge can be developed from demonstration projects [1], important challenges remain in order to diffuse technologies beyond the demonstration project [1, 11]. For example, in the growth market different actors need to be addressed [11] and specific learning trajectories and networking initiatives need to be developed. An important barrier that remains is

that the market arena itself has to be extended towards integrated solutions for thorough renovations. However, the housing renovation industry is characterized by mainly small and micro enterprises with poor uptake of innovation. Relevant innovations need to be made visible to a larger group of suppliers, contractors and clients.
Although many initiatives focus on the uptake of individual energy saving measures, thorough renovation needs an integrated approach that is often missing on the supply side [6]. On the supply side, usually different small enterprises - including contractors, architects, energy intermediaries and investors – contribute in an offer for highly energy-efficient renovation. This fragmentation is an important barrier for integrated thorough renovation. At the same time, some quality, energy performance and cost guarantee has to be offered to the customer. Also, when high energy performance targets are set, a high quality of execution has to be reached.
It is also notoriously difficult to convince potential adopters to implement integrated energy renovation. Often owner-occupants choose for phased renovation and the implementation of single measures. The implementation of energy-efficient solutions is even not always directly related to convincing the client to adopt energy efficiency [5]. For example, owner-occupants can have a priority to increase the comfort of certain rooms or to extend a house: this can imply choosing for energy efficient solutions, but the main renovation objective of the owner-occupant might be different. From the demand side there is a need for neutral information and guidance in the adoption-process. A better understanding of what drives consumers to adopt innovations, and at what moment in the decision-process, might therefore be helpful in order to spread sustainable consumption.
So, both on the supply and on the demand side barriers have to be eliminated. Next to these barriers, an integration of both sides appears to be needed in communication tools. In order to make a stronger link between the ‘integral supply’ and the ‘demand for innovation’, an integrated model appears to be necessary. Of particular interest can be a focus on the development of novel web platforms, since these are known to create an environment of formal relationships and contracts between enterprises, providers and clients and cooperation between enterprises.

2. Research approach

2.1 Framework of the one-stop-shop research project

Integrating the customer in the development of web platforms is believed to be a novel powerful means to reduce failure rates. The innovation literature speaks of a ‘paradigm shift’ in the sense of turning away from innovation purely dominated by the manufacturer [2, 4, 12, 13]. Customer peer-to-peer communication is perceived as a special challenge in the development of web tools. For example, it is known that owner-occupants of passive houses are proud of their realization and regularly show their houses and give advice to other potential clients in the same situation. Even afterwards such clients exchange useful information on who to consult and where to find suitable materials, suppliers, grants and services. It was noted that some web tools already allow such customer-to-customer communication, next to company-to-customer or customer-to-company communication.
As part of the ERANET Eracobuild project “From demonstration projects towards volume market: innovations for one stop shop in sustainable renovation” – the project is described on the web site www.one-stop-shop.org -, scientific partners were gathered from Belgium (Flanders), Denmark, Finland and Norway to examine the development of novel web platform for thorough renovation, with a specific focus on those that reach the customer directly. The researchers focused on comparing web sites from different European countries that (partially) offer an integrated demand/supply interface for thorough renovation. To compare these tools, a research model was developed to examine how these tools address the whole innovation-decision process.
The present work is part of this project. Examining strengths and weaknesses of existing web sites should allow us to find a suitable structure of a web site in order to facilitate innovation uptake in supply and demand of owner-occupant highly energy-efficient renovation of single-family houses.

2.2 Theoretical framework

We investigated already existing web platforms in order to provide a better understanding how innovation-decisions can be steered. The use of innovation-decision models (e.g. [10]) can contribute to a better understanding of what drives decision processes in both customers and SMEs to adopt innovation and how this relates to possible solutions in order to increase the uptake of highly energy-efficient renovation. A full theoretical overview is beyond the scope of this paper. In this research we focus on a communication approach, exemplified by the work of Rogers [10].
According to Rogers' concept of innovation-decision processes, communication channels can influence each step of the decision-process. These steps in the innovation-decision process were defined by Rogers in 5 levels: from first knowledge of an innovation, to forming an attitude towards the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. In each step of the decision process potential adopters can decide to quit adopting the innovation, so communication channels need to provide the right information in each step and guide the potential adopter through the whole process.
The research uses this model to evaluate existing communication tools, in particular web sites, in order to understand how these relate to each step in the innovation-decision process. This should lead to idea generation, as well as possible pre-selection of suitable web tools to extend towards quality supply and sustainable demand, with a focus on improved supply interfaces towards the consumer.
Following Rogers' model, the following considerations provide a clarification on what is relevant in the decision-process of adopting thorough renovation.

