LEARNING AS PART OF UP-SCALING INNOVATIONS

1   Introduction

1.1 Scaling-up complex collaboration processes

The realisation that buildings consume a very large proportion of our fossil fuels worldwide has prompted numerous ideas and initiatives for reducing this consumption substantially (e.g. Mlecnik (2011), Oostra (2011)). In practice, however, it has proved a difficult challenge. The performance of specific measures such as installing insulating material or double glazing must be assessed in their overall context and their implications for aspects such as comfort, health and the nuisance caused while implementing them must be considered. This means a need for integrated, tailored packages of measures and thus collaboration between providers. Many initiatives that are launched never proceed beyond the initial pilot phase and are not scaled up to the mainstream. In the knowledge that consumers show relatively little interest in energy saving (Emmert et al., 2010) and that the market for energy-related innovations is not fully mature (Sandick and Oostra, 2010), it is important to investigate how the up-scaling of these innovations can be more successful.

Scaling-up of innovations is a complex and risky process. It cannot be controlled, but basic conditions can be created to increase the chance of success (Sandick and Oostra, 2010). Up-scaling can be seen as a series of learning processes of the different actors involved (Raven et al., 2008).

1.2 Aim of the paper

This paper discusses how the chances of successfully scaling-up innovations can be increased by encouraging the actors involved to learn during the process**.** A framework is introduced to

systemically monitor learning processes among the actors that are jointly involved in scaling-up innovations. The framework is based on theories of learning processes and theories of up-scaling innovations. The case E.nu (2008-2010) is used as an example to illustrate the learning framework.

1.3 The case E.nu

E.nu is an initiative in which research and projects are carried out with consortia of contractors in the building renovation and maintenance market in the Netherlands. A cooperative is set up to operate in a specific region and sell their services jointly to clients. A consortium can include an electrical contractor, a plumbing contractor, a building company, an Energy Performance Advice consultant, an architect, an insulation company, a glazier, etc. The consortium can also form partnerships with companies that can provide additional expertise, skills and/or competences. There are currently 18 regional clusters.

The next paragraph discusses the theoretical basis resulting in a framework for learning. The following paragraph applies the framework to E.nu. Here the different forms of learning are illustrated and the practical implementation of the framework is discussed. Paragraph 4 then presents some general conclusions.

2 Theoretical framework

2.1 Scaling-up of system innovations

Central to this paper are the concepts of learning processes leading to the scaling-up of innovations to wider application.

We use the term *innovation* in the broad sense, defined by Rogers (2005) as anything that can be regarded as new. It can be a product, a process or a complex combination of the two, but also a new method of cooperation. It is new if it is new for the organisations concerned. The type of innovation that E.nu is engaged in is also known as a system innovation (Rotmans, 2005). System refers here to the entire population of consumers, companies and organisations that have organised themselves in a sector, a domain or a region (Klein Woolthuis et al., 2005). We refer to a system innovation if a particular (social) need is fulfilled in a fundamentally different way than previously (Bosch, van den, 2010). The innovation E.nu is currently engaged in, is regarded as a system innovation, since the entire system as it exists is being reformed. Ultimately, the clients will ask other questions, the companies will supply other products and services and new partnerships will be needed between these companies. The financing of energy-efficient facilities will be modernised with the support of the government and financial institutions (Oostra, 2011).

When we speak of *scaling-up*, we are talking about changes in various domains that evolve from a single application, to wider application and ultimately to general use (from a niche to mainstream). Van den Bosch (2010) describes it as a development where innovations produced on a small scale expand into a dominant new way of thinking, working and organising.

Scaling-up innovations is often a lengthy process. In the construction industry, for example, there was a study of the process of the scaling-up of high-yield central heating boilers (Brezet, 1992). It took ten years after the high-yield boiler had been developed to scale up. Up-scaling takes a long time and it is an unpredictable and risky process. Many parties are involved, with often no single party that drives it.

2.2   The role of learning in the scaling-up of innovations

Scaling-up involves securing the wider adoption of innovations that have already been used. The knowledge possessed by a small group of people has to be disseminated to a larger group. As we mentioned before, scaling-up innovations can also be seen as a series of learning processes in which various actors develop new methods of thinking, acting and organising. Learning is an active process of acquiring and developing new knowledge, skills, standards and values, and applying them in practice, leading to different behaviour (Raven et al., 2008). The new knowledge, skills and standards are translated into new products, processes and services, but also into new organisational structures, new rules, etc.

