In: Outsourcing
Editor: Andre Deering
ISBN: 978-1-63463-257-7

Chapter 3

OUTSOURCING INDUSTRIAL ENERGY MANAGEMENT: INDUSTRIAL ENERGY EFFICIENCY NETWORKS PROVIDED AS AN ENERGY SERVICE

Svetlana Paramonova*[*], *Jenny Ivner and Patrik Thollander
Department of Management and Engineering, Division of Energy Systems, Linköping University, Linköping, Sweden

ABSTRACT

Improving industrial energy efficiency (IEE) is of the outmost importance for both individual industrial companies, and governments. Improved IEE leads to reduced energy costs for companies, and improved sustainability through reduced CO_2 emissions. Despite a large untapped potential for improved IEE, many energy efficiency measures (EEM) remain unexploited due to the existence of various barriers to IEE. One of the reasons for the large untapped IEE potential is the apparent low level of energy management practices in industry. A promising approach to stress improved IEE, and improved energy management practices, are industrial energy efficiency networks (IEEN), which in essence is a type of energy service where energy management is partly outsourced to a

[*] Email: svetlana.paramonova@liu.se.

third party. There is a need to study how IEENs could and should be structured. Successful networks have been under operation in many different areas and disciplines. A large part of the organizational issues of previous research on networks, could thus be transformed to IEENs, e.g., in terms of transition theory, transformation etc. The aim of this book chapter is to present a general model for the management of IEEN.

INTRODUCTION

Improving industrial energy efficiency (IEE) is of the utmost importance for both individual industrial companies, and governments. Improved IEE leads to reduced energy costs for companies, and improved sustainability through reduced CO_2 emissions. Despite a large untapped potential for improved IEE, many energy efficiency measures (EEM) remain unexploited due to the existence of various barriers to IEE (Thollander and Palm, 2012). One of the reasons for the large untapped IEE potential is the apparent low level of energy management practices in industry (Christoferssen et al., 2006; Thollander and Ottosson, 2010; Brunke et al., 2014). A promising approach to stress improved IEE, and improved energy management practices, are industrial energy efficiency networks (IEEN), which in essence is a type of energy service where energy management is partly outsourced to a third party. There is a need to study how IEENs could and should be structured. Successful networks have been under operation in many different areas and disciplines, e.g., Elmhester (2008) and Villa (2009). Many of the organizational issues of previous research on networks could thus be transformed to IEENs, e.g., in terms of transition theory.

The aim of this book chapter is to present a general model for the management of IEEN. In order to do this a brief background to organizational barriers to IEE is given in section 2, followed by an explanation of how IEEN can contribute to overcoming these barriers as well as some lessons learned from pioneering energy efficiency networks. Then a theoretical background to known mechanisms for organizational change is presented in section 3. Section 4 gives a brief overview of findings from research on business networks and finally section 5 presents a model for the practical implementation of an IEEN program, with some final remarks.

1. IMPROVING INDUSTRIAL ENERGY EFFICIENCY

Improved industrial energy efficiency is one of the foremost means of cutting energy cost for companies, and one of the foremost means for reducing greenhouse gas emissions. Research indicates a vast and untapped potential for improved energy efficiency in industry which remains unexploited due to the existence of various barriers to IEE (Thollander and Palm, 2012) and which, with adequate energy management practices, including adoption of new technologies and improved operations, well-developed energy service markets, and tailor-made policies, can be exploited.

1.1. Barriers to EE investments

Research on barriers has been an ongoing research field for more than two decades. In Table 1 theoretical barriers to EE investments originating from this ongoing field of research are presented.

Table 1. Barriers to energy efficiency (Thollander and Palm, 2012)

Classification	Theoretical Barriers
The technical system	Access to capital Heterogeneity Hidden costs Risk
The technological regime	Imperfect information Adverse selection Split incentives Form of information
The sociotechnical regime	Credibility and trust Principal-agent relationship Values Inertia Bounded rationality Power Culture

1.2. Outsourcing Energy Management Practices

A promising approach to improve energy management practices is outsourcing of energy management to a third party. Outsourcing emanates from a paper by Prahalad and Hamel (1990), which somewhat reshaped parts of how cooperation and individual firms do business and formulate strategies. In essence, a company should according to Prahalad and Hamel (1990), focus on their core competencies. For the industrial manufacturing companies of today, this means that improved energy end-use efficiency should become a core competence. However, it never does because it does not create direct revenues, only cost minimization. For some, a select few, energy-intensive companies, that may be able to utilize the excess heat, in turn supplying electricity and heat to an external market, the supply of energy (electricity or heat) can in fact be a core competence. The latter however is beyond the scope of this book chapter as it primarily focuses on improved energy end-use efficiency. For companies not able to utilize excess heat, outsourcing parts or the whole energy management responsibilities has theoretically then proven to be a solution. For the vast majority of companies, where e.g., within the EU, 99.9 % of the companies are categorized as micro, small or medium-sized, the maturity of energy management within the company is often low. This is the major logic of industrial energy efficiency networks (IEEN): in essence, an IEEN means that parts of the energy management within the firm are outsourced to the network administrator.

1.3. Networks as a Means to Overcome the Efficiency gap

Participation in an IEEN, at least in theory, is an opportunity to overcome barriers related to credibility, uncertainty, and lack of information as it offers opportunities for information-sharing and sharing of experiences. Table 2 below gives a brief overview of potential benefits offered by IEEN. The table is based on the taxonomy by Sorrell et al. (2000), later elaborated by Thollander and Palm (2012).

