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Learning in single & double loops – interaction as key to scientific & practical insights

Abstract

Efforts to reduce energy consumption of private households face a multitude of challenges. Intermediary organisations specialised in the implementation of energy demand-side management (DSM) programmes frequently fall short of achieving far-reaching or long-lasting behavioural changes in their target groups. The European research project CHANGING BEHAVIOUR is developing an online 'toolkit' containing theoretical background information and practical activities aiming to improve the success of DSM programmes. This work is carried out in an action research approach, conducted by a group of scientific researchers and a group of intermediaries, i.e. DSM programme managers. Therefore, theoretical analyses have a focus on implementation practices and the 'tools' developed are practically tested in six pilot projects.

This paper addresses the learning process involved in one of these pilots - the renovation of large multi-apartment building blocks in Latvia. This pilot project aims to increase the number of residents in support of increasing the energy efficiency of their building. The role of the intermediary in this case is that of an energy advisor that provides clear, transparent and relevant information to residents and that supports their decision-making process by improving stakeholder interaction. During the pilot researchers facilitate the testing of the 'toolkit' by the intermediary. This is a highly interactive process which has been well-documented throughout the period. Analysing this rich documentation allows us to qualify the learning process resulting from using the 'toolkit' and being supported by the researchers. Thereby, this paper discusses the question in how far the researcher-intermediary interaction forms an important aspect in the effectiveness of the 'tools' in supporting learning processes.

In order to answer this question the rich material sources collected from the onset of the pilot are analysed with respect to the additional benefit of personal interaction during application of these 'tools'. At the same time the more practical question concerning the autonomous effectiveness of online 'tools' for DSM programmes is answered by a substantiated call for process facilitators supporting reflexive learning in DSM programme implementers.

Keywords: behavioural change, consumption reduction, energy demand-side management, intermediaries, learning

Introduction

Current modes of energy production and consumption are not sustainable. They are not as efficient as they could be and their reliance on fossil fuel is one of the main causes for climate change. In order to avoid adverse effects of climate change, changes in energy production and consumption towards increased energy efficiency and lower carbon dioxide emissions are necessary. Such system transitions are possible, but they take a long time, involve changes in actors, infrastructures and institutions and are difficult to stimulate, let alone manage (Geels 2005).

Domestic consumption is one sector where energy efficiency can be significantly improved. On the one hand, changes in efficiency behaviour, e.g. investment in building renovation and in renewable energy sources on a micro-level can contribute to reduction in fossil fuel consumption and CO_2 emissions. On the other hand, changes of curtailment behaviour involving only little or no monetary investment, e.g. taking shorter showers and switching electronic devices completely off rather than in stand-by mode, can have a significant effect on a household's energy consumption (Dietz et al. 2009). Unfortunately, engaging in and sustaining behavioural changes is not an easy thing to do for energy end-users. Behaviour is highly habitual and embedded in sociotechnological context. Changing behaviour often requires contextual changes that may be difficult to achieve for groups of people and impossible to achieve for a single person alone. For instance, someone is highly unlikely to change to a more sustainable mode of transport to get to work, e.g. car sharing or public transport, if none of his colleagues live close by and the travel by public transport takes him an hour longer than using his own car. If, however, a larger group of people of the same company cooperates, a communal van or bus can be organised leaving from a stop easily reached, requiring fewer and shorter travels by personal transport.

Intermediary organisations in the energy field have committed themselves to the realisation of energy consumption reduction by implementing demand-side management (DSM) programmes aimed at behavioural change. They are playing an important role in networking different (groups of) actors and working towards a transition to sustainability in the energy system (Van Lente et al. 2003). Unfortunately, DSM programmes frequently fail to reach their targets, partially because behavioural change is so difficult to achieve and maintain, which may be one of the reasons why the work of energy intermediaries remains underappreciated.

The FP7-funded research project Changing Behaviour aims to develop theoretical insights into the reasons for success and failure of demand-side management (DSM) programmes and to provide practical support to energy intermediaries. The Changing Behaviour research consortium consists of both research and intermediary organisations. Together, these parties conducted case study and literature analyses, engaged in dialogue with over 150 EU intermediary organisations and developed a conceptual framework for DSM. The resulting theoretically rich, yet practical support for intermediary work comes in the form of a 'toolkit', preliminary versions of which have been tested in six pilot studies. The 'tools' have therefore been developed by means of close interaction and collaboration of research and intermediary organisations.

