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# ACTIVATING THE ADOPTION OF INNOVATION: LESSONS FROM A PASSIVE HOUSE NETWORK

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## Abstract

**Purpose –** The paper aims to explore innovation adoption theory and to define a model to investigate operational activities and communication in innovation networks that can stimulate both supply and demand. It also aims to exemplify this model with the activities of an innovation network dedicated to promoting passive houses.

**Design/methodology/approach –** Autoethnography and literature research were used to develop a model in order to conduct a structured analysis of operational activities and facilitate innovation-decision processes using networks. Data on the activities used to steer client decisions and businesses' innovation were gathered from network archives and from the results of social research methods applied within a passive house network.

**Findings –** The findings reveal that operational activities of multi-player networks should focus on reinforcing conditions and communicative activities that support innovation-decision processes from one step to the next. In order to activate supply and demand, communication strategies can be modelled to increase the adoption of innovation and continued knowledge generation in networks.

**Research limitations/implications –** Because only one network was evaluated and only the housing sector was exemplified, it may not be possible to generalise the research results. Researchers are therefore encouraged to test the proposed model further.

**Practical implications –** The paper helps developing activities in innovation networks, in order to guide both businesses and customers through the steps of the adoption-decision process.

**Originality/value –** This paper connects innovation adoption to activities of a network in the field of construction.

**Keywords:** Innovation; Housing; Energy saving; Networks; Passive House.

**Article Type:** Research paper

## 1. INTRODUCTION

One of the key priorities in recasting the European Performance of Buildings Directive (EPBD, 2010) is the market deployment of 'nearly zero-energy' buildings in EU member states by 2020. In the construction sector, it is acknowledged that an increase in the uptake of highly energy-efficient concepts such as the 'passive house' [i] (Feist, 1993; von Weizsäcker *et al*., 1998; Pass-net, 2011; PassREg, 2015) is essential in order to meet the challenges of a changing climate and European policy objectives (van Hal, 2000; Femenias, 2004; Mlecnik, 2013a).

Although innovations [ii.] have been developed in various demonstration projects, important challenges remain in order to 'diffuse' solutions beyond the demonstration project phase (Femenias, 2004; van Hal, 2000). Market infrastructure and customer demand must be created to achieve innovation in the construction sector (European Commission, 2010), particularly related to the passive house (Pass-net, 2011; Mlecnik, 2013a). There are not enough regional market players, and companies' competencies are limited (Pass-net, 2011).

'Literature on innovation theory is scarce with regard to the barriers and opportunities that may inhibit or stimulate the effective adoption of integrated design concepts and related innovations. The literature shows that there is a need for a consistent flow of information to avoid the regeneration of deficiencies (Femenias, 2004). Specific know-how retrieval centres (Ornetzeder and Rohracher, 2009) and new approaches to systemic innovation in businesses (Mlecnik, 2013a, 2013b) are also required.

In this respect, a better understanding of the theory of the adoption of innovation would be particularly useful when identifying ways to stimulate the development of emerging markets.

An analysis of the communication tactics of a network dedicated to stimulating the adoption of innovation in the field of passive houses may help to identify lessons for the promotion of

innovation in fields such as the construction sector and help to identify which activities lead to market transformations. Our primary research question was therefore:

*Which activities can stimulate the adoption of innovation in the field of passive houses, as determined from the management of an innovation-oriented passive house network?*

## 2. RESEARCH STRATEGY

The aim of this study is to gain a deeper understanding of the activities that can be organised to promote innovations in passive housing in the construction sector. The study does not attempt to determine conclusively the best available communication activities for networks. It simply aims to review and reflect upon innovation adoption literature and bring in new ideas.

A research model taken from innovation adoption theory (Rogers, 2003) was used to study the operational activities of innovation networks. The personal experience of the author, who was also the network leader, was used as self-reflection, using autoethnography (Ellingson and Ellis, 2008) as a research method. An analytical autoethnographical section discusses the broader social phenomenon of pro-environmental innovation, while an evocative section illustrates the use of these theoretical ideas.