- If knowledge about thorough renovation possibilities or innovative energy saving technologies is not available, the potential client will not think about adopting these options.
- When the knowledge is not deepened, exemplified and simplified for the specific situation of the owner-occupant, the client will not be persuaded.
- If the client cannot find financing or actors to do the work, the choice for thorough renovation will be abandoned. For renovation, solutions addressing selection of turnkey and do-it-yourself home solutions are a special challenge.
- Even when the renovation has started the client can stop the choice for thorough renovation, for example when contractors are unwilling to collaborate or can not find integrated solutions of detected problems.
- Finally, when the client perceives that the actors did not provide the expected quality – for example when the client misses certain grants because the energy performance is not reached in the end - , the client will not recommend this type of action or actor to other potential clients and might even hinder future market development. Otherwise, a satisfied customer might also recommend certain types of actions or actors to future clients.

To analyse web sites in this framework, it can be important to have a rather complete view of their introduction and development, including qualitative details and information about the underlying actors that might be of importance in decision-making and replication of the communication initiative. The web sites were therefore reviewed focusing on: Who are the actors behind the initiative? What kind of information and tools are accessible to the owner-occupant? How does this link with the suppliers? What are the observed strengths and weaknesses of this approach?

3. Analysis

Different relevant web sites that could contribute to answering the research question were assembled by the experts of the Eracobuild project with a focus on developments in the countries Belgium, Finland, Denmark and Norway. Further, within this project, also useful web sites were suggested by regional steering committees involving construction industry. The web sites found and their main strengths are listed in Table 1.
We found 20 already existing web platforms from 7 countries. From our research we detected that different actors could lead such web sites: public actors, vendors, consumer organisations, non-profit organizations, architect organizations, contractor federations, and so on. The richness of the existing web sites was found to vary from simple text communication and selection tools to multi-level interfaces or user toolkits where the customer can manipulate the final product or desired outcome. In order to systematically analyse different web sites' strengths and weaknesses, five

levels of information were defined, as illustrated in Table 1.
Table 1 gives an idea about the questions that clients would expect to be answered from a web platform in order to guide them from each level to the next. Following this methodology, Table 2 gives an overview of main strengths of examined web sites.
From our research we detected that today most European countries are still in the phase of first demonstration projects or early adoption of thorough renovation. Most sites do not cover thorough renovation or related innovations, but focus on single measures. Some web sites are strong in providing knowledge and weak in supplier selection or finalizing a decision to adopt. Vice versa, some supplier oriented sites are less concerned with providing neutral information and quality assurance. In many web sites, feedback of the site visitor on experiences with renovation or the involved actors was not included, although it is known to be a possible strong element in convincing new clients. So, both on the supply and on the demand side there are still major challenges to develop a better web model and supplier/client interface, and we did not find all items of concern to be solved in existing web sites.

Table 1 Guiding questions that clients would expect to be solved from a web platform, in order to guide them through each step of the innovation-decision to adopt thorough renovation.

1. Knowledge	What is thorough renovation?
	What are available solutions? (concepts, technologies, innovation)
2. Persuasion	Why should I take the step to deep renovation? (long-term saving, ecological motivation, energy saving, , avoiding future works or long-term renovation, combining different grants and tax benefits, and so on)
	Why should I choose thorough renovation compared to what I had in mind? (awareness raising based on own situation: kitchen/bathroom renovation, wish for extension, improvement of comfort or air quality of certain rooms, improving degrading roof or façade,..)
	What are experiences from other clients that chose thorough renovation? (process, actors, cost-benefit, achieved quality)
3. Decision	Where can I ask for offers? (suppliers, financing, consultants)
	How can I compare, choose, reject offers? Fro example, what needs to be specified in a contract proposal?
4. Implementation	How should I plan the intervention of actors?
	What questions do I have to ask during the works to check the quality?
5. Confirmation	How do I get a guarantee/ recognition/ label of good execution/ energy performance?
	How can I express positive/negative experiences?

The examined web sites tend to have a very specific emergence history which is highly related to the wishes of the lead actor, local context and side conditions in a social context, which can limit the way a model can be transferred to another region or social context. Notably, the local context of energy performance of buildings legislation if different in different regions, and supply and demand structures can vary regionally. The local success of a transfer process of a web initiative might also be highly dependent on motivation and competences of the lead actors, resources and social capital generation.

Table 2 Web sites studied in the framework of the ERANET Eracobuild project "From demonstration projects towards volume market: innovations for one stop shop in sustainable renovation", and their detected main strengths.