The Changing Behaviour project has shed light on the difficulties related to behavioural change and the different instruments available to support its origination and longevity. Encouragingly, intermediary organisations possess relevant characteristics for successful DSM programme implementation, namely versatility, flexibility and the ability to create networks of relevant actors that can support their endeavours (Moss, Medd, Guy & Marvin 2009). One of the crucial success factors for DSM programmes identified by the Changing Behaviour partners and others is learning (Breukers et al. 2009). This paper discusses the

success of the Changing Behaviour tools in supporting learning in DSM. Two main issues are addressed in this paper. First, the importance of learning in the context of changes in energy consumption is discussed. This lays the groundwork for an identification of learning mechanisms occurred in a Changing Behaviour pilot project. Thereby, the practical question is answered in how far 'learning tools' are self-sufficient in triggering learning and in how far interaction with people outside of the DSM project is required to stimulate and make use of learning effects.

Defining (the importance of) learning in energy demand reduction
Sociological research deems most previous DSM programmes as ineffective because the overall energy demand has not been decreased. Instead, norms and values with respect to comfort and convenience have risen, thereby undermining energy efficiency gains previously achieved (Wilhite et al. 2000). Therefore, sociological approaches to DSM proclaim the necessity to understand the construction and evolution of end-users' needs in order to change current patterns of energy consumption. The focus is on how new and more sustainable energy consumption practices can make sense in a specific context (Guy & Shove 2000). Against this backdrop, the design and implementation of DSM programmes should be informed by an understanding of current energy consumption patterns and end-users' needs. Therefore, one aspect of successful DSM programmes is learning about end-users' current practices, norms, values and needs with respect to energy consumption.

In the constructivist tradition of sociology, practices, norms, values and needs are seen as socially constructed and context dependent (Guy & Shove 2000). In addition to energy end-users there are other relevant actor groups which are needed to make negotiations and implementation of new practices successful. Building renovation to reduce energy consumption, for instance, may require the support of tenants and owners and may be facilitated by public funding programmes. Therefore, DSM programme implementation can be understood as a multi-stakeholder process in which a number of actors collectively work towards common goals. Which actor group is needed to support a certain change in practices of course depends on the energy consumption behaviour to be changed. This implies that successful DSM programme implementation requires a thorough understanding of context and important stakeholders. This process can be termed social learning. In the context of innovation studies, much attention has been paid to learning processes on a systemic level in order to bring about social change and the much talked about transition to sustainability in the energy system (Van Lente et al. 2003; Van Mierlo, Arkesteijn & Leeuwis 2010). However, there are also important learning processes on the micro-level which are needed for successful implementation of DSM projects and which can help paving the way for larger systemic changes (Moss 2009). These 'micro-level' learning processes within the social context of a single DSM project are the subject of this paper.

An understanding of behaviour as context-dependent entails a focus on learning. Energy intermediaries as DSM project implementers need to learn about their target group, the (social) context of their project, other stakeholders' role and motives, and about their own role as facilitators for change. However, this learning cannot remain one-sided. The target group needs to reflect (i.e. learn) about its current behaviour and its possibilities and motivations for change. Due to the fact that often contextual changes are required to stimulate change, stakeholders may need to get insight into their possibilities and motivations to support such change. In other words, a social learning process should take place in order for change to happen and to be long-lasting.

Within the context of a single DSM project, social learning processes can be analysed in terms of single and double-loop learning. Single-loop learning is concerned with the effectiveness and efficiency of intervention instruments to bring about the targeted behavioural change. Hereby, project goals and problem definition are pre-defined and remain uncontested. Double-loop learning involves reflection on the context-dependency of behavioural change. From the perspective of the project implementer double-loop learning means learning about prevailing norms and rules underlying the defined problem and gaining an understanding how current infrastructures, institutions, knowledge and conventions sustain the problem to be solved (i.e. targeted behaviour). During project implementation, the intermediary aims to involve actors in such a way that new infrastructures, institutions, knowledge, and frames of thinking can give rise to behavioural change. Double-loop learning implies a reflexive understanding about intermediary work and the intermediary as part of the context the targeted behaviour is embedded in. In other words, double-loop learning is a form of continuous and collective learning in which project goals and ways to achieve them emerge in stakeholder negotiations. By aiming at contextual change able to sustain new practices, this type of learning is also concerned with long-term achievements, beyond project targets (Breukers et al. 2009). Table 1 provides an overview of single and double-loop characteristics:

Type of learning	single-loop	double-loop
who learns	intermediary	intermediary, target group, stakeholders
about what	effectiveness and efficiency of intervention instruments	context-embeddedness of behavioural change and ways to adapt context in order to stimulate and sustain change
how	evaluation of energy consumption data or evaluation of 'softer' targets measuring effectiveness and efficiency of intervention (e.g. number of project participants)	(together with target group and stakeholders) reflection on problem definition and ways to collectively achieve long-lasting change

Table 1: Summary of 'who learns', 'what' and 'how' in the case of single and double-loop learning