The author has been involved as an innovation project facilitator since 2001, helping the network to define its innovation promotion activities by applying the principles and processes of group dynamics. Methods including focus groups were used to define relevant network activities based on the experiences of companies. The definition of innovation activities was the result of a dialectic process of group facilitation, collecting information at task group meetings, and regularly reflecting on the learning cycles with a growing number of enterprises and customers. The analytical section of this study reflects the context of the decisions taken by the management board from an analysis of the network's archives. This

paper neither aims to present these analyses in detail, nor to quantify the resulting diffusion of innovation, but to indicate the key experiences gained through this network in relation to what actors perceive as effective methods for stimulating pro-environmental behaviour.

The study first develops a theoretical perspective (Section 3) with possible wider applications in innovation research, reflecting on Rogers' theory of innovation adoption (Rogers, 2003). This section also indicates a number of elements from the literature on transition research and theory on environmental behaviour change. Relevant points were then incorporated into a model proposed for the network to clarify which activities stimulate innovation.

The study then identifies lessons based on network activities in relation to stimulating regional supply and demand of innovation. In the light of the proposed model, Section 4 illustrates the model using the activities of an innovation network in Flanders, Belgium (Passiefhuis-Platform vzw, further named PHP) which has been successful in advancing the market for passive housing. The network activities discussed were undertaken between 2003 and 2007, and were developed with the support of the Flemish Agency for Innovation by Science and Technology (IWT, 2007; PHP, 2007) in a region where passive housing did not previously exist at all. Section 5 discusses the lessons learnt from the network. Finally, the research question is addressed in the conclusion (Section 6).

## 3. INSIGHTS FROM THEORY

### 3.1. Activities in multiplayer networks leading to transition

What is apparent from one strand of transition research (for example: Mlecnik, 2014; Hegger *et al.*, 2007; Elzen *et al.*, 2004; Raven, 2005; Weber *et al.*, 1999) is that socio-technical experiments or innovation journeys only evolve into actual technological or market niches in a few cases. Researchers identify an important need for the articulation of expectations and

sustainability visions, learning processes with multiple dimensions, and the development of multiplayer networks (Hegger *et al*., 2007; Elzen *et al*., 2004; Kemp *et al*., 1998; Caniëls and Romijn, 2008; Raven, 2005; Weber *et al*., 1999). Within networks, decisions and strategies are developed, negotiated and implemented, leading to changes in societal structures (Loorbach, 2010). Within this framework, communication in market niches – using multiplayer networks – is considered particularly effective (Caniëls and Romijn, 2008; Schot and Geels, 2008; Hegger *et al.*, 2007; Elzen *et al.*, 2004; Kemp *et al.*, 1998; Verheul and Vergragt, 1995).

Some researchers (Van der Brugge and Van Raak, 2007; Loorbach, 2010) identify four different types of governance activities that are relevant to societal transitions: strategic (vision-related), tactical (regime-related), operational (innovation-related) and reflexive (monitoring-related). Strategic and tactical activities are effective over the long term and medium term respectively, and it is therefore often difficult to identify lessons due to the long period of observation needed. However, operational activities, experiments and actions that have shorter-term horizons can be more readily identified.

The study in Section 4 therefore focuses on examining the operational activities of a multi-player network, with the aim of determining communication practices and operational activities that could, in turn, filter through to transform views on the adoption of innovation. One of the underlying principles of this study is that operational activities can be hosted within networks to promote the adoption of innovation.

### 3.2 Adoption of innovation

*Rogers' viewpoint*

A communication perspective on the diffusion of innovation has been developing since the 1950s. An early milestone can be found in the work of Rogers (1962, 2003), who defined the

diffusion of innovation as the process whereby an innovation is communicated through certain channels over time among the members of a social system. Rogers (2003) defines 'innovation' as any idea, practice or object that is perceived as *new* by an individual or other unit of adoption, and he defines (2003) perceived characteristics of innovations which help to explain the adoption of an innovation. Studies show these characteristics are relevant to decision-making on energy use in housing (Wilson, 2008) and passive houses (Mlecnik, 2013a). Rogers (2003) also highlights the important role played by 'change agents' and diffusion networks in organising the communication of innovations.