2.3   Types of learning processes

There has been a lot of research into how individuals learn and how organisations and networks learn. A lot of emphasis has been placed on the specific experience which forms the basis for learning (Kolb, 1984). The model of Kolb is important in relation to scaling-up innovations because it focuses more on the relationship between acquiring knowledge and taking action and less on the passive absorption of knowledge.

The concept of single-loop and double-loop learning (Agyris and Schön, 1978) is even more relevant for up-scaling of complex innovations. In innovative projects established patterns of action and thought are punctured. These patterns are often unexpressed and implicit. Bringing

these established patterns to the surface and reflecting on them can reveal new possibilities and opportunities, which is what is needed for innovation.

Single-loop learning focuses on the immediate solution of a problem. The problems addressed by single-loop learning arise within existing frameworks. The problems have often already been reflected on; someone has already learned about them, but now more people are going to learn.

Double-loop learning involves studying the patterns underlying a problem and finding new frameworks and basic conditions for a fundamental solution of the problem. With double-loop learning the established patterns of thought are identified and questioned. Double-loop learning often occurs in response to unanticipated situations or crises, which causes people to abandon their certainties. Consequently, double-loop learning leads to major changes. It is important to observe that people learn either because of an urgent need, for example a crisis situation, or because they are driven by a strong desire, for example an interesting future opportunity.

Both types of learning process are involved in the scaling-up of innovations. Scaling-up calls for new frameworks and preconditions, which produce new ways of thinking and acting (double-loop learning). Single-loop learning is important for disseminating the knowledge, although that is a slightly simplistic way of presenting it. Within the new frameworks, knowledge and expertise will be developed and transferred by means of single-loop learning.

2.4   Learning process at various levels

Learning processes occur at different levels. Four levels can be distinguished:

1.   The individuals who learn in the organisation;

2.   Learning in the organisation: learning about subjects within the organisation itself;

3. Network learning: organisations jointly learn how to collaborate and innovate with each other.

4. The entire innovation system learns about the innovations.

2.4.1 *Individual learning*

Individual learning forms the basis of every innovation. The learning can encompass various levels. On the mental level, for example, individuals can learn because feelings of opposition, fear or powerlessness are transformed into a feeling of confidence, which causes people's behaviour to change. With regard to the ratio, individuals learn about technical solutions, language and other subjects. And people also learn new skills, such as how to operate a new telephone, how to approach a customer or generate enthusiasm among tenants.

As Loeber et al. (2007) have remarked, the learning process is usually initiated by interaction between individuals. This is connected with the fact that the problem is brought home to people more if they are in a group. Loeber et al. even assume that interaction with other people is essential for double-loop learning because it is then no longer possible to cling to presumptions and established opinions. People with a different perspective or who suffer more from the problem, in particular, can be so confrontational that it is impossible to avoid discussing your fixed ideas.

2.4.2 *Learning in the organisations*

Organisational learning is more than the sum of the learning by the individual employees of the organisation concerned, because the organisation itself learns. For example the organisation learns from the change in what the individuals want, but also through the prevailing standards and values in the organisation. Standards and values evolve through the collective consciousness, and are more or less automatically passed on to future generations (the culture in the organisation, its external reputation, etc.) (Lawrence and Dyer, 1983).

Other examples of knowledge generated at the organisation level in up-scaling processes are new business strategies and new ways how processes are organised. An important element of organisational learning is the dissemination of knowledge (Nonaka and Takeuchi, 1995). The learning is only effective if the lessons learned are communicated to all of the employees in the organisation who have to adopt the innovation.

2.4.3   *Network learning*

Learning at network level focuses on new forms of cooperation, new working methods, but also, for example, on generating new ideas for solving shared problems. In E.nu, for example, four or five companies work together as partners in a single region. This means that they will have to formulate a joint strategy and make agreements on the allocation of tasks, for example. Learning at network level is similar to learning at organisational level.

An important distinction however is that a network is far more loosely organised, which means that learning processes are far less structured. The instruments employed to promote learning will therefore have to be designed to establish and maintain interaction between people and organisations (Spekman et al., 2002).