Table 2. Barriers to energy efficiency on which energy manager networks have potential positive effects (Ivner et al., 2014)

Category	Theoretical barriers	Potential effect from network participation
Technical system	Heterogeneity	Sharing experiences about available measures and technologies within the network reduces the risk of technology inappropriateness
	Hidden costs	Hidden costs such as overhead costs related to investment, costs for collecting and analyzing data may be reduced, or even avoided
	Risk	As managers share experiences of previous technology investments and process improvements, networks contribute to minimized risk aversion
Technological regime	Imperfect information	Improved information on the positive effects of energy efficiency investments and process improvements may lead to implementation of cost-effective energy efficiency measures
	Adverse selection	Information-sharing among managers already undertaking investment and process improvements reduces the chance to select "wrong" technologies
	Form of information	Information is exchanged in person, either by an expert or a peer, which improves the conditions for learning and adoption of ideas and knowledge
Socio–technical regime	Credibility and trust	Information provided by a trustworthy source, for example at network meetings is more likely to be accepted. The adoption of certain technologies or measures by peer business colleagues is more likely to be seen as credible (or as a norm)
	Values	The adoption of energy management systems or energy efficiency measures by peers affects what is perceived as a norm and "common sense" in the business sector, and thus the possibilities to overcome this barrier
	Inertia	The adoption of energy efficiency measures by peers affects what is perceived as a norm in the business sector, hence affecting attitudes and behavior, helping to reduce this barrier
	Bounded rationality	The downside of acting bounded rational in regard to energy efficiency is reduced as attitudes and what is regarded as a norm change and information is gained from improvements undertaken by other companies
	Power	Low effect of energy management networks as this barrier refers to internal organizational structures
	Culture	Attitudes towards energy efficiency change as the norms change due to new knowledge and experiences gained in the network. In the long run, as staff changes positions, a "business culture" where energy efficiency is a natural part evolves

1.3. Networks as a Means to Overcome the Efficiency gap

Participation in an IEEN, at least in theory, is an opportunity to overcome barriers related to credibility, uncertainty, and lack of information as it offers opportunities for information-sharing and sharing of experiences. Table 2 below gives a brief overview of potential benefits offered by IEEN. The table is based on the taxonomy by Sorrell et al. (2000), later elaborated by Thollander and Palm (2012).

1.4. Previous Research on Energy Efficiency Networking

Switzerland was first to successfully introduce an IEEN in 1987 called EnergyModel (Koewener et al., 2011). The model got support from the Swiss Energy Agency and all the participating companies were exempted from a fossil fuel surcharge if they managed to reduce carbon dioxide emissions. The emission targets were negotiated between the companies and the Swiss government (Jochem & Gruber, 2007). Now there are around 70 energy efficiency networks run in Switzerland involving approximately 2,000 companies.

The networks run between four and five years (Koewener, et al., 2011) and are financed by the participating companies. The evaluation showed an average annual reduction of individual energy costs of € 110,000 per company (Koewener et al., 2011).

Encouraged by the Swiss success, Germany established its first energy efficiency network in 2002. German networking is usually referred to as Energy Table or learning energy efficiency networks (LEEN). One network consists of 10-15 primarily medium-sized companies in nearby proximity. Like the modern Swiss networks, LEENs are financed by the participating companies (Koewener, et al., 2011). The evaluation of the first network showed a positive tendency in reducing energy costs, which led to subsequent development of similar networks. Now there are more than 50 networks functioning (Koewener et al., 2011).

The LEEN model includes an acquisition phase, an initial consulting phase, and a network phase. The average energy-cost reductions were reported to be €120,000 for German networks.

1.5. Effective IEEN

As for all forms of challenges, there is no guarantee that participation in an IEEN will lead to improved EE. A closer look at Table 2 indicates that information sharing is a key issue for the IEEN to succeed in overcoming organizational barriers, and that is it is very important how information is shared from experts and between peers and who is the receiver. These are issues closely related to the design of the network model and how the network is managed.

One of the most important means in starting an IEEN and an in-house energy management program is to conduct an energy audit. Väisenen et al. (2001) categorize the four primary types of actors involved in a governmental energy audit program. These are (Väisenen et al., 2001):

- Program administrator
- Program operator
- Energy auditor
- The company

In relation to an IEEN, the primary roles in an IEEN are:

- Network administrator (a number of networks)
- Network operator (one network)
- The company

In addition, another important actor which may not be applicable in some networks, is the energy auditor.

2. BRINGING CHANGE INTO COMPANIES

In order to understand a network model, there is a need to understand mechanisms that lead to organizational change, change that is needed to enable the participants to receive and translate new knowledge into their own context. This section provides insight into how organizations learn and change, and how business networks help companies to face common challenges. These insights will later be used when we present our model for IEEN.

2.1. Organizational Learning and Organizational Change

Peter Senge's *The Fifth Discipline* (2004) is devoted to organizational change. In his book Senge states that in a complex world of business, companies have to work in a more "learningful" way and become "learning organizations". Senge (2004) thinks however that the majority of organizations have problems with learning due to "learning disabilities" that can remain despite the work of devoted people in the company. The two main disabilities are the illusion of taking charge and fixation on events.

The illusion of taking charge means, according to Senge, taking initiatives to do something in a reactive manner instead of being proactive and continuously working on improvements. If organizations instead try to foresee problems, this would contribute to mutual thinking and thus organizational learning. In relation to improving energy efficiency in companies, this means that results cannot be achieved after implementing one or a few energy efficiency measures with a short payback time. To see the results from energy efficiency measures the work on energy management should be practiced all the time.

Fixation on events such as last month's sales or the upcoming quarterly budget means dealing with the current agenda which hinders companies from solving problems that have a more delayed character. This linear thinking (*seeing lines*, as Senge calls it) prohibits systematic thinking. Seeing circles, on the other hand, help to understand interrelations. According to Senge, variables of a particular event can be put in a feedback process or loop of iterative cause-effect responses. Focusing only on short-term happenings hinders learning how to predict and create. In relation to IEEN, however, it will be important to find structure that allows both a holistic continuous approach together with quarterly economic time periods that every company today is facing. Following up the achievements during the fixed time periods would help to achieve a successful continuous work.