Rogers (2003) developed a useful model to determine how an adopter could be reached through communication channels. Rogers (2003:170) depicts this model as a timeline through which a decision-maker passes, from initial knowledge of an innovation to forming an attitude towards it (persuasion), to a decision to adopt or reject it, to implementing the innovation, and finally to confirming its value.

According to Rogers' model, communication channels can exert an influence at each step in the decision-making process. The perceived characteristics of an innovation play an important role in the persuasion phase. Note that parties who decide to adopt may change their minds if they fail to find suitable players for implementation.

*A critical reflection*

Rogers' model is very general and tends to ignore the particularities of the construction sector. Compared to many other technologies, buildings are often produced at a relatively high cost, take a long time to produce, and the end products are one-off or limited in number. Moreover, cooperation based on temporary contracts between changing constellations of

market players tends to complicate communication processes and thus slows down the uptake of innovation (Ivory, 2004). One persistent problem in the construction sector is that the communication of innovation is limited, because of the ad-hoc nature of the generation of knowledge and networking (Silvester, 1996; van Hal, 2000; Femenias, 2004). 'System innovations' Passive houses are identified as 'system 'innovations' (Cainarca et al., 1989) by the integration of multiple independent innovations that need to be put together to perform new functions or improve overall performance (Jochem, 2009; Mlecnik, 2011).

Various researchers (for example, Ariely, 2009; *Meer met Minder*, 2010; Rødsjø *et al.*, 2010; Mlecnik, 2013a) argue that the market needs to be developed through an interplay between supply (enterprises), demand (inhabitants) and intermediary facilitators (governments). There is a defined need for the presence of 'market infrastructure' when knowledge is introduced (Brown, 1981; Miller, 2009; Rødsjø *et al.*, 2010). Miller (2009) also contends that innovation is impossible without entrepreneurial competencies and resources. Research also indicates a need for categorising adopters into customer segments, particularly based on environmental concerns (Zimmer *et al.*, 1994; Straughan and Roberts, 1999; McDonald and Oates, 2006; Jones and De Meyere, 2009).

Kaplan (1999) also argues that Rogers' model does not specifically emphasise motivation, experience, and familiarity as critical influences. Peattie (1998) identifies the importance of confidence and compromise on the part of end users in the case of green purchases (see also McDonald and Oates, 2006). Confidence can mean that the adopter is certain that the product represents a genuine environmental benefit. Compromise can mean that purchasing a green equivalent might involve a 'sacrifice'.

Jones and De Meyere (2009) suggest a circular model that articulates the need for learning cycles. : Customer acceptance of demonstration projects indeed depends on their broader 'confirmation' of demonstration projects (e.g. van Hal, 2000; Femenias, 2004). It would

make sense to connect ‘knowledge’ to ‘confirmation’, since innovations ‘confirmed’ in demonstration projects represent trusted knowledge.

### 3.3 A model to study network activities

The network activities were modelled in the light of the various critiques on Rogers’ model. Figure 1 displays the used-to-fit model for studying innovation network activities, incorporating the notion of learning cycles in the construction sector and the learning process using focus groups and the recurrent evaluation of communication activities (see Section 2). This model maintains the relative parsimony seen in Rogers while also adding practical features, specifically in order to examine the network activities that may stimulate pro-environmental behaviour.