2.4.4   *Innovation system learning*

In section 2.1 the innovation system was introduced. Learning on this level means that the actors, like companies and institutions, learn new ways of working together and make changes in the rules and customs and the infrastructure.

Learning processes in the innovation system are even less organised than in a network. An innovation system usually has no structure or organisation at all. Loeber et al. (2007) argue that the effectiveness of learning processes in innovation systems is determined mainly by the relationships between suppliers and consumers and the impact of policy. Where this system does not function optimally, innovations will require changes in the frameworks. In other

words, a process of double-loop learning will be required to raise questions about the existing frameworks. At system level this type of learning calls for new instruments which bring the parties in the innovation system into contact in new ways. Incremental innovations (which fit within existing frameworks) can find their way to the market with single-loop learning and traditional instruments can support them. System innovations call for a different type of learning between the actors, and hence different instruments. With system innovations, it is mainly double-loop learning that should be promoted.

2.5   Support for learning

Table I below sums up the characteristics of single-loop and double-loop learning (Agyris and Schön, 1978).

Table I. Characteristics single-loop and double-loop learning

Single-loop learning	Double-loop learning
• direct solution of a problem • within existing frameworks • Someone has already solved the problem • Consultation of existing knowledge in written sources plays a major role • Aimed at disseminating and publicizing knowledge	• Research into patterns underlying the problem • Finding new frameworks and basic conditions • Explicitly addressing assumptions; • Consequently, it is deep and fundamental • Arises in unexpected situations and crises • Trial and error, only then try to discover patterns • Results in a radical change, breakthrough

Table II differentiates single-loop from double-loop learning on the different levels mentioned. Special features of the various types of learning process at the different levels will

be given, including some examples and points to consider. The points to consider for single-loop learning are also valid for double-loop learning. In this table we summarised the theoretical knowledge and complement it with practical experience from the E.nu project. The purpose of this table is to provide a framework for designing and monitoring learning processes.

Table II **Points to consider and examples of learning aimed at scaling-up**

Type of learning process / Level of learning	**Single-loop learning**	**Double-loop learning**
Individual Targeted at development at individual level	*Points to consider:* — Match to individual learning styles — Make time to prepare an action plan Examples: — All type of traditional educations — Experience — Thinking — Reading manuals — Training-on-the-job — Learning-by-doing	Concerning fundamental developments at personal level, for example, development of new competences, new ways of thinking, etc. *Points to consider:* — Organise feedback loops, for example through written exercises, coaching etc — Leave time and opportunity for reflection Examples: — Coaching — Intervision — Community of practice (Duijn, 2009)
Organisation Aimed at recording, saving, transferring and providing access to the knowledge available within the organisation so that it can be used for the organisation in the future	Disseminating knowledge within the existing strategy *Points to consider:* — Should again be matched to learning styles — Adapt learning to priorities. *Examples:* — Training people within existing competence profiles — Analysing and correcting mistakes (quality management) — Knowledge management, recording knowledge in databases, etc. — Recording procedures, etc.	Developing a new strategy, working methods, new business *Points to consider:* — Allow scope to depart from the standard during the development phase — Secure commitment from the management for the process and results — Ensure the strategy is anchored in the organisation — Arrange for transfer to others; — Ensure it leads to permanent change — Reward the additional effort *Examples:* — Allow development outside the established procedures, working methods in a small group ("skunk works") — Community of practice (Duijn, 2009) — Learning History, to gain a thorough understanding of what has been accomplished (Willems et al., 2009)