Both types of learning have been found conducive to success as both deliver important insights to the much needed improvement of DSM programmes (Breukers et al. 2009). Additionally, both types of learning can take place on an actor and network level. On the one hand, the project implementing intermediary can be subject to one or both types of learning, which may lead to changes in further project implementation or work approaches in future projects. On the other hand, the network of organisations and people involved in the project can collectively undergo single and double-loop learning, with a convergent learning effect how to solve the problem the project aims to tackle (van Mierlo, Arkesteijn & Leeuwis 2010). Therefore, the research project Changing Behaviour set out to find ways to support single and double-loop learning in the practical work of energy intermediaries implementing DSM projects. The resulting 'toolkit' contains practical activities accompanied by relevant background information for intermediaries to support all project phases: design, implementation and evaluation. During the research project preliminary versions of these activities were tested in six pilot projects, each set in a different country and making use of different intervention methods. Considering the importance accredited to

learning, this paper aims to analyse in how far learning has occurred and whether its occurrence can largely be attributed to the toolkit activities. In the following, the approach to analysis is discussed.

Methodology – Case study

The paper at hand focuses on one of the six pilot projects carried out in the Changing Behaviour research project. These pilots functioned as test beds for the 'tools' developed to support the practical work of DSM project implementers. Each pilot was implemented by a different intermediary in its own country, supported by a research institute. Therefore, the 'tools' were tested in collaboration of and interaction between the two organisations, enabling an improvement of the 'tools' based on practical experience, on the one hand, and an adaptation of pilot implementing strategies based on 'tool employment', on the other hand. Questions to be answered in this paper with respect to the effectiveness of the Changing Behaviour 'learning tools' are therefore:

1.   Which type of learning has occurred and with what effect?
2.   What was the object of learning, i.e. <u>what</u> did the intermediary learn <u>about</u>?
3.   What was the process of learning, i.e. <u>how</u> did the intermediary learn?

Answers to these questions are based on material collected during pilot implementation. (1) A 'collaboration diary' has been kept to record the progress of the pilot project, the development and testing of the 'learning tools' and interaction between pilot intermediary and research partner (18 A4 pages, covering the period November 2008 until July 2010). (2) An elaborate documentation of pilot implementation was written based on this diary and additional research and pilot partner interaction, aiming to answer questions with respect to how project goals were developed, what implementation strategies were followed, what outcomes were achieved and how pilot progress was monitored and evaluated.

The pilot project under scrutiny took place in the period November 2008 until July 2010 and was implemented in Cēsis and Sigulda, two Latvian cities close to Riga, the Latvian capital. Ekodoma worked as energy intermediary and the Energy research Centre of the Netherlands (ECN) functioned as supporting research partner. The pilot focused on the improvement of energy efficiency in Latvian multi-apartment blocks. Nine buildings participated: four already renovated and five non-renovated ones. Those already renovated were included to learn from their experiences and use them, if possible, as showcases. Those buildings that were not yet renovated were approached in order to bring about a decision-making process towards building renovation. In Latvia, a 51% majority of residents has to support renovation plans to allow their execution. Usually, Latvian multi-apartment buildings are managed by public (municipal) or private building management companies, taking care of maintenance and servicing. Each building has an elder who works as residents' representative and establishes communication between building management company and residents whenever necessary. Ekodoma managed the pilot, was in direct contact with building residents and their building management company. ECN supported this processes as coach on content- and methodology related questions, e.g. by supporting the testing of Changing Behaviour 'tools'.

In order to answer the questions formulated above, indicators for the two types of learning need to be defined (table 2). As mentioned earlier, single and double-loop learning can occur on the single actor level, here analysed from the perspective of the project implementer, and on the network level, comprising all actors involved in the pilot (e.g. implementer, target group, policy makers, other stakeholders). Single-loop learning is in both cases concerned with learning about the intervention instruments employed. Double-loop learning entails on the part of the implementer (actor level) to know about the own role in project implementation and understanding the context-dependency of energy consumption behaviour and behavioural change. The own role and actions are thereby seen as part of

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the (change in) context of pilot implementation. Additionally, work procedures are adapted to integrate some of (the ideas) of Changing Behaviour 'tools'. Learning in particular received (new) attention (i.e. developing a learning culture). On the network level, everyone actively involved in the pilot learns about intervention instruments used (i.e. single-loop learning) and about the necessity of new forms of collaboration in order to achieve desired change.