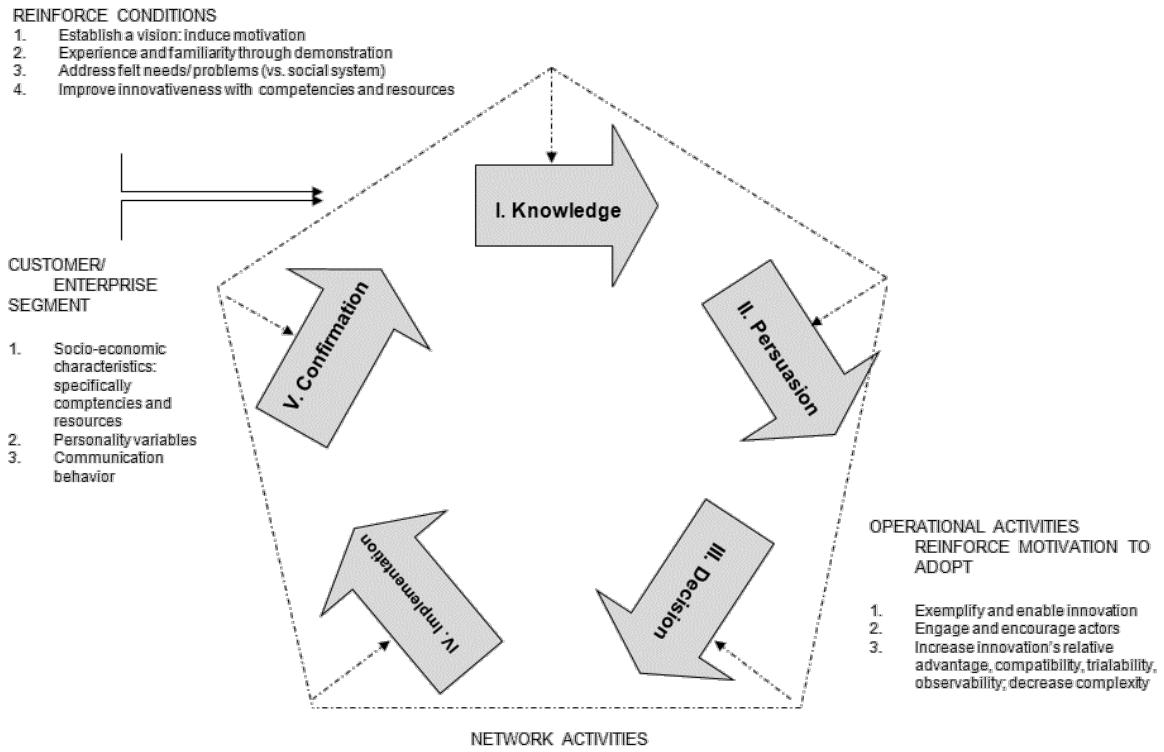


Figure 1: Integrated model for analysing activities of a network, from the perspectives of project-based innovation adoption, using closed learning cycles and stimulating pro-environmental behaviour

There are clear similarities with the conventional model, but there are differences too. The five steps form a closed loop (as a projection of a helix) to emphasise the (various stages of the) need for learning and the development of skills among the actors who consult the network. The model revises Rogers' prior conditions relating to transition for the construction sector and the parallel input line reflects the need to reinforce these prior conditions through the experiences of involved actors. Knowledge is seen as a product of motivation and context, as suggested by Kaplan (1999) and confirmed by transition research, which identifies the need to articulate expectations and sustainability visions. The model emphasises the importance of addressing both the enterprises and the customers, as well as the need for competencies and resources. The target group for communication may also differ with respect to customer segmentation.

In this model, Rogers' communication channels are interpreted as *actively facilitating* the movement of the adopter from one step in the innovation-decision process to the next. Such activities aim to stimulate the adoption of innovation – by influencing perceived innovation characteristics – and to reinforce environmentally conscious behaviour by providing an example and enabling relevant innovation, as well as engaging actors and encouraging them to collaborate.

The model for the analysis of network activities in Figure 1 thus combines experiences from various theoretical backgrounds which can help to identify potential communication activities and strategies for networks. To highlight the validity of the main features of this conceptual framework, the model will now be exemplified in section 4.

## 4. ACTIVATING THE ADOPTION OF INNOVATION: EXPERIENCES FROM A PASSIVE HOUSE NETWORK

This section presents a history of the activities already undertaken by a passive house innovation network to illustrate various elements of the model in Figure 1. First, the prior conditions (as defined by Rogers) are discussed. Second, the various activities undertaken are presented. Subsequently, the network's activities are discussed in the light of Rogers' innovation decision-process scheme (Rogers, 2003:170) and Figure 1, going from Step 1 (Knowledge) to Step 5 (Confirmation). Finally, Step 5 activities are discussed as the key to 'closing the loop', as shown in Figure 1, and the importance of the additional elements in Figure 1 (Segmentation and Reinforcing conditions) is discussed.