Level of learning	Single-loop learning	Double-loop learning
Network Method of organisation is looser, hence learning is less structured that at previous levels	Main purpose is dissemination of knowledge *Points to consider* − Instruments must facilitate interaction between people (how do you convince people, you can't compel them) − It is important to closely monitor the relationship of the stakeholders with your own organisation *Examples:* − presentations, − education and training courses − and conferences; − Documenting procedures − Approaches, tools etc, methods of making knowledge transferable − Certification − 'Joint fact finding'; profiting from all available knowledge	Main purpose is developing new strategies, new methods of cooperation, developing a vision *Points to consider* − Willingness to evaluate your own role; − Mutual dependence is important − Ability to provide certainty, establish confidence − Participants are convinced of their added value, have an open attitude − Rewarding innovative behaviour (with additional budget, projects, PR, etc.) *Examples:* − Joint formulation of objectives and vision − Transition experiments as a learning tool (Bosch, van den, 2010) − Tools, such as vision creation, backcasting, − Reflexive monitoring (van Mierlo et al., 2010) − Learning History (Willems et al., 2009)
Innovation system Generally less organised than networks	Main purpose is dissemination of knowledge *Points to consider:* − Sense of urgency for joint action − Common goal − Synergy, distinct added value for each other − The gap in knowledge and competences must not be too great or too small, overlap is needed to initiate cooperation − Common view of what needs to be done − Understanding of your own potential contribution *Examples (see also above)* − Marketing communication is important to reach consumers − Books, internet tools etc. to disseminate existing knowledge − Congresses − Visits to pilot projects	Double-loop learning is necessary, in particular, if the innovation system fails and frameworks therefore have to be changed. *Points to consider:* − Special attention to learning between the actors − Learning process must identify the interaction between system elements and the changes (system thinking, understanding how the system works, what effect actions have on each other) − Developing new frameworks that change the entire context of the system, and hence facilitate a change of behaviour in a large group − Choice between starting from a niche (small parties, which are flexible but not very influential) or from the mainstream (influential parties, which may suffer badly from lock-ins) *Examples:* − see examples network learning

3   Learning framework applied to E.nu

3.1 Learning about collaboration

Central in the processes of learning within E.nu is realising collaboration in supply chains to implement energy-measures. In the learning process all sorts of questions in relation to collaboration have to be addressed, both within a specific E.nu region (e.g. who will approach the client?) and between the E.nu regions (e.g. how will investments be distributed among the partners?). Collaboration makes it possible to upscale energy-saving measures. In this process other questions emerge, for example how to make pro's and con's of alternative approaches transparent to clients, how to improve the performance of heath pumps and how to organise work on site to minimise nuisance?

3.2 How is learning taking place?

All forms of learning mentioned in the learning framework E.nu uses or plans to use, some examples:

At the *individual level* single-loop learning takes place in all sorts of ways, through knowledge transfer during joint E.nu meetings, joint concept development projects with TNO, through sessions with Syntens on collaboration and through conversations with clients about E.nu's approach etc. Double-loop learning was enhanced by sharing experiences and reflection on personal actions during joint E.nu sessions for chairmen. The participants in development meetings and sessions on collaboration were also likely to experience double-loop learning.

At the *level of the organisation* single-loop learning took place by sharing experiences and new insights of individuals in the organisation. This resulted in changes in organisational quality management systems, knowledge management systems or into new procedures. Single-loop learning at *network level* included 'joint fact finding', for example by jointly

examining what subjects need to be explored in more depth, what topics need to be addressed in courses and, in time, certification. This happened by forming dedicated teams around specific items, e.g. marketing. This team jointly developed formats for marketing, website, house-style and publicity materials for customers. Double-loop learning at the level of a network occurred when participants worked jointly on the formulation of the goal and a vision. An example is the discussion and reflection on the E.nu approach in the steering group.

An example of single-loop learning at *system level*, beyond the boundaries of the E.nu network, and directly influencing the potential and the functioning of E.nu, is conceiving alternative technical concepts fitting in with the conditions of Green financing. This enables the offering of Green financing with the E.nu method. Existing concepts did not match them. Double-loop learning took place e.g. in a discussion on societal costs and benefits with a local authority. This kind of reflection on the innovation system exposes changes that are necessary to support E.nu coalitions. When this leads the system actors to make strategic changes, it is referred to as double-loop learning.

3.3 Experiences with learning in the E.nu project

The role of the companies changes dramatically within E.nu, from installing a heating boiler, to advising clients about energy savings in general. For the company, important competences are now the so-called 'soft' competences, such as interviewing techniques, the ability to ask the right questions, empathising with the client, and explaining things clearly in terms that the client can understand. That calls for double-loop learning, because it is a fundamentally different way of acting for the company. This makes the companies uncomfortable and uncertain. It helps when E.nu regions and the organisations involved can gain a greater

understanding why they should change and have discovered for themselves the need to do so in order to make progress.