Another difficulty can be that management is often seen as a group of the most experienced staff in the company supposed to solve problems of any kind (Senge, 2004). This can endanger learning of an organization since top management may refuse to admit their lack of competence and thus neglect important issues in order to maintain their own image. It can prevent other personnel from affecting their decisions or expressing their opinion, which can cause a conscious unlearning.

These disabilities to learn can be counteracted by the structured work and sharing of ideas as well as technical and managerial know-how (Senge, 2004).

Senge mentions some important aspects of the learning organizations. One of them is development of personal visions. Organizational learning starts with personal learning through mutual commitments. Devoted people working with energy efficiency on a network level will be able to transfer the knowledge into their organizations and thus build a new culture within them. Another important aspect is building mental models (generalizations and assumptions about the surrounding environment). Working constantly with mental models on an individual and company basis, the management of the company can achieve institutional learning. In a context of IEEN this can be achieved through providing coaching from the network administration to the participating companies. These two aspects can contribute to building shared visions. Building of shared visions is a possibility to create a picture of a mutually desirable situation inspiring to implement actions towards it (Senge, 2004). An IEEN can become a sort of guiding organization on how to build shared visions among participants. Participating in a network would help to increase commitment to the work with energy efficiency and later transfer the built visions further to the participating companies' staff. Thus, this can also eliminate the risk that vision related to energy issues will be determined on the top management level.

All this can eventually contribute to team learning or a situation when a team is thinking and learning together and when the potential of the team exceeds the potential of the individuals within it. Senge (2004) claims that for team learning dialogue is very important when ideas flow freely and lead to efficient exchange. Thus, it is important to achieve a good level of dialogue at network meetings where all the participants will be able to contribute to the discussion. The last aspect important for successful learning, according to Senge, is system thinking or the ability to combine all the interrelated components of a system in order to understand the whole and bring visions to reality. Participating in an IEEN can be a crucial factor for building system thinking because it can give SMEs a possibility to access information and resources they could not otherwise access.

In order to face challenges in an appropriate way and maintain ongoing improvements organizations should be able to learn to work repeatedly and proactively. The learning process should be put in the loop of iterative cause-effect responses which can eventually result in the ability to see circles instead of lines.

2.2. Double-loop Learning

Several years before Senge (2004) published *The Fifth Discipline*, Argyris and Schön called for iterative routines in their book *Theory in Practice: Increasing professional effectiveness*. Agyris and Schön suggest a management model based on three blocks: *governing variables* (objectives and norms within the organization that people try to keep under control), *action strategy* (the way people act in order to keep the variables under control), and *consequences of these actions*. If the consequences happen to be according to the plan then our assumptions are approved. However, outcomes can be unexpected and then correction of errors may be needed. If fixing the errors comprises only choosing another action strategy while keeping all the variables constant this is called single-loop learning. However, one can also question the reliability of governing variables, which is double-loop learning.

Continuous double-loop learning can help to find structural explanations for the events and adapt the patterns of behavior accordingly. This confirms the importance of continuous working with energy issues initiated on the network level. If learning is achieved on the network level then the members can get motivated and affect the learning process in their respective companies. Applying longer-term strategic thinking and thus continuous learning helps to teach the companies to act in a proactive way, which can again give the possibility of seeing circles instead of straight lines.

Thus, double-loop learning can develop personal visions and mental models as well as contribute to building shared visions which together can result in team learning and ability for system thinking. All this can help to counter learning disabilities and build learning organizations.

2.3. Learning Bringing Change

An IEEN exists and is started with the aim to facilitate energy efficiency in industry. But sustained changes in energy use need change in how companies act. And change of action, as we have seen argued by for example Senge (2004) and Argyris & Schön (1974), requires learning organizations. Senge (2004) claims that to achieve success in learning organizations there is a need for a new type of management that must take responsibility for building a group whose members foster and develop the characteristics mentioned above: building shared visions, understanding complexity, etc. Kanter (1983) in Paton and McCalman (2000) confirm that for changes to be successfully

implemented there is a need for "master of change" or the one who initiates a change. In our situation the IEEN can become this fostering organization, initiating changes among participants first and then transferring them to the respective companies. However, even within a work group there can be a need for one ultimately responsible person, a change agent whose role can be taken by a project manager or a network coordinator. A change agent has several tasks to minimize resistance to change and achieve positive results. According to Boddy and Buchanan (1992) in Paton and McCalman (2000) they are:

- to detect and organize stakeholders
- to work on goals and strategy
- to assure good communication systems.

Participating in an IEEN can provide the participants with the latest information about the energy efficiency technologies available in the field through peers or energy experts as well as lists of good-quality energy auditors or checklists of how to perform audits without external help. Also, a coordinator of an IEEN should be available for the companies if they face some difficulties with implementation of measures or have any other questions during the networking period. The coordinator does not need to be expert in all energy-related questions but should be able to redirect the companies to the experts. The network should become a source of information and a place where the companies can turn to at any time in order to get competent consultancy help. Thus, if work in an IEEN is organized in a properly structured way and if a coordinator takes the necessary administrative burden to organize network meetings and create a good atmosphere of trust for knowledge and experience exchange, this can be a trigger for change within the companies.

2.4. Standardized Management Systems

Standardized Energy Management Systems (EMS) are administrative systems oriented towards continual improvements. This means that continuity has a key role as the work follows a pre-defined cycle of mapping, planning measures, follow-up and new measures. Standardized systems for continual improvements have existed for decades, where quality (ISO 9000) and environment (ISO 14000, EMAS) have been followed by concepts for energy management (ISO 5000).

Research about environmental management systems has shown that the systems lead to change in organizational behavior and measurable results (see for example Prajogo et al. (2014)). A systematic approach supported by administrative routines is therefore a key to success with a continual approach based on double-loop learning. It has also been shown that the implementation of environmental management systems in SMEs has been facilitated by network cooperation (Ammenberg et al., 1999).