### 4.1 Emergence of the network

The network named 'PHP' was formally established as a non-profit member organisation in the Flemish Region in October 2002, with the aim of 'diffusing knowledge about highly energy-efficient building'. At that time, the market infrastructure and the customer demand for passive houses in Flanders were negligible and neither were policy conditions conducive to high energy efficiency becoming more popular. In addition, the members had very limited experience with passive house innovation. However, some frontrunner enterprises and customers set ambitious energy targets for future projects, which raised initial interest in developing communication activities.

Having acquired innovation funding resources, the network was able to attract the competencies that it deemed necessary (3 employees, 2.1 FTE). These employees were able to draw on advice from a multidisciplinary management board and on the experience of members of the network. PHP first engaged in activities for the construction of newly built single-family passive houses. This segment choice implied that mainly small companies, such

as architects, engineers, contractors, installers, suppliers, engaged with the network. The easiest customers to attract were highly motivated ‘green’ families.

The emergence of PHP in relation to strategic niche management is further discussed in another paper (Mlecnik, 2014).

### 4.2 Network activities

The employees identified a range of activities to address innovation adoption. Table 1 provides an overview of the activities undertaken in 2003-2006. At the same time, potential clients and businesses were convinced to adopt demonstration projects or innovative technologies.

| Target group | Communication activities | Number of actions 2003-2004 | Number of actions 2005-2006 |
|---|---|---|---|
| Companies and clients | Visits to companies and projects | 70 | 67 |
| | Publications | 12 | 80 |
| | Lectures/seminars | 22 | 45 |
| | Website promotions/ newsletters | 9 | 18 |
| Mainly companies | Networking/ membership actions | 30 | 39 |
| | Innovation studies and support | 12 | 28 |
| Mainly clients | Technological questions | 300 | 450 |
| | Knowledge transfer | 100 | 60 |

Table 1: Communication activities undertaken by PHP in the period 2003-2006. Based on: IWT 2003; PHP 2007

The employees developed specific knowledge-related activities and communication tools that were directed at both companies and clients. They supported businesses and clients by acting as a contact point, drawing on their own expertise and that of other members. Their presence at important regional building fairs helped to disseminate information on the innovations available and first-line consultancy for potential adopters. Examples of innovations were also shown during workshops, symposia, building fairs and study trips.

The primary goal of these efforts was to raise awareness of the passive house concept. In general, the website that was set up turned out to be particularly effective, with over 1,000

visitors per day. Media channels such as magazines, newspapers, radio and television were important allies in reaching a wider audience provide initial knowledge about passive houses.

Clients and businesses were mainly approached with information on how passive house principles can offer higher levels of comfort (thermal comfort in both winter and summer, air quality, acoustic comfort, lighting quality, healthy indoor environment), better structural quality and higher profitability and future value. The visible passive house fair and symposium in particular, persuaded businesses and clients that there was a regional market infrastructure for passive houses. Visits to ‘confirmed’ demonstration projects in Germany and Austria were an essential source of information and communication, as they helped to convince architects, contractors, suppliers, consultants and clients of the feasibility of passive houses in Flanders.

Potential adopters could schedule a meeting to discuss draft plans. The website provided direct referrals to ‘experienced’ parties. Web forum activities enabled people to discuss their doubts about and solutions for passive houses.Companies that decided to innovate were assisted to apply for Flemish SME innovation grants and find potential research partners. A telephone consultancy service addressed any questions that arose during the implementation phase of passive houses. In addition, enterprises could hire a network employee if they wanted personalised, impartial advice on passive house technologies or assistance in the development and coordination of an innovation journey.

Projects were ‘certified’ by network employees, using specialist energy-calculation software. A list of actors and technologies for the construction of passive houses was compiled, based on involvement or use in such projects.

To summarise, Figure 2 shows the various communication activities of the network during the various steps of the model from Figure 1.