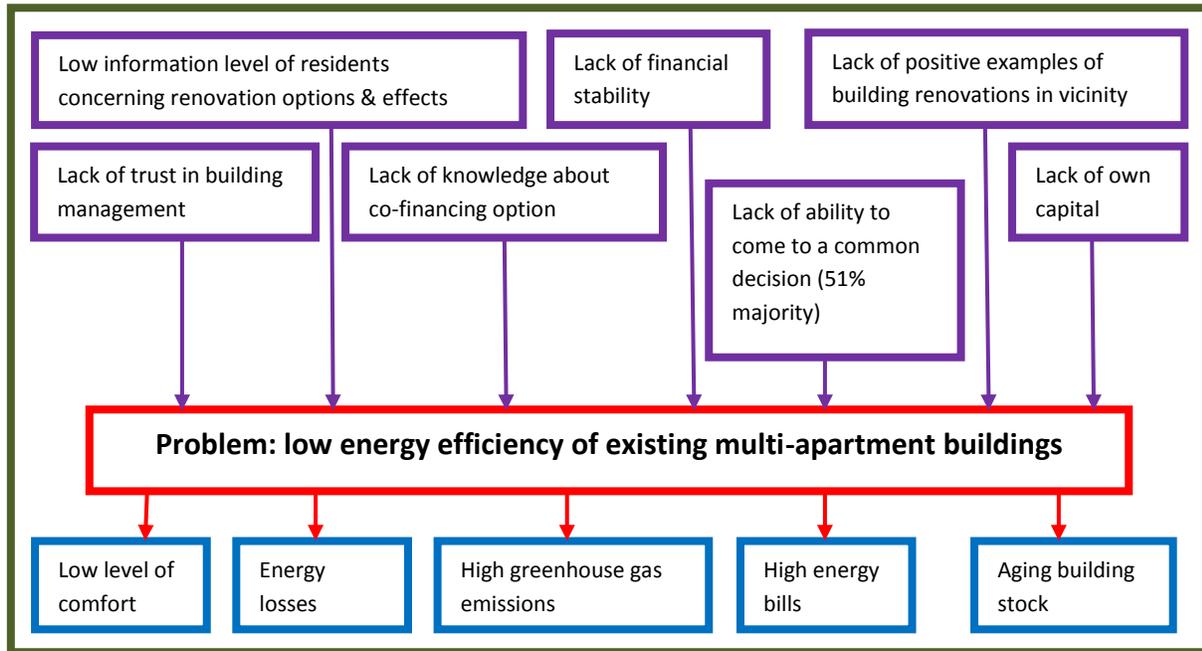| type of learning indicator	single-loop	double-loop
actor level (i.e. intermediary)	improved understanding of effectiveness and efficiency of project (intervention) instruments	improved understanding of own role in project implementation and context dependency of behaviour(al change), developing a learning culture
network level (i.e. everyone involved in DSM project)	convergent learning about effectiveness and efficiency of instruments	understanding of necessity of new forms of collaboration, coordinated action towards common goals

Table 2: indicators for single and double-loop learning on actor and network level

Throughout the process of pilot development and implementation, Changing Behaviour tools were tested in order to increase the context sensitivity of the pilot (and hopefully its success) and in order to report back to the Changing Behaviour research consortium on the usability and usefulness of the tools. For each of the categories shown in the table above, examples or a lack thereof are discussed in the following. Within each category, descriptions will follow a chronological order from early to late stages of pilot implementation.

Intermediary learning in double-loops
Several Changing Behaviour tools were of particular help during an early stage of project development. Initially, Ekodoma, the Latvian intermediary managing the pilot 'energy efficiency for Latvian dwellings', formulated project goals in terms of realised renovation plans and was planning to measure success in saved energy and CO_2 emissions. The tool 'Analyse the problem' revealed the complexity and multi-layeredness of barriers that keep residents from investing in energy efficiency measures for their houses, especially since these decisions are linked to a majority vote in multi-apartment buildings. Figure 1 shows the problem tree Ekodoma filled in to get an better overview of the problem at hand.

In the following, more attention was paid to barriers, such as trust in the building management company and lack of knowledge about the availability of governmental co-financing that keep residents from supporting renovation plans. In collaboration with the pilot research partner, project goals were reformulated to aim at building trust between residents and their building management and facilitating decision-making processes in buildings. The new success criteria still included a monitoring of residents' opinion formation concerning renovation and their support for renovation plans. Instead of energy savings after renovation, two new criteria were set: improved interaction among residents and their building management company, and (a strategy for) the development of renovation plans.