Country	Web site	Main strength
BE	www.ikzoekeenvakman.be	Selecting a contractor
BE	www.ecobouwers.be	Consumer-to-consumer communication (forum)
BE	www.passiefhuisplatform.be	Neutral actor, project database and certification, actor listing
BE	www.renovatie2020.be	Direct supplier link with renovation policy
BE	www.zoekeenarchitect.be	Finding an architect from project information
D	www.modernus.de	Financial simulation tool based on consumer perspective (environmental, cost, energy)
D	effizienzhaus.zukunft-haus.info	Quality label connected to finding suppliers
DK	www.goenergi.dk	Independent public actor, calculation tool and technical information on renovation solutions, selection of carpenters and suppliers
DK	www.energibolig.dk	Consortium of well-known actors that provides analysis and complete package for energy renovation
FI	www.k-rauta.fi www.rautia.fi	Easy access to energy saving renovation services under one roof and getting all from one trusted nationwide vendor
FI	www.korjaustieto.fi	Renovation and maintenance portal provided by the Finnish Ministry of the Environment, tools, guidance and information for apartment buildings and single-family houses
FI	www.kuluttajavirasto.fi	Information on all sorts of consumer issues, one part dealing also housing renovations Gives some information on choosing a renovation company and making renovation agreements
NL	www.verbouwkompas.nl	Information regarding energy introduced based on consumer's idea of renovation (for example renewal of kitchen, extension of room,..)
NL	www.energiebesparingsverkenner.nl	Project simulation tool
NO	www.enovaanbefaler.no	Public actor which warrants for credibility and recommends good products.
NO	www.energiraadhuset.no	Private actor which starts with the analysis and can provide the complete package including guiding about lighting and electric equipment.
NO	www.entelligens.no	Starts with the analysis and act as the house owner's "advocate" from selection of suppliers through the renovation phase.
NO	www.alttilbolig.no	Portal for selecting all types of suppliers of products and services for homes.
UK	www.tzero.org.uk	Widely supported simulation tool allowing for different optimisations (cost in function of budget, CO_2 savings, long term value, ...)

4. Discussion

4.1 Developing a new model starting from four knowledge elements

The integrated model we aim for does not attempt to conclusively answer what a best practice supply-demand interface for highly energy-efficient renovation is, or is not, but attempts to compile strengths of existing initiatives and to evaluate if existing web sites can be improved or new national web sites can be developed. Integrating all strengths into a new model should help in providing a convincing liaison between sustainable consumers and innovating enterprises. From examining the web sites, we believe that four types of knowledge are needed to start from.
First, knowledge about the concept of thorough renovation is needed, in particular to explain the visitor what the benefits are of thorough renovation compared to not renovating or doing only single energy-saving measures. *Depending on the perceived renovation problem of the visitor*, such information can focus on funding, thermal comfort, air quality, health, lettability (rental), protection of construction, sustainable building, climate protection or urban revaluation.
Demonstration projects of thorough renovation – in different forms like turnkey solutions, phased renovation and do-it-yourself renovation - appear to be very important for providing tacit knowledge, both for potential adopters as for suppliers. Consequently, a web platform for thorough renovation should integrate information from demonstration projects. Another work package of the Eracobuild project therefore focuses on providing reliable and useful information from demonstration projects to be spread as initial know-how in a new web model. Incentives for learning from demonstration projects mostly still have to be created. Project information therefore should also be linked with actor selection, project visits, information sessions, feeding of the web site, and so on.
Further, we found that best available technology and service innovations for thorough renovation are poorly addressed in many web sites. However, providing knowledge, examples and feedback of such innovations might be crucial for the adoption of the technologies and services involved in thorough renovation.
An important challenge in (the survival of) novel web tools is how to close the information circle so that experienced suppliers, contended clients and intermediary organizations can provide useful communication to future actors and clients. The circle can close when successful innovators, pleased adopters and renovation demonstration projects will set an example for new potential adopters, thus creating a virtual circle of learning. This is an important consideration for new web developments. Currently, the integration of customer and supplier experience is often poorly addressed, but perceived as an essential element in some of the traced new web developments.

4.2 Four groups of actors to be involved

The further model development qualitatively focuses on a communication tool that provides an interface between thorough renovation suppliers and a specific type of customers (owner-occupants of single-family houses), hereby keeping in mind the importance of other actors like architects, investors, energy intermediaries.