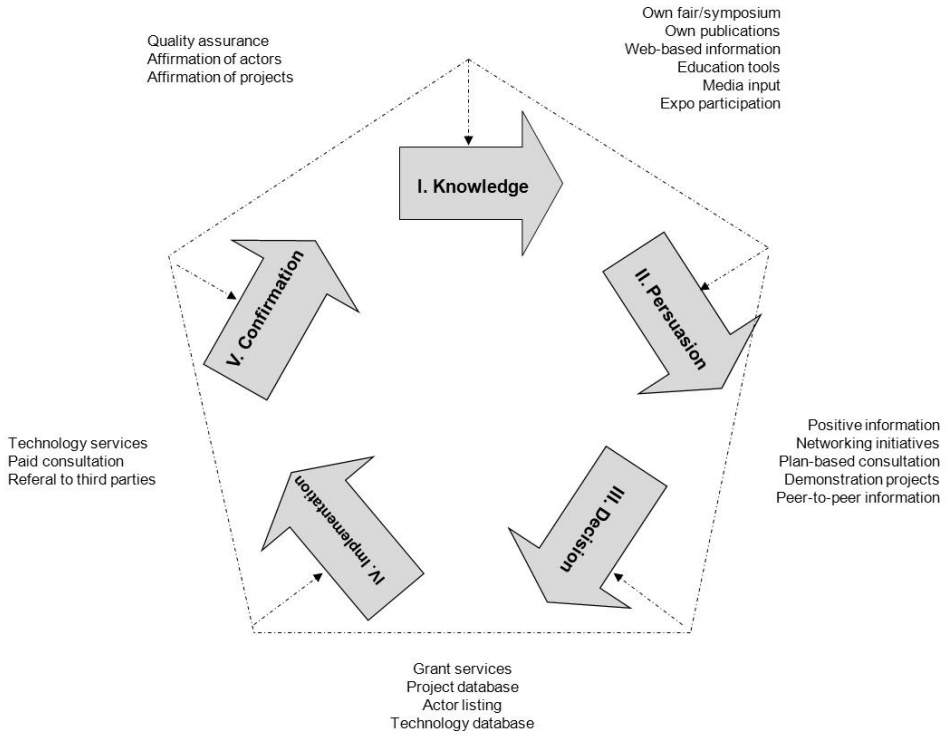


Figure 2: PHP activities guiding the innovation adoption processes

These activities were later adapted to changing conditions in various segments.

## 5. LESSONS FROM THE NETWORK

### 5.1 Network operational activities lead to adoption of passive houses

The operational activities led to a steady increase of passive houses built in Flanders (see Figure 3). Adoption was delayed somewhat because housing project developments usually last a number of years from initial idea to design, realisation and evaluation. Figure 4 also shows that the number of companies involved in the realisation of passive houses – registered by their membership of PHP – increased steadily.

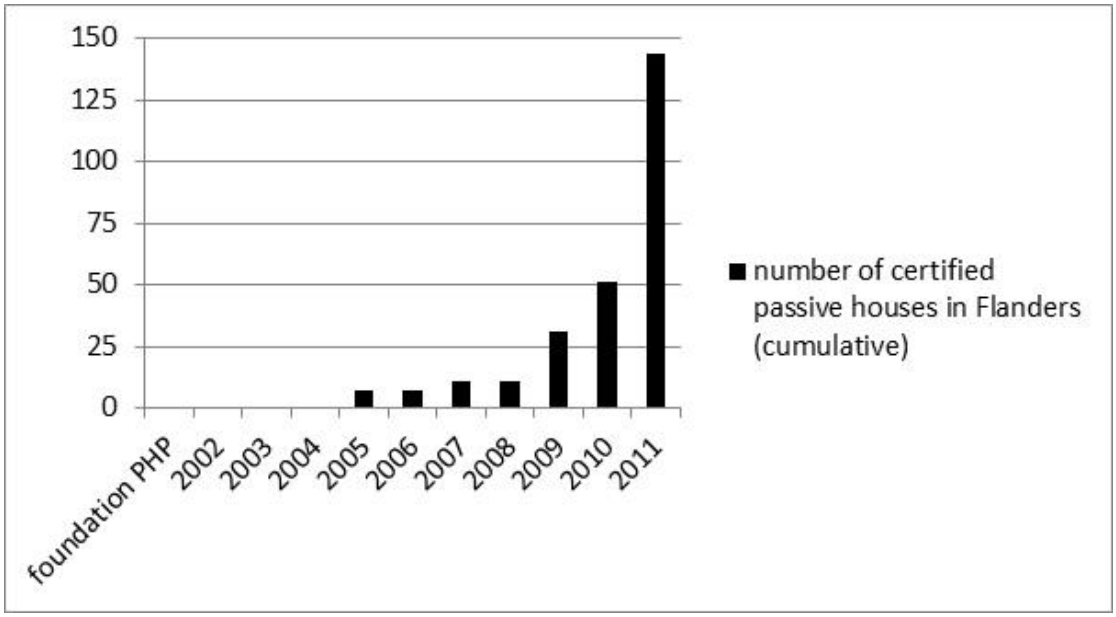


Figure 3: Number of certified passive house projects in Flanders (per year, cumulative)