However, it cannot be assumed that the mere adoption of a standardized management system automatically leads to substantial change (Ammenberg and Hjelm, 2002; Ammenberg and Hjelm, 2003). Even if the administrative procedures are implemented, there is a risk that the administrative system becomes a paper tiger where following the procedures becomes prioritized before actual action. It has been argued that management systems can only be effective if the administrative procedures are integrated in the daily procedures and become a "practice" rather than a "technique" (Hjelm et al., 2011). This means that the system is simplified and adapted to the user rather than following the strict pattern of a certification body.

One known tool to introduce management systems in SMEs according to international standards (ISO 14001 and EMAS) is the Hackefors model (Altea, 2013). The model got its name from the area of Hackefors, Sweden, where a joint environmental management system was introduced at 26 SMEs (Ammenberg et al., 1999). The model has been used in several industrial areas of Sweden (Ammenberg et al., 1999) and has resulted in the implementation of around 1,800 standardized management system certificates (Altea, 2013).

The organization is built around a central coordinator who can be either from one of the companies or an external expert (Hallinan, 2003). The coordinator is responsible for documentation, identifies legal requirements, creates engagement within the network, and organizes meetings and environmental education (Ammenberg et al., 1999). It is also the coordinator's task to lead the steering committee. The steering committee develops the EMS and is responsible for environmental auditing. The central coordinator and the steering committee are supported by the support group.

The evaluation showed that costs for introduction of the joint EMS are half compared to if the system had been introduced individually at each company (Ammenberg et al., 1999). The companies that cooperated in the environmental network also began to cooperate in other areas. It was concluded that the coordinator involvement was crucial to the project's outcome. The coordinator can decrease the administrative burden common when introducing the EMS at an individual company.

3. BUSINESS NETWORKS AS A MEANS TO FACE COMMON CHALLENGES

In the following section we will give a brief overview of findings from research on business networks. In the organizational research, the publications about networking or collaboration emerge in the late 1970s and refer mostly to two-party collaboration. Andersson (1979) in Elmhester (2008) states that collaboration is a good way for SMEs to get access to the resources they lack: it can increase companies' effectiveness and help achieve the goals (Andersson, 1979; Nilsson & Nilsson, 1992, in Elmhester, 2008). From the 1990s on, research testifies to collaboration between more than two parties that have something in common (for example in education). This is referred to as strategic networking and implies that the companies strategically choose to actively take part in the network activities under the coordination of some sort of leader (Elmhester, 2008).

Human & Provan (1997) state that strategic networks result in both transactional (i.e., monetary) and transformational (thinking and action) changes. Thus, it is important to distinguish between a network's transactional effects (capital) and transformational effects (social capital). By participating in networks companies can achieve benefits from social capital through such mechanisms as innovation (Gronum et al., 2012). The innovation process contributes to other positive effects of networking such as access to necessary resources and distribution of skills and knowledge (Gronum et al., 2012). Policymakers often believe that social capital results in transactional changes by default. However, while showing the transfer of knowledge and other social expectations of networking the social capital leaves unexplained the economic side of networking (Huggins, 2009). Thus, in order to achieve specific economic expectations, they have to be expressed. Gronum et al. (2012) claim that "social capital is more likely to be built by social networks, while network capital is formed through calculative," meaning that there is a need to focus on the expected transactional outcomes when designing the network.

Elmhester (2008) studied strategic SME networks focusing on how networking (*collaboration* in Elmhester's terms) can affect a single company. SMEs, in distinction from bigger companies, have characteristics that contribute to networking ability to impact development of SMEs. These characteristics are the ability of management to have an overview of the whole organization, closer connection between management and employees, short communication routes, good adaptability and flexibility, and a need to cover

lack of resources. Also, SMEs have different approaches to long-term planning as plans are seldom formalized on the organizational level but rather depend on specific projects (Gibb & Scott, 1985 in Elmhester, 2008). Elmhester (2008) shows that working within a network has a positive impact on the development of a single company despite how actively a company participates in the activities. This is because development happens not only consciously but also unconsciously. Such strategic developments as goal orientation and structural change can happen unconsciously. An example of change in goal orientation is a shift from market-oriented to competence development-oriented goals (increased education or alteration in the production processes). An example of a structural change of a network is an increased involvement of employees in the network in addition to top management .

Other positive results from collaboration that can be achieved by participating in strategic networks are cost reductions, synergies, new business models, risk sharing and increased trust as well as personal and organizational learning (Varamäki & Vesalainen, 2003). Another effect is higher self-confidence within a company due to the possibilities to consult and discuss with someone in the same field. This can result in a willingness to try new things and consequently in company development (Elmhester, 2008). Furthermore, education of personnel results in personal development that may also lead to implementation of new solutions and increased knowledge within a company (Elmhester, 2008).

3.1. Success Factors for Innovative Business Networks

A study (Elmhester, 2008) of strategic networks showed the main success factors for the network to be a good atmosphere with slight competition, trust between participants, good organization and similar problems or interests. When defining success factors, Elmhester (2008) studied such aspects as the structure of a network, performed activities, network goals and their fulfillment, and socialization (Elmhester, 2008).

Structure of Networks

Before showing how the structure of networks affects the networking result let us have a look at how Varamäki and Vesalainen (2003) describe the structure of networks based on levels of possible collaboration. These types are chosen according to two aspects: formalization level (availability of rules, procedures, and contracts) and strategic intensity (companies' commitment in

terms of resources involved). The type of collaboration with lowest level of formalization and strategic intensity is referred to as development circle and the only strategic goal of this kind of collaboration is to learn from each other. Development circle is followed by cooperative circle which implies that participating companies share some of their resources and thus minimize costs (the goal of the collaboration). The next type of collaboration is a project group when the companies combine resources and competencies. This type of collaboration has a higher level of strategic intensity and formalization due to the availability of contracts. A project group is followed by joint venture when the companies initiate a new company by means of joint efforts and resources. The last type of collaboration with highest level of strategic intensity and formalization is a joint unit when participating companies become part of a new, mutually founded company.