- A special role is needed for mediators or innovation change agents. Different authors [3, 7, 8] noted, and our analysis showed, that nowadays *consumer organizations, supplier confederations and knowledge centres* focusing on highly energy-efficient housing already mediate between suppliers and consumers and transfer innovation into the construction sector. Such organizations might play a special role in the development of new web solutions, in particular when they can provide neutral information. In particular, such interest organizations - or other intermediaries focusing on energy efficiency, like for example municipalities, chambers of commerce, innovation or energy agencies, and so on - can provide the necessary knowledge about the concept of thorough renovation. For example, in the Belgian situation, the non-profit Belgian Passive House Platform provides neutral clients information about how to realize a thorough renovation (also information sessions and courses for contractors), helps clients with advice and finding actors and grants, and provides clients with a confirmation (certificate) that a low energy standard is reached. Amongst other, its web site www.passiefhuisplatform.be generates newsletters; provides a low-barrier web cast about concepts; explains concept and product solutions with animated models; lists and links experienced actors with demonstration projects; embeds an innovation technology transfer market initiative; links to blogs of clients.

- Deepening the knowledge for personal projects will probably require the involvement of consultants (service suppliers). These could for example be *energy consultants* providing detailed calculations for decision-making or *financial consultants* that can propose a way of financing thorough renovation. For example, in the Belgian situation, a provincial network of energy advisers was installed. The potential adopters can consult them at regional contact points to discuss their plans and predesigns regarding energy and sustainability issues and ask possible detailed questions they have when comparing with other options.
- Further, there will be a need to address and involve technology suppliers, in particular those that can supply the required innovation for thorough renovation. They will need to engage in providing neutral information about the innovation and they will need to deal with consumer appreciation of their innovation.
- Finally, an involvement is needed of acknowledged executors that can guarantee the quality of the execution of the final product. In the Belgian situation, a questionnaire was set up to detect the most suitable partners on the contractor side. It appears that *architects* can play a crucial role in coordinating the execution of thorough renovation, especially those that are performance-oriented and can specify some guarantee of their experience in thorough renovation. Another option to investigate would be the involvement of *turnkey renovation suppliers*. These are usually small companies with 10 to 20 employees that have experience with turnkey solutions and cost/performance guarantee. Architects and turnkey companies further work with contractors and subcontractors, but for the client it is important that one company is responsible and can guarantee the quality of the final product. Addressing the do-it-yourself market would probably require other types of executors and difficulties will occur to provide the necessary quality.

5. Conclusion

As part of the ERANET Eracobuild project “From demonstration projects towards volume market: innovations for one stop shop in sustainable renovation”, web platforms were investigated considering the implementation of consumer/supplier interaction, the integration of thorough renovation, and with a specific focus on each phase in the whole adoption-decision process.
A web tool for steering decisions to implement thorough renovation should be based on subsequent levels of information. Besides providing knowledge, such a tool can stimulate persuasion and a favourable attitude towards innovation by providing detailed information to both clients and suppliers. Organizing continuous feedback from innovating companies and customers is a detected opportunity. A web platform can help the individual with engaging in activities that lead to a choice to decide to choose thorough renovation, for example by providing or directing to consultants, independent professionals or further personal training. Guiding the visitor through the whole decision process, with suitable responses in each step, might be imperative to success of a web platform.
It was found that most existing web sites show some shortcomings when addressing thorough renovation, or when providing a response to each stage in the innovation-decision process. Each existing web site has strong and weak points and the challenge is to combine strengths of existing initiatives and of different actors (mediators, consultants, suppliers, executors) to exploit the opportunity of fulfilling the need of the house-owner for a holistic solution in a simplified way. Each detected web site has a specific strength, but no examples were found that combine all these strengths. Both on the supply and on the demand side there are thus still major challenges to develop a better web model and supplier/client interface. A more holistic approach promoting an integrated concept of thorough renovation and involving actors from different disciplines on a regional level is now needed. A specific role for a web platform as an integrating interface - or even as a formal gate-keeper between innovation-push and demand-pull - can be discussed.
Our work finds that information on individual renovation measures is mostly available, but what is still often missing is knowledge about the benefits and possibilities of an integrated approach for energy renovation. In the framework of the Eracobuild project, we will now focus on developing a new model starting from four knowledge items that we detected to be of high importance: (missing) conceptual information on integrated energy renovation, knowledge about demonstration projects, information about innovative technologies, and continued integration of customer/supplier experiences. An exercise in integration is needed and a new web model will be developed that

enables to address four different target groups: mediators, consultants, technology suppliers and executors.
The aim of the project is to integrate all necessary items and levels in one 'ideal' web model that then can be refined and implemented according to regional needs: partners will be able to select which elements they want to implement in their region with their preferred target group.

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