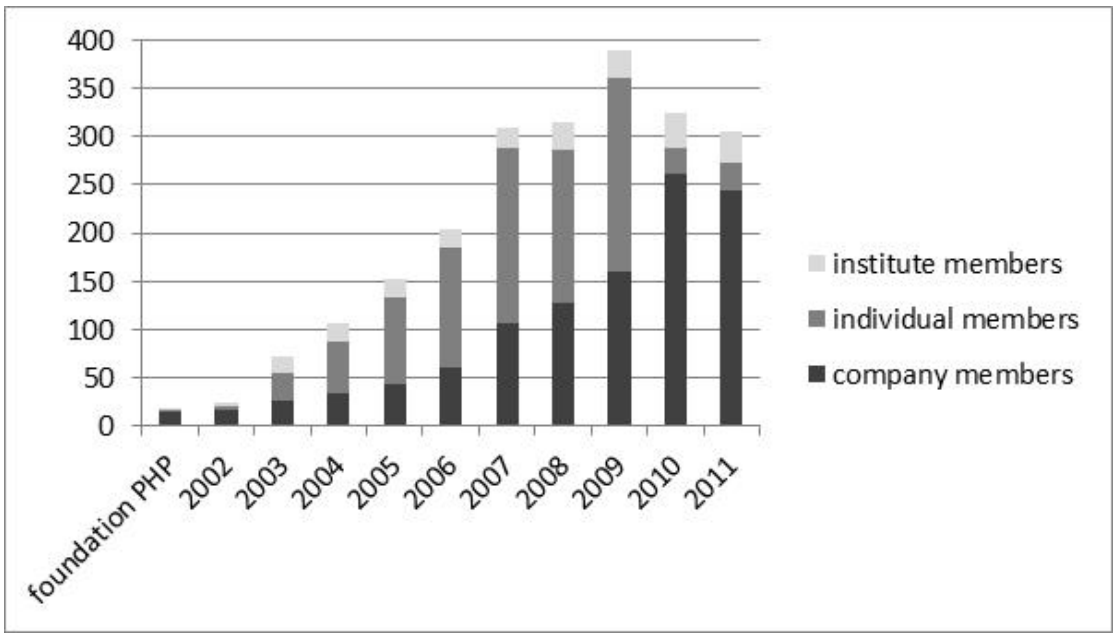


Figure 4: Total membership of PHP in Flanders (per year)

Within a few years, the market scope included larger-scale housing projects, non-residential buildings and renovations. The certification system was linked with financial and non-financial benefits. Passive house requirements were recently made obligatory in the Brussels Capital Region (see also: PassREg, 2015).

### 5.2 Confirmation and closing the loop

PHP needed to engage in ‘guaranteeing the quality’ of initial regional demonstration projects. The network employees developed specific ‘confirmation’ activities – such as energy calculation and air-tightness testing – for this purpose, and a Belgian ‘quality assurance declaration’ for passive houses, which quickly became viewed as an independent certification.

Furthermore, the network needed to create the necessary peripheral conditions to endorse enterprises with expertise. Knowledge and players from ‘accepted’ projects were the most important basis for knowledge generation for future builders, enterprises and the general public, thus providing an input loop from ‘confirmation’ to ‘knowledge’.

In practice, confidence was further increased by developing and communicating a confirmation system linked to knowledge generation. Innovations demonstrated in confirmed demonstration projects convinced enterprises that they could benefit to promote their own specific products, systems and services. In turn, this led to the acquisition of knowledge within these enterprises. Similarly, positive experiences of customers were used as new knowledge to create confidence in potential new customers.