According to Elmhester (2008), a higher level of organization can make it easier to collaborate and achieve the goals. The network's structure should comprise developed and well-defined procedures, delegation of responsibilities, and definition of long- and short-term goals. Defined procedures and well-planned meetings would make the process of goal fulfillment easier (Elmhester, 2008). However, the networks developed in time can increase trust and activities without changing the level of formalization and strategic intensity. Elmhester (2008) also claims that a project leader or coordinator when performing several activities at the same time can increase the success of the collaboration regardless of the availability of rules and routines. Thus, it is very important to have a person that is responsible for the coordination of network activities in order to keep the work going. Thus, not only do formalization and strategic intensity play important roles for development of strategic networks but also resources in terms of commitment and time which should be used effectively by the project leader.

Network Participants

Another finding by Elmhester (2008) is that a positive result does not necessarily depend on the whole company involvement in the network's activities as personnel participating in the activities spread the results within their company and affect other employees. Involvement on a managerial level leads to a higher chance for the positive effects of the network collaboration. This is according to Elmhester (2008) due to less complexity and good concentration of knowledge and also because managers have better possibilities to promote changes due to they directly influence the company's strategy and activities. On the other hand, if the goals are more related to

competence development level more persons from the company should be involved. However, according to Elmhester (2008), the outmost important success factor is that person(s) participating in the network's activities should be motivated.

Network Goals and Their Fulfilment

Elmhester (2008) argues that goals should be defined and written down from the start of the network activities. This is important since networks may undergo changes and the interpretation of the goals may change as well. If the goals are not written, there is a risk that a network would be counted as successful without the possibility to present the goals' fulfillment. Therefore Elmhester (2008) suggests that a strategic plan describing the pattern and procedures towards goal fulfillment on both company and network level assuring the correct resource distribution as well can be important.

Elmhester (2008) also concludes that defined goals have great influence on network success, and even more important is whether a network has one or several goals. Elmhester found that if the network activities were focused on one goal they were more likely to succeed than when the activities were scattered to achieve several goals. However, the results are ambiguous: there could be more positive effects achieved (so-called bonus effects) in a network with diverse goals, so total effects could be equivalent.

It is important that the collaboration has both long-term and short-term goals. Long-term goals are important to secure continuous efforts and fulfillment of short-term goals is an important motivator to work further (Elmhester, 2008). Also, ambition level of the goals can play a role. Varamäki & Vesalainen (2003) think that more positive results can be achieved with more precise goals together with higher level of involvement and formalization. Elmhester (2008) on the other hand argues that even if networks goals are vaguely defined, regardless of structure and performed activities, the goals can be fulfilled. But, if the goals are strictly defined there is a need for a more structured network. The level of goals, according to Elmhester (2008), should be considered carefully to optimize distribution of resources, time, and attention.

It is important to monitor the outcome of network activities as they should result in tangible and registered achievements. According to Elmhester there are several barriers to goal fulfillment important to be aware of: inappropriate goals, lack of managerial competencies, and differences in resource availability in the participating companies. Varamäki & Vesalainen (2003) mention that the success factors for goal fulfillment can be a driven person,

network organization, and motivation of the participants. To increase motivation within the network there is a need for a good atmosphere. Elmhester (2008) noted that if the companies could build good relations of trust with slight competition and similar problems or interests, it can increase the degree of collaboration, number of meetings and will to work further together.

Socializing

In order to build good relations, the socializing process within networks is intrinsic for the network to be successful (Elmhester, 2008). If the companies get acquainted at an earlier stage it leads to higher possibilities to find areas for collaboration. This is easier if the companies are situated in a closer proximity. In reference to Varamäki's model, Elmhester (2008) mentions that if the level of socializing is high the level of formalization of collaboration within a network is not of major importance. Socializing can result in learning and joint adaptation independently of collaboration goals. Goal fulfillment can also increase with a good level of socializing among the companies, as this leads to more positive attitude to perform the required work (Elmhester, 2008). A good socialization process can be facilitated by regular meetings, informal meetings, and site visits.

Network Activities

When it comes to activities, Elmhester (2008) claims that activities within the network do not have to be strictly determined beforehand. There is a higher chance to achieve positive results if the companies can choose between a variety of activities depending on their preferences and capacities. This also means that the results from participation in a network can differ widely between companies in the same network. Companies performing similar activities would however lead to similar results.

3.2. Governance of the Networks

A governance of a network is shown in an example given in *A Road Map to the Development of European SME Networks* (Villa, 2009) where how to coordinate a network in an efficient way and make its constituents work together is described. First of all Villa claims there is a need for efficient management of the network and for that a graph needs to be drawn showing a network's necessary constituents, a basis for a conceptual model (a firm,

suppliers, and clients of the firm). A network can have hierarchical or polycentric governance structure depending on how many firms can be categorized as primary. In the hierarchically built network one primary firm plays the role of a leader responsible for production and innovation. If the network is polycentric all primary firms are of equal importance. The governance structure would then determine the role of public organizations in the networking activity: In the hierarchically built network they will not have a large impact on the network while in polycentric cases the role of public organizations would be more important for the primary firms to coordinate their sub-networks (Villa, 2009).

Villa (2009) describes the necessity of the networks' governance in the example of a demand and supply network. He mentions that a network is a temporary organization where the participants are different companies that chose to cooperate on a particular area. The cooperation should be supported by an agreement that regulates only that part of the companies' activities, time, and business resources that would be dedicated to the network.

Villa (2009) states that the positive impacts of belonging to a network are not always defined in terms of economic revenues, which is also discussed by Huggins (2009) and Gronum et al. (2012) and presented above. Villa (2009) claims that if the benefits are defined in exact terms it can be problematic to assess the performance of a network and quantify the amount of improvements. A successful collaboration requires some options to be fulfilled: business processes coordinated on a network level, common standards for data format, the importance of including the results of collaboration into operational systems, the availability of key performance measures for activities. Villa (2009) presents the three critical aspects for improvement of SME networks: good coordination, availability of tools for improved network performance, and good competencies of participating personnel. However, management attitude and knowledge is also importance for a network's development (Villa, 2009).