Low information level of residents concerning renovation options & effects	Lack of financial stability	Lack of positive examples of building renovations in vicinity

Lack of trust in building management	Lack of knowledge about co-financing option		Lack of own capital
		Lack of ability to come to a common decision (51% majority)	

Problem: low energy efficiency of existing multi-apartment buildings

Low level of comfort	Energy losses	High greenhouse gas emissions	High energy bills	Aging building stock

*Figure 1: Problem tree filled in by the Latvian intermediary to 'analyse the problem'*

In the beginning, the network of actors to be included in the project comprised a (yet undefined) number of buildings, their building management companies, policy actors from the local municipality and actors from the financial sector with an expertise in loans for planned construction. The tools 'Understanding your existing intermediary network and context' and 'Strategic assessment of partnerships' lead to a change of plans. Instead of a broad and large scale focus, only nine buildings of the same building management company were included. Due to the fact that people's trust in the financial sector was rather low and had taken additional damage caused by the financial crisis starting 2008, no banks were involved at the start. Ekodoma decided that banks could become engaged with the project once trust had been established and collective plans for building renovation had been developed. Policy actors were excluded from the network of actors following the decision to have a small-scale project. Again, these actors could possibly be included or at least informed about the project and its outcomes at a later stage.

After a first analysis of the problem at hand and a decision on the exact target group for the project the tool 'Learn to know your target group' was employed to get more insight into people's needs and concerns and in order to see whether the problem analysis carried out by Ekodoma matched with the target group's perception of the problem. A survey was carried out in eight buildings initially involved in the pilot.[1] Quite substantial help by the research counter partner was required in setting up and organizing the distribution of the survey among residents. Analysis of results was largely conducted by the

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[1] A ninth building of the same building management company joined the pilot shortly after the survey was carried out. The elder of this building had been interested in renovation for a while and had read about the pilot in local media. She contacted her building management company which in turn established contact to Ekodoma. Since the building matched well with the rest of the target group and could profit from its motivated elder, Ekodoma approved its participation.

intermediary, while a translation of survey outcomes to adaptations in project design was accomplished in close collaboration of research and pilot partner.

Four of the buildings included in the survey were already renovated and contacted to learn from their experiences Unfortunately, lack of support by two buildings elders prevented the participation of their buildings in the survey. Missing out on results from these buildings exemplified the importance to first gain elders' trust and support before proceeding with pilot implementation. Since these buildings were both already renovated, no further action was taken to motivate elders and residents to participate in the project. The survey among the four non-renovated buildings revealed a strong concern with current energy costs, comfort level and outer appearance of the building. Their main motivational factor for building renovation was the possibility to reduce energy cost (see figure 2 for answers given in the four non-renovated buildings).
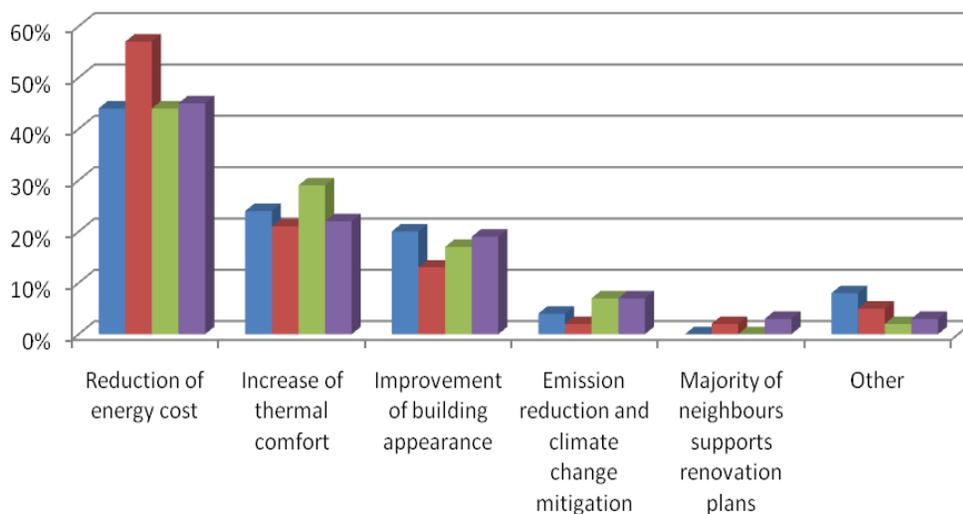
Figure 2: Answers by residents of four different multi-apartment buildings to the question 'why would you support renovation plans for your building?'