There are a lot of issues that require time and resources. The more tangible they are and the more they are related to existing knowledge, expertise, interest and influence, the more likely it is the issue will be addressed by one of the E.nu partners. Double-loop learning explores the reasons for a change in more depth and is intended to bring about more fundamental change. The risks involved are also greater, outcomes are not yet clear, and it usually calls for greater patience from those involved. A practical learning experience from E.nu is that companies have a natural preference for single-loop learning processes. This means double-loop learning issues need extra attention. This was especially important, since the participation of the companies in E.nu is voluntary. The direct involvement of clients in the development processes proved to be a powerful tool in double-loop learning. Client involvement helped in exploring issues outside the normal scope in the development process, thereby opening up opportunities to create additional customer value. For example, housing cooperations indicated that the attention should be on ways to extend active involvement of renters in stead on the technical issues.

Within the network different islands of innovation will emerge. For example, a team within E.nu develops a way how to meet the conditions of green financing while another is making an overview of the costs for different concepts. Knowledge transfer between these islands does not happen automatically. These islands should actively be linked in order to embed the innovation in the new system.

One could also conclude that single-loop and double-loop learning needs to be matched. When it becomes clear via double-loop learning change is necessary, time and resources have to be put in place to investigate the consequences. It is important to translate this change into what it means in more tangible terms (single-loop learning), to keep people committed. If this

moment of insight is not captured, momentum is lost and people will shift their focus to other issues that need to be addressed.

The experience is that sometimes all learning activities can cause feelings of chaos and confusion. Especially in a situation in which it is impossible to oversee the consequences. It is therefore important to map how all necessary learning efforts and innovations fit together in order to regain overview and control.

In general the expectation companies had while getting involved in E.nu, did not match with reality. The investments in resources, manpower and additional efforts that appeared to be necessary were higher, and the time it took getting everything ready-to-market was longer than initially anticipated. It may have actually scared parties away if they would have had a realistic expectation. More time was needed as well for the dissemination of the lessons learned within the network. If the chairman of an E.nu region understands the need for change and its implications as a result of a meeting or discussion, the other E.nu partners in his region, and their employees are still unaware of these lessons. Additional efforts have to be made to include learning on all levels within the E.nu network and this takes time.

It became clear that there was a big difference between knowledge and professionalism of the different companies caused by different interests, ambitions, background and size of the organisations. The frontrunners had to share their knowledge with the other companies. Interests, ambitions and character had to match for companies in order to establish collaboration.

4 Final conclusions

Firstly, this paper structures current knowledge and theory on learning as essential ingredient in up-scaling of innovations. By integrating theory on learning in a framework this paper

provides a solid basis to reflect on learning processes that prove to be essential in the up-scaling of innovations in construction. By fleshing out a list to structure learning and comparing it with the levels and types of learning appropriate to its own objectives, initiatives like E.nu can monitor whether learning occurs at all different levels. With this framework they can discover gaps in the types of learning. It can therefore be used to support learning in the scaling-up process. Learning processes in the context of up-scaling are however, complex, unpredictable and not controllable. This framework on learning is not claiming to be some sort of dash board, which can be used for steering the up-scaling process. It is a tool to systemize reflection. The findings from such an exercise can be used to highlight points that need to be addressed to strengthen the learning capacity for scaling-up.

From the theory about innovation and learning it is known that double-loop learning is important in change processes for parties aiming at system innovation. Especially when the initial initiative for change arises from a social objective, where by definition the gains will not be immediate but in the longer term, a form of double-loop learning is important for creating new awareness among stakeholders that are open to a fundamental change. In practice it seems, as we learned from the case E.nu, that this creates tension with the stakeholders that are more focused on single-loop learning. They want to learn and grow, but prefer to apply it and cash in soon. In general, only people with a clear sense of urgency are ready for double-loop learning. A step-by-step approach, with the emphasis on single-loop learning and which closely matches the day-to-day practice of the companies is important for maintaining the commitment of companies. At the same time occasions should be created that can provide double-loop lessons at a scale that is manageable for them. To supply knowledge and skills when they've reached the understanding that the change they are going to make is necessary. By sharing successes the participants can steadily gain a clearer understanding of

the possibilities, which will in turn increase their willingness to implement. The gradual path therefore seems the most appropriate route.