4. DISCUSSIONS AND RECOMMENDATIONS

This book chapter has covered a number of important and overlapping areas in which networks are affected. These areas are based on three main research fields:

Industrial Energy Efficiency (IEE)

- Barriers to investments
- Industrial energy efficiency networks

Learning and managing change

- Learning organizations
- Double-loop learning
- EMS as practical double-loop learning
- Business networks

Experience from the Swedish SME networks

- Governance of networks
- Success factors for business networks

There are several important conclusions that can be drawn after reviewing these research areas. To start with, IEEN can be seen as a good means to overcome barriers to energy efficiency intrinsic to SMEs. So far there is no evidence that SMEs see improved energy end-use efficiency as a core competence of their business and most often energy management at SMEs is immature. This can be solved by participating in IEEN and outsourcing of energy management practices to the administrator of IEEN. By participating in IEEN SMEs can access resources they would not be able to access otherwise. The companies involved in IEEN have a chance to get information about available energy efficiency solutions from their peers experienced in this field. They can also eliminate many risks related to implementation of technologies and avoid hidden costs. This can contribute to changing the attitudes and behavior helping to reduce such barriers as inertia and bounded rationality as well as to avoid fears of the unknown and failure. All this would eventually result in increasing companies' effectiveness and help in the goals' fulfilment. The positive effects can be supported by the successful examples of energy efficiency networking in Germany and Switzerland as well as networking for implementations of EMS.

However, in order for changes in behavior and attitudes to occur the companies should be able to learn from their own and others' experiences. As we showed in section 3 the process of learning requires additional attention

and continuous work to overcome such learning disabilities as illusion of taking charge and fixation on events. The companies should learn how to be proactive and think from an energy efficiency point of view and put energy issues on an everyday agenda. This can be achieved by participating in an IEEN that can become a fostering organization initiating changes among participants. Enrollment in networking activities requires commitment from the chosen personnel. It is also important to create conditions for a good level of dialogue during meetings so that all participants can feel that they contribute to the discussion and gain from it. As we presented above learning and thus development, this happens not only consciously but also unconsciously. Later on a network's representatives can transfer knowledge acquired to their respective companies. An IEEN can become an area for double-loop learning spreading the knowledge about energy efficiency to every employee of a company. In a loop every participant should feel responsibility for the changes that happen in the system. By participating in an IEEN, companies can achieve a higher level of self-confidence for trying new solutions due to the possibilities to consult and discuss with someone in the same field or experts. Confidence and enthusiasm to try new things would eventually lead to companies' development.

Special attention should be given to the role of top management since its attitudes and actions are decisive for the whole strategy of the companies. If the interests of the management group are not in line with energy efficiency it could be hard to implement energy efficiency actions in the company, which can become a serious obstacle to building a culture of energy-efficient behavior. In this situation enrollment of top management in networking activities can be important. This can help to create a new type of manager who will be able to build shared visions of energy efficiency at their companies.

The mentioned disabilities to learn can be counteracted by continuous and structured work within an IEEN. Education of network participants results in personal development that will later lead to increasing the knowledge within companies. Networking can help to develop attitudes to efficient energy use by network representatives first and spread further to the company level resulting in team learning and system thinking. This can help to develop the abilities to see circles instead of lines as discussed above. It is important to mention that the process of learning should become a never-ending process and sharing of knowledge and experiences should be practiced all the time. Time is needed to foster visions and thus long-term strategic energy efficiency thinking should become a common practice among the SMEs.

However, participating in an IEEN cannot guarantee successful learning and improved energy efficiency. In order to spread the knowledge and thus make changes within a single company a network should be properly designed and managed. A network and its administrator should become a master of change, helping to change attitudes among participating companies. Thus, the most important is a committed person taking an administrative role which would be able to drive work within a network, organize meetings, create engagement, and find experts within the field. Network participants need to feel secure that any time they have questions they will be able to get consultation help. Also, the participation in the network activities of someone from top management of the companies at least from time to time would contribute to knowledge distribution within the companies.

A higher level of formalization, availability of contracts, defined procedures, and strategic planning can help to organize the activities within a network. This would simplify the work and help to achieve goals as well as enable the right distribution of resources. However, the learning process can be achieved in time even without well-defined planning and the importance of commitment and motivation is mentioned to be more important for positive results of networking. A person administrating a network should be able to increase motivation among the network's participants as well and that is possible only if there is a good atmosphere of trust in the network with a high level of socializing. A good level of socializing results in learning and joint adaptation independently of network goals as it leads to positive attitudes to perform the work. Creation of good relations of trust can be facilitated by regular and informal meetings and site visits.

Also, it is very important to have the goals defined in order to lead the work within an IEEN. There can be no answer to whether it is better to have one or several goals, long- or short-term orientation, or precise or vaguely defined goals. This would depend on a specific network and what is important is to set the goals right depending on the specific circumstances. However, it is important that the goals are quantified, otherwise there may be problems trying to follow up the work of an IEEN. Follow-up procedures are very important in order to register the achievements of a network.

To sum up, good administration is necessary for networks. An IEEN is a complex type of energy service that needs structure in order to be successfully adopted. Based on the presented research and findings from already ongoing IEENs, we end this book chapter by presenting a general model on how an IEEN can be managed.