Results also supported Ekodoma's idea of the core problem: a lack of trust in information provided by the building management company and a lack of trust in financial institutions. Residents were calling for an independent energy advisor to help them with questions concerning different renovation and financing options. Therefore, Ekodoma decided to focus on information concerning renovation options and costs, financial savings following renovation and other (e.g. increased comfort) consequences, and financing options. Due to the fact, that decision-making concerning renovation developed differently in each of the four buildings, Ekodoma had to find individually-tailored ways to provide support and advice residents were asking for. In other words, Ekodoma learned to define its role as decision-making facilitator in each context differently. Two of the non-renovated buildings dropped out of the process early on. One of them was still paying off a loan for a recently repaired roof-damage and in the other one the elder's support could not be gained. Unfortunately, Ekodoma lacked time and resources at the time to try and increase the elder's sense of urgency and engagement with the pilot. In two other buildings, slow but fruitful progress was made towards reaching agreement. When the pilot ended, residents were willing to invest in renovation of the heating and hot water systems. In the fifth building which joined the pilot slightly later,

consensus was reached comparatively fast to apply for governmental co-financing and implement full renovation (incl. insulation of roof and envelope, heating and hot water system, new windows and doors.) In this building, the elder was a driving force, making many decisions together with the building manager, seeking approval of residents, rather than commonly made decisions. Therefore, Ekodoma learned to support top-down as well as bottom-up decision-making processes in the development of renovation plans. This approach has been shown to be effective as the majority of non-renovated buildings has developed or is developing renovation plans.

The developments presented above show how the pilot project was successively built in relation to its context. In the beginning the design was kept broad and flexible. This flexibility allowed playing with various options and basing the actual design on earlier findings. A general analysis of the problem of low energy efficiency in Latvian multi-apartment buildings helped to sensitise Ekodoma to the issues requiring attention. An analysis of the network of actors to be included in the project resulted in a focus on a small-scale project. The survey among residents delivered insight into people's motivation and concerns. These were taken as point of departure for further communication with residents to build trust among stakeholders, provide tailored energy information and advice and to support decision-making processes on a case-by-case basis. Hence, each step of the project helped shaping the following.

The actions taken in between steps were supported by Changing Behaviour tools and interaction between pilot and research counter partner. The tools were employed collaboratively and results were also analysed and discussed by both partners in regular telephone meetings. The geographical distance between the pilot implementer in Latvia and the research institute in the Netherlands hampered a very active involvement of the Dutch partner in the pilot. However, the distance enabled the Dutch partner to take on a 'coaching' role to help with practical guidance.

Intermediary learning in single-loops

Intervention instruments were improved successively with great appreciation of context, suggestions and previous progress made in the project. The Latvian pilot project manager Ekodoma learned to improve the efficiency and effectiveness of intervention instruments used. The main instrument was communication with building elders, building managers and residents in phone calls and personal meetings. Each of these meetings was carefully planned, often in cooperation with the research counter partner. Ekodoma flexibly integrated the Changing Behaviour tools and their outcomes into te planning of communication interventions. Additional suggestions received by the Changing Behaviour consortium, for example at project meetings, were also taken into account. For instance, other project partners suggested to use images to communicate to residents and to start informing people about bad consequences if no decision on renovation could be reached. The intermediary also responded flexibly to progress made in the three buildings actively involved in the project, always providing the information requested by residents or the building management company. In other words, Ekodoma learned to improve the effectiveness and efficiency of intervention instruments as the project was ongoing.

Two other important intervention instruments which also informed project design and evaluation were two surveys carried out among residents. The first one aiming to learn about the target group's initial opinion, knowledge and concerns with respect to renovation has been discussed above. A second survey was developed in the end in order to re-assess residents' (changes in) opinions, knowledge and concerns and to evaluate the impact of the pilot intervention. The construction and carrying out of these surveys was not straightforward for the pilot intermediary. Ekodoma greatly underestimated the time it takes to

carry out a survey and required substantial help by its research counter partner in the development and reporting of survey results. Thereby, Ekodoma experienced a steep learning curve with respect to this particular intervention instrument to learn about a target group and to evaluate the impact intervention actions have had on people's opinions, knowledge and concerns.

Ekodoma reported an improved understanding for the necessity to include the target group in project design and to cater to people's needs and requirements. Additionally, Ekodoma voiced during a phone call with the research partner quite late in the implementation phase, while reflecting on the pilot as intervention, that governmental financing of building renovation will never suffice to bring about desired changes. Instead, energy advisors (like Ekodoma itself) are required to act as mediator between parties involved in decision-making and as facilitator to arrive at decision by providing relevant information. This remark revealed a much better understanding of intervention instruments required to renovate the Latvian building stock, including the realization of the own role one can play as energy advisor in this process.

Network learning in double-loops
During the pilot project the collaboration between Ekodoma, the project implementing intermediary, and the building management company of all buildings involved in the project increased significantly. The first meeting for all residents involved in the pilot was hardly successful. Ekodoma had prepared the meeting alone, without consulting the research partner, the building management company or the Changing Behaviour tools which provide suggestions for target group interaction. The building management was invited to give a presentation showing possible benefits of building renovation and the research counter partner was present to inform residents about the pilot and its relation to the overall research project Changing Behaviour. Both organisations were only informed about the contents of the meeting two days in advance, with no time or room left to change plans. Few residents attended the meeting and in between the many presentations planned, little interaction with residents was possible. The little feedback and few questions voiced by residents were rather negative, loaded with unsubstantiated hearsay about renovation cost, bad construction works and little effectiveness of renovations. After this experience, all parties realised that communication with residents needs to be personal, but should be dealt with differently.