One last remark on a pitfall that could easily occur, while using the learning framework, is a patronizing attitude. It is very easy to criticise others for missing learning opportunities. It is much more difficult to see your own blind spots. What should be kept in mind is that necessary knowledge is scattered among all different stakeholders. Double-loop learning of all participants is required. This means everything should be open for discussion, also your own role. Therefore, trust and an open atmosphere are of utmost importance, enabling everyone to question everything as a means for mutual learning.

References

Argyris, C. and Schon, D. (1978), *Organizational Learning: a Theory of Action Perspective*, Reading, Mass: Addison-Wesley

Bosch, S.J.M. van den (2010), *Transition experiments, Exploring societal changes towards Sustainability*, Doctoral Thesis, Erasmus University Rotterdam, Rotterdam

Brezet, H. (1994), *Van prototype tot standaard. De diffusie van energiebesparende technologie.* Ph.D. Thesis, Erasmus University Rotterdam, Rotterdam

Coenen, L., Oostra, M. and Sandick, E.H.D. van (2008*), Opschalingscan innovatie voor projectleiders; Oftewel gammageneuzel voor beta's werkend aan projecten op het gebied van duurzame energie*, internal TNO report, Delft

Duijn, M (2009), *Embedded reflection on public policy innovation*, Eboron, Delft

Emmert, S., Lindt, M. van der and Luiten, W.J. (2010), *Barriers to changes in energy behaviour among end consumers and households*, Final report, project 'Barenergy', European Union 7th framework programme

Klein Woolthuis, R., Lankhuizen, M. and Gilsing, V. (2005), "A system failure framework for innovation policy design", *Technovation,* 25, pp. 609-619

Kolb, DA (1984), *Experiential learning: experience as the source of learning and development,* Englewood Cliffs, NJ: Prentice Hall, New Jersey

Lawrence, P.R. and Dyer, D. (1983), *Renewing American Industry*, The Free Press, New York

Loeber, A., Mierlo, B. van, Grin, J. and Leeuwis, C. (2007). "The Practical Value of Theory: Conceptualizing learning in pursuit of sustainable development", in Wals, A. and Ley, T. van der (eds.), *Social Learning towards a sustainable world.* Wageningen UR, Wageningen, The Netherlands, chapter 3 (p. 83-97).

Mlecnik, E. (2011), "Passive house networks: a social innovation targeting innovation in sme's in the construction sector", *proceedings MISBE conference, Amsterdam, 20-23 june 2011, session W65 & W112,* The Netherlands

Nonaka, I. and Takeuchi, H. (1995), *The knowledge creating company; How Japanese companies create the dynamics of innovation*, Oxford University Press, USA

Oostra, M. (2011), "Co-developing a renovation approach for housing in order to achieve energy efficiency", paper will be presented at Architecture in the Fourth Dimension: Methods + Practices for a Sustainble Building Stock conference, 15-17 November 2011, Boston

Raven, R., Bosch, S. van den and Weterings R. (2008), "Transitions and strategic niche management: towards a competence kit for practitioners", *International Journal of Technology Management (IJTM)*, Volume 51 - Issue 1 – 2010, Special Issue on Social Innovation, pp. 57-75

Rogers, E.M. (1995), *Diffusion of innovation,* The Free Press, New York

Rotmans, J. (2005), *Societal Innovation: Between dream and reality lies complexity*, shortened inaugural speech, Rotterdam School of Management, ERIM, Erasmus University Rotterdam.

Spekman, R. E., Spear, J. and Kamauff, J. (2002), "Supply chain competency: learning as a keycomponent", *Supply Chain Management: An International Journal*, Vol. 7 Issue 1, pp.41 – 55

Sandick, E.H.D. van and Oostra M.A.R. (2010), "Upscaling energy related innovations", *Conference proceedings CIB World Congress: Building a Better World... May 10th-13th 2010,* TG66, Salford, UK

Suurs, R.A.A. (2009), *Motors of sustainable innovation. Towards a theory on the dynamics of technological innovation systems* , Utrecht University, Utrecht

Mierlo, B.C. van et al. (2010), *Reflexieve Monitoring in actie. Handvatten voor monitoren van systeeminnovatieprojecten.* WUR/Altena instituut, Wageningen

Willems, M., Roelofs, E. and Weterings, R. (2009), "Learning history as an evaluation method for the policy formulation of the Dutch Societal Innovation Agenda on Energy", paper submitted at ECPR conference Germany (10-12 September 2009)