Table 3. A general model for the management of an industrial energy efficiency network (IEEN)

Phases		Pre-proj S0	Pre-proj S0	Initiation S1	Initiation S1	Energy act. pl w. inv. est. S2	Energy act. pl w. inv. est. S2
	Responsible	Tasks	Deliverable	Task	Deliverable	Task	Deliverable
Network strategy and goal formulation							
Formulate strategy for the creation of innovative energy awareness culture in network organisations through continuous improvements	NC	T0.1	D0.1		D1.1		
Formulate strategy for the creation of innovative energy awareness culture in company organisation through continuous improvements	NC	T0.2	D0.2		D1.2		
Set impact in EUR (kWh) saved during the network period	NC	T0.3	D0.3		D1.3		
Set impact in EUR (kWh) saved per company during the network period	NC	T0.4	D0.4		D1.4		
Promotion and marketing							
- Communication plan (where communication channels are set, e.g. form of marketing (site-visit, telephone, email etc.))	NC			T1.5	D1.5		
- Creation of information material	NC	T0.6	D0.6				
Framework							
- Who is participating (regional network, sector, size, company stakeholders (bank, ESCO, energy auditor, network operator & administrator, management consultant)	NC+NWC	T0.7			D1.7		
- Total network period	NC+NWC	T0.8			D1.8		
- Number of companies	NC+NWC	T0.9			D1.9		
- Financial support (external)	NC+NWC	T0.10			D1.10		
- Network fee (for participating companies)	NC	T0.11			D1.11		
- Letter of Intent (contract signed from company top management)	NWC	T0.12			D1.12		
- Formulate a code-of-conduct policy including joint vision formulation (e.g. including g	NC+NWC			T1.13	D1.13		
Administrative model							
- Management model (LEAN, PDCA, project management, etc.)	NC+NWC	T0.14			D1.14		
- Structure of network (set the different phases with clear timeline, meeting frequency, locations, invited experts)	NC+NWC	T0.15			D1.15		
- Energy audit model (tools like software, database, report templates etc.)	NC+NWC	T0.16			D1.16		
- Monitoring and evaluation system	NC+NWC	T0.17			D1.17		
- Create a user manual	NC	T0.18	D0.18				
- Impact evaluation, network level	NC	T0.19			D1.19		
- Process evaluation, network level	NC	T0.20			D1.20		
- Impact evaluation, company level	NC+NWC	T0.21			D1.21		
- Process evaluation, company level	NC+NWC	T0.22			D1.22		
Network operationalization							
- Site visits	NC+NWC			T1.23			
- Network meetings	NC+NWC			T1.24			
- Energy audit report	EA					T2.25	D2.25
- Energy action plan	NWC					T2.26	D2.26
- Realization of energy efficiency potentials	NWC						
- Network extension (Y/N)	NC+NWC						
- Monitoring & evaluation report	NC						
Quality control							
- energy auditor training and certification/ackrediation (e.g. use ISO 50003)	NC	T0.30	D0.30				
- interim network report audit	NC	T0.31	D0.31		D1.31		D2.31
Network finalization							
- Final networkreport	NC+NWC						

Phases	Implementation S3	Implementation S3	Monitoring&evaluation S4	Monitoring&evaluation S4		Finalization S5	Finalization S5	Evaluation S6	Evaluation S6
	Task	Deliverable	Task	Deliverable				Task	Deliverable
Network strategy and goal formulation									
Formulate strategy for the creation of innovative energy awareness culture in network organisations through continuous improvements			T4.1	D4.1					
Formulate strategy for the creation of innovative energy awareness culture in company organisation through continuous improvements			T4.2	D4.2					
Set impact in EUR (kWh) saved during the network period			T4.3	D4.3					
Set impact in EUR (kWh) saved per company during the network period			T4.4	D4.4					
Promotion and marketing									
- Communication plan (where communication channels are set, e.g. form of marketing (site-visit, telephone, email etc.))									
- Creation of information material									
Framework									
- Who is participating (regional network, sector, size, company stakeholders (bank, ESCO, energy auditor, network operator & administrator, management consultant)									
- Total network period									
- Number of companies									
- Financial support (external)									
- Network fee (for participating companies)									
- Letter of Intent (contract signed from company top management)									
- Formulate a code-of-conduct policy including joint vision formulation (e.g. including g									
Administrative model									
- Management model (LEAN, PDCA, project management, etc.)									
- Structure of network (set the different phases with clear timeline, meeting frequency, locations, invited experts)									
- Energy audit model (tools like software, database, report templates etc.)									
- Monitoring and evaluation system									
- Create a user manual				D4.19					D6.19
- Impact evaluation, network level				D4.20					D6.20
- Process evaluation, network level				D4.21					D6.21
- Impact evaluation, company level				D4.22					D6.22
- Process evaluation, company level									
Network operationalization									
- Site visits									
- Network meetings									
- Energy audit report									
- Energy action plan	T3.27	D3.27							
- Realization of energy efficiency potentials						T5.28	D5.28		
- Network extension (Y/N)			T4.29	D4.29					D6.29
- Monitoring & evaluation report									
Quality control									
- energy auditor training and certification/ackrediation (e.g. use ISO 50003)		D3.31		D4.31					
- interim network report audit									
Network finalization						T5.32	D5.32		

NC=Network Coordinator, NWC = Network Company; EA=Energy Auditor; T=Task, D=Deliverable.

4.1. A General Model for Successful IEEN

Based on the presented research and findings from ongoing IEENs, we end this book chapter by presenting a general model on how an IEEN can be managed. The model is presented below in Table 3 and consists of seven important elements:

- Network strategy and goal formulation
- Promoting and marketing
- Framework
- Administrative model
- Network operationalization
- Quality control
- Network finalization

The model is also presented in a step-by-step operationalization beginning with pre-project phase, initiation phase, energy action plan with investment estimation phase, implementation phase, monitoring and evaluation phase, finalization and evaluation phase. On the most detailed level, the model consists of suggestions for task and deliverables for every step.

This should by no means be seen as the "one-and-only-model" but rather a suggestion for a theoretical model, that by the network administrator before the launching of a network, needs to be revised in order to fit the region's culture and juridical conditions, the regarded companies which will form the network, the country's current policy mix, and many other issues.