In the following, Ekodoma interacted with the building management company and the research counter partner at least once a week in order to discuss recent developments and plan further steps to be taken. Each time a meeting with residents was organised, Ekodoma discussed with these two organisations the contents and set-up of the meeting. Thereby, the research partner helped to stay in line with suggestions made by the Changing Behaviour toolkit, e.g. to keep a focus of information presented on co-benefits of renovation relevant to residents. The building management company was able to control the different renovation options offered to residents. In the interaction preceding and following these meetings, all organisations involved learned about effective cooperation and strategic cooperation towards common goals.

Additionally, Ekodoma considered the toolkit advice to not only tailor information content but also delivery to the target group's need. Building elders were asked for advice how to best organise meetings with residents. As a result, the get-togethers to discuss renovation for one of the buildings were always held in the building stair case. Residents were used to this, because important decisions for the building were always discussed in this setting. This approach proved to be a great improvement, as almost all residents showed up at meetings and the interaction between everyone present increased significantly.

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Renovation plans and financing options were discussed actively and agreement emerged slowly. This event was also an eye-opener for the building management company.

Based on this project, the collaboration between Ekodoma and the building management company continues. The building management realised the importance of an independent energy advisor in gaining residents' trust and support. In other buildings where plans are developed, Ekodoma is included to conduct energy audits and discuss results and possible actions with residents. At a large meeting of residents of all buildings managed by the same company in the Latvian town Cēsis where also local and regional policy makers were present, the pilot was presented and Ekodoma was invited to share its experiences. These events following the pilot project indicate a learning effect on the network level. Ekodoma is aware of its dependence on the support of building management companies to gain access to Latvian buildings and support building renovation. The building management company values the expertise and trust-building measures Ekodoma can add to discussions with residents and residents value information provided by an independent advisor.

Network learning in single-loops

Following the descriptions above it becomes clear that all actors involved in the pilot learned about how to tailor the intervention instrument 'providing energy advice' to a specific context and thereby improve its effect. Ekodoma gained improved understanding of how and what to discuss with respect to energy efficiency and renovation options with residents. The building management company underwent the same learning process. This learning effect may play a role in future collaboration of these two organisations.

Relation of single and double-loop learning

The case study presented in this paper indicates that double-loop learning may be a prerequisite for single-loop learning to occur. Improving the effectiveness of intervention instruments (i.e. single-loop learning) was always forgone by an improved understanding of own or other actors' role, concerns and aims (i.e. double-loop learning). The pilot implementer Ekodoma, for example, aimed to effectively and efficiently support decision-making processes toward building renovation (i.e. single-loop learning) and managed to do so in the majority of buildings participating in the pilot by using the own role and position to strengthen trust between actors, by tailoring advice to residents' needs and concerns and by supporting the development of mutual interests (i.e. double-loop learning). This success was based on frequent exchange of information and ideas among all stakeholders (i.e. Ekodoma, elders, building managers, residents).

Increased effectiveness of the intervention could be achieved by stronger collaboration of different actors in order to find out and provide in more detail the information residents require. The same holds for efficiency: more frequent interaction among stakeholders may have cost more time and money but it facilitated processes that were better targeted at the specific needs of residents in one building. Prerequisite for both types of learning was therefore a strong working relationship based on trust among project partners.

The rather small size of the target group chosen for the project may have greatly contributed to the occurrence and effect of double-loop learning, thereby also allowing single-loop learning to occur. The focus on only five non-renovated buildings, three of which remained active throughout the project allowed close and in-depth interaction with residents also over a longer period of time and tailor-made advice for

each building individually. Residents' questions, problems and suggestions could be much better integrated into information sessions.

Discussion and conclusions

This paper set out to show the importance of learning in demand-side management projects in order to achieve behavioural changes. The effectiveness of learning tools to bring about such learning was discussed by means of a case study pilot project. Social learning processes need to take place to understand the context-dependency of behaviour and to bring about its change. Energy intermediaries as DSM project implementer need to be the driving force and facilitator of such learning processes. They need a thorough understanding of the problem and the target group to design a project tailored to people's needs and motivations. In addition, there are usually other actors whose support is needed to enable the stimulation and implementation of change. The target group itself needs to learn what factors influence its current behaviour and how changes can be achieved.