### 5.3 Defining new segments and continuously reinforcing conditions

The closing of each learning cycle led to follow-up demonstration projects, which resulted in both market expansion for single-family homes and spill-over to other segments.

Supply-side network activities focused initially on designers and architects, who usually help the customer during the persuasion phase, and later the segment of contractors and indoor climate engineers. This segmentation proved useful, since specific communication channels

and activities were needed to reach various target groups. For example, architects appeared to be in need of a design handbook, while heating engineers needed specialist calculation tools.

The first clients were a limited target group of well-off, double-income families who were highly committed to green issues. While such 'green innovator' families were relatively easy to convince using sustainability visions and energy savings, for later customer target groups it became apparent that this focus should shift towards proven comfort and/or financial benefits. For example, project developers had a greater need for cost data. Adapting activities was key to the market development for non-residential buildings.

Innovation adoption was very much influenced by endorsing frontrunners in various segments (businesses as well as clients), by strengthening the status of the network as neutral player using a system of accreditation and by continuously adapting and revising activities based on changing prior conditions and segments.

### 5.4 Addressing each step of the decision process is a success factor

Communicative activities were organised to provide answers to businesses or clients at each step of the decision-making process (see Figure 2), regardless of the innovation-decision phase in which they found themselves. The activities reduced complexity, enhanced the attractiveness and improved the availability of innovations, all of which led to a gradual increase in emerging supply and demand.

Some guided innovation trajectories (for example: Mlecnik, 2013b) led to innovation in individual companies. However, only a small number of individual enterprises engaged in guided innovation journeys. The limited focus on this aspect was later identified as a weakness in the definition of the activities.

## 6. CONCLUSION

Which activities can stimulate the adoption of innovation, looking at these experiences of managing an innovation-oriented passive house network? To address this question, this study has used autoethnography, social research methods and literature and archival research to develop an innovation adoption model and analyse the activities of an innovation network.

The research findings reveal certain operational activities and reinforcing factors that can increase the level of adoption of innovation, essentially by ensuring that learning cycles are used more effectively, particularly in project-based fields such as the construction sector. The study has revealed that a broad range of potentially interlinked activities can be developed, which target both the development of customer demand and the uptake of innovation by businesses.

One important lesson that relates to the adoption of innovation was the systemic approach to defining network activities that address the project-based construction sector and various enterprise and customer segments. A set of coherent communication activities can be defined in order to diffuse innovation by focusing on behavioural change and creating synergies in order to produce identifiable innovation outcomes.

Another important lesson has been that various segments of customers and businesses should be supplied with appropriate information. Continuous learning, the development of vision and network formation are important. Short-term activities should persuade potential adopters and assist them in their decision to adopt an innovation. The study has revealed the need to provide suitable responses at each step in the decision-making process, both for businesses and clients. Networks should be wary about continuously changing prior conditions when defining or redefining activities in various segments.

Confidence on the part of businesses and customers can be enhanced and perceived compromises can be mitigated by nurturing motivation, increasing availability, highlighting attractiveness and using confirmed innovations as new knowledge. Activities that address the

confirmation of an innovation – such as certification - are very important, as these can assuage the lack of confidence and stimulate knowledge acquisition, thus leading to learning cycles.

The model developed and the lessons identified can be used to improve innovation theory and develop communication activities in order to stimulate regional supply and demand, and particularly to stimulate emerging innovation in project-based sectors. However, the reader should bear in mind that only one network in one region was studied. Future research can test whether this approach to promoting the adoption of innovation could be used successfully in other networks and sectors.

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## Endnotes

[i] Several studies confirm vibrant business opportunities for passive houses (for example: IEA SHC Task 28, 2006; PEP, 2007; Pass-net, 2011; PassREg, 2015).

[ii.] 'Innovation' is defined as some form of technological change, either in a product or in the production of goods or services (Blake and Hanson, 2005; Edquist, 2005). Innovations were associated with passive houses in such fields as thermal insulation, building airtightness and high-efficiency mechanical ventilation with heat recovery, as well as passive solar and light gains, and additional heating and renewable energy systems (and combinations of these), architectural concepts and services such as passive house certification and specialist quality assurance (Mlecnik *et al.*, 2010; Mlecnik, 2011).

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