CONCLUSION

As has been presented in this chapter, IEENs are a complex type of energy service that needs structure in order to be successfully adopted. When properly managed, an IEEN can help reduce barriers to energy efficiency in industry and support the industrial companies in their important transition to improved IEE. However, we would like to highlight that the general model proposed in this book on how an IEEN can be managed is a set of guidelines for the administrator. There cannot be an ultimate model for every IEEN and only general recommendations can be given. A system should be simplified and

adapted to the user rather than following strict prescriptions. Then it is a task for a network's administration how to adapt a model to specific networking circumstances. That is why it is very important that the administrative organization has the necessary tools, knowledge and competencies to manage the network right.

All this would help to go all the way from personal learning to distribution of knowledge among the staff of participating network companies. However, it is important to repeat that this is only the starting point in the process of continuous learning. The key to learning success is never-ending movement from practice to performance and back which helps to build an energy efficiency culture in the industrial sector.

REFERENCES

Altea, (2013). Hackeforsmodellen - Ett verktyg för ledningssystem. Retrieved December 31, 2013, from Altea Web site: http://altea.se/ hackeforsmodellen/ [In Swedish].

Ammenberg, J., Börjesson, B., Hjelm, O. (1999). Joint EMS and group certification: a cost-effective route for SMEs to achieve ISO 14001. *Greener Management International*, 28, 23-31.

Ammenberg, J., Hjelm, O. (2002). The connection between environmental management systems and continual environmental performance improvements. *Corporate Environmental Strategy, 9(2), 183-192.*

Ammenberg, J., Hjelm, O. (2003). Tracing business and environmental effects of environmental management systems: a study of networking small and medium-sized enterprises using a joint environmental management system. *Business Strategy and the Environment*, 12(3), 163-174.

Andersson, G. (1979). *Samverkan mellan små företag*. PhD dissertation, Lund University, Lund [In Swedish].

Argyris, C., Schön, D. (1974). *Theory in Practice: Increasing Professional Effectiveness*, San Francisco: Jossey-Bass.

Argyris, C. (1982). *Reasoning, Learning, and Action: Individual and Organizational*, San Francisco: Jossey-Bass.

Boddy, D., Buchanan, D. (1992). *Take the Lead: Interpersonal Skills for Project Managers.* London: Prentice-Hall International.

Brunke, J.-C., Johansson, M., Thollander, P. (2014). Empirical investigation of barriers and drivers to the adoption of energy conservation measures,

energy management practices and energy services in the Swedish iron and steel industry. *Journal of Cleaner Production*, in press.

Christoferssen, L., Larsen,.A., Togeby, M. (2006). Empirical analysis of energy management in Danish industry. *Journal of Cleaner Production,* 14(5), 516-526.

Elmhester, K. (2008). *Små företag I strategiska nätverk – hur påverkas det enskilda företagets utveckling?* PhD dissertation, Linköping University, Linköping [In Swedish].

Gronum, S., Verreynne, M., Kastelle, T. (2012). The Role of Networks in Small and Medium-Sized Enterprise Innovation and Firm Performance. *Journal of Small Business Management*, 50(2), 257–282.

Hallinan, P. (2003). *The SME battle against environmental performance - The Hackefors model in Sweden,* Linköping University, Linköping.

Hjelm, O., Gustafsson, S., Cherp, A. (2011). From tool technique to tool practice: Experiences from the project SEAMLESS: Strategic Environmental Assessment and Management in Local Authorities in Sweden. *Research report.*

Huggins, R. (2008). *Forms of Network Resource: Knowledge, Access and the Role of Inter-Firm Networks.* Centre for International Competitiveness, Cardiff School of Management, University of Wales Institute.

Ivner et al. (2014). Swedish energy manager networks for energy-intensive industry as a driver for improved energy efficiency. *ECEEE Industrial Summer Study Proceeding,* 629-635.

Jochem, E., Gruber, E. (2007). *Local learning-networks on energy efficiency in industry – successful initiative in Germany.* Germany: Elsevier Ltd.

Kanter, R. (1983). The change masters: corporate entrepreneurs at work. New York: Thomson Business Publishing.

Koewener, D., Mielicke, U. & Jochem, E. (2011). *Energy efficiency networks for companies - concept, achievments and prospects*, Karlsruhe, Germany: The Foundation of a Low-Carbon Society.

Nilsson, K., Nilsson, P. (1992). Småföretag i flerpartssamverkan – en studie av aktörer, byggstenar och fogmassa vid nätverksbyggande. *PhD dissertation, Umeå School of Business and Economics,* Umeå [In Swedish].

Paton, R., McCalman, J. (2000) *Change Management: A Guide to Effective Implementation.* SAGE Publications

Prajogo, D., Tang, A., Lai, K. (2014). The diffusion of environmental management system and its effect on environmental management

practices. *International Journal of Operations and Production Management.*

Prahalad, C.K., Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review* 68(3), 79–91.

Senge, P. (2004). *The Fifth Discipline: The Art and Practice of the Learning Organization.* Doubleday.

Sorrell, S. et al. (2000). Reducing barriers to energy efficiency in public and private organizations, SPRU's. Science and Technology Policy Research.

Thollander, P., Ottosson, M. (2010). Energy management practices in Swedish energy-intensive industries. *Journal of Cleaner Production,* 18 (12), 1125-1133.

Thollander, P., Palm, J. (2012). *Improving energy efficiency in industrial energy systems - an interdisciplinary perspective on barriers, energy audits, energy management, policies & programs.* London: Springer.

Varamäki, E., Vesalainen, J. (2003). Modelling different types of multilateral interfirm cooperation in the SME-sector. *Entrepreneurship and Regional Development Journal,* 15 (1), 27-48.

Villa, A. (2009). *A road map to the development of European SME networks: towards collaborative innovation.* London: Springer-Verlag.

Väisenen, H. et al. (2001). *Guidebook for energy audit programme developers.* SAVE-project AUDIT II.