The Changing Behaviour toolkit has been developed to support energy intermediaries in their own and in bringing about learning processes in others. Social learning processes can be analysed in terms of single and double-loop learning. Indicators for the occurrence of either type of learning have been tested against experiences made in a Changing Behaviour case study. Single and double-loop learning have occurred on the level of the pilot project implementer as well as on the level of all organisations actively involved in pilot implementation. In other words, the Changing Behaviour tools have contributed to social learning and successful project implementation. The intermediary learned to tailor the pilot project to the target group's needs and requirements. At the same time, a learning process in an important stakeholder, the building management company, was set in motion. By the end of the project both organisations have realised the importance of trust building measures and independent advice for changes in investment behaviour for building renovation. Further plans for collaboration were already under development at the end of the pilot.

However, the discussion at hand has also shown that solely providing 'tools' to support learning may not be sufficient. The pilot manager was influenced by the research project Changing Behaviour in general, and strongly supported by a research counter partner throughout the process of project development and implementation. The research counter partner coached the pilot implementer through the application of Changing Behaviour tools. At times, for example in conducting a survey among the target group, more support than plain guidance was required. One reason why the practical employment of the 'tools' may have been difficult is a lack of time to read about and learn how to use and then implement the tools. The example of the survey also hints at a lack of knowledge with respect to the use of tools to learn about the target group, which is hardly surprising considering that the pilot implementer had a technical and not a social scientific background. The many phone conversations planning and reflecting on meetings with the target group revealed that the project implementer required feedback from someone slightly detached from practical project implementation in order to reflect on ongoing processes and consider different approaches to target group interaction.

The experiences analysed support the conception of learning as a social and intersubjective activity. Considering the importance of learning, the Changing Behaviour 'tools' encourage frequent interaction among project stakeholders in order to enable exchange of concerns and ideas. For some projects, the 'tools' provided may be too rigid in the interaction they aim to stimulate. Therefore, they should be employed flexibly, adjusted to the particular needs of project implementers. In the pilot project

described here, the research counter partner tailored the 'tools' to the project implementer's needs, by pointing out the particularly relevant ones, by practically supporting their employment and by providing feedback to the implementer's actions based on knowledge provided in the 'tools'. Thereby, the actions of the research counter partner became interwoven with actions triggered by the 'tools', rendering an analysis of the effectiveness of the 'tools' alone impossible.

Furthermore, exact monitoring and evaluation of the learning occurred in the project also proved to be difficult. Some effects of double-loop learning processes (e.g. an increase of trust in information provided regarding building renovation) could indeed be found in the target group by means of a survey. For other effects could only be found hints, for example for an increased understanding of the building management company to use trust building measures to facilitate decision-making processes. The question whether a 'learning culture' has developed has to remain unanswered because the new approaches to project design and implementation during the pilot resulted from 'tools' and interaction with the Changing Behaviour project. Only future projects can show whether these approaches that include a focus on learning with and about project stakeholders will persist.

References

Breukers, S. et al. 2009. *Interaction schemes for successful energy demand side management. Building blocks for a practicable and conceptual framework.* Deliverable 5 of the Changing Behaviour project. http://energychange.info/deliverables.

Dietz, T., G.T. Gardner, J. Gilligan, P.C. Stern, and M.P. Vandenbergh. 2009. Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences of the United States of America*. http://www.pnas.org/content/106/44/18452. (accessed May 5, 2010).

Geels, F.W. 2005. The Dynamics of Transitions in Socio-technical Systems: A Multi-level Analysis of the Transition Pathway from Horse-drawn Carriages to Automobiles (1860-1930). *Technology Analysis & Strategic Management*. 17(4): 445-476.

Moss, T. 2009. Intermediaries and the governance of sociotechnical networks in transition. *Environment and Planning A.* 41: 1480-1495.

Moss, T., W. Medd, S. Guy, and S. Marvin. 2009. Organising water: The hidden role of intermediary work, *Water Alternatives.* 2(1): 16-33.

Shove, E. 2003. Converging conventions of comfort, cleanliness and convenience. Journal of Consumer Policy, 26, 395-418.

Van Lente, H., M. Hekkert, R. Smits, and B. van Wavern. 2003. Roles of systemic intermediaries in transition processes. *International Journal of Innovation Management.* 7(3): 1-33.

Van Mierlo, B., M. Arkensteijn, & C. Leeuwis. 2010. Enhancing the Reflexivity of system Innovation Projects With System Analyses. *American Journal of Evaluation* 31 (2): 143-161.

Wilhite, H., E. Shove, L. Lutzenhiser and W. Kempton. 2000. The Legacy of Twenty Years of Energy Demand Management: we know more about Individual Behaviour but next to Nothing about

Demand. pp. 109-126 in E. Jochem et al. (Eds.) *Society, Behaviour, and Climate Change Mitigation*. Dordrecht: Kluwer Academic Publishers.