Measurement of Competence and Professionalism in Energy Consulting

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Abstract

Rising energy prices and stricter energy laws have dramatically increased the need for energy consulting services in Germany. However, the energy consulting market lacks uniform standards, and craftsmen working in this branch have difficulties to transfer their high skill level in their original jobs into energy consulting services. To ensure a high level of service quality, it is important to develop a measuring instrument for energy consultant competence.

Energy consulting services are characterized by various sources of uncertainty and paradoxical requirements, which make it difficult to find clear-cut solutions. Therefore, a specialized competence model for energy consulting was defined, which consists of the three dimensions “area of competence”, “field of activity”, and “level of reflection mode”.

From this model, a concrete tool for the measurement of competence and professionalism in energy consulting was developed. Energy consultants deal with text-based “trilemma exercises”, real life scenarios which feature paradoxical requirements, especially regarding the dimensions of sustainable development (i.e. economic, ecological and social responsibility). Using the Heidelberg structure formation technique, the participants work out the best possible solution. By measuring the technical viability and the enforcement of sustainability, the competence and professionalism of energy consultants can be measured.

1 Introduction

Rising energy prices and the new German Energy Saving Ordinance (EnEV), which includes the now-compulsory energy certificate and which was published in accordance to the EU Directive on the Energy Performance of Buildings (EPBD), have dramatically increased the demand for energy consulting services in Germany. However, there is a lack of uniform standards, and it remains unclear, what competences are important for this branch. Craftsmen who provide energy consulting typically have a high level of competences in their original job (e.g. carpenter, chimney sweeper, system mechanic), but have difficulties transferring these skills into this new area of work, because their handicraft skills do not directly relate to the required set of energy consulting services [Lüneberger and Frenz 2009].

Energy consulting is characterised by uncertainty, which results from several factors, e.g. complexity of the domain, paradoxical requirements and perspectives, dynamic of the interaction and others. This uncertainty effectively eliminates clear-cut solutions. To take these observations into account, a specialized competence model and, in consequence, a specialized competence measurement tool are needed.

2 Theoretical model for energy consulting

To provide a theoretical foundation for measurement of competence, the existing energy consulting competence model of Lüneberger and Frenz [2009] was adapted and refined. The new theoretical model contains three dimensions: fields of activity in energy consulting, areas of competence, and levels of reflection (see Fig. 1). In the following sections, these concepts are described in further detail.

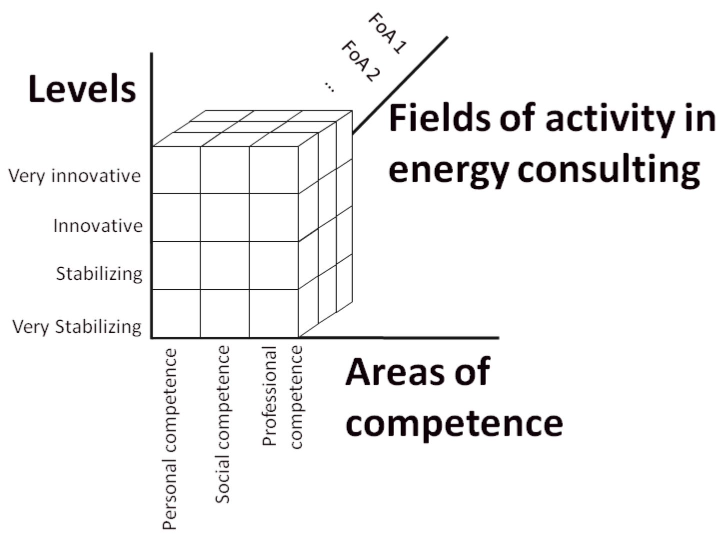

Figure 1: Competence model of energy consulting

[adapted from Lüneberger and Frenz 2009]

2.1 Validated fields of activity in energy consulting

After conducting workshops with energy consultants, Heinen et al [in proceedings] defined a validated curriculum containing ten fields of activity (FoA) along the chain of economic value added for energy consulting (see Fig. 2).

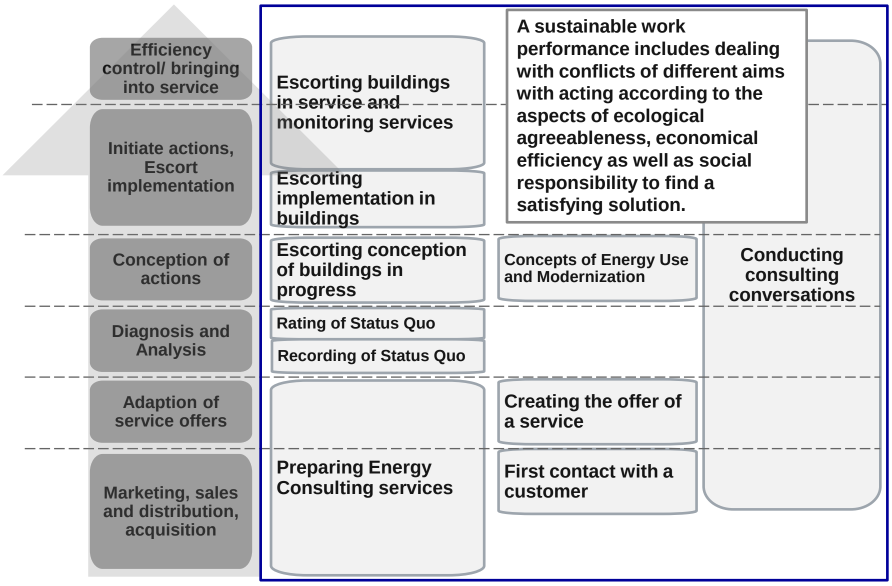

Figure 2: Validated fields of activity in energy consulting [Heinen et al, in proceedings]

Expert workshops have shown that fields of activity in energy consulting are atypical of traditional job descriptions. Energy consultants are far more often confronted with paradoxical and conflicting situations than in the fields of activity of their original jobs, e.g. chimney sweeper, carpenter or draftsman. There are several reasons for these conflicts.

Firstly, energy consultants should comply with the UNESCO definition of sustainability and with the principles of Education for Sustainable Development (ESD), which describe sustainability as an interaction and conscious balance of three dimensions: an individual must recognize, understand and evaluate the mutual dependencies (triple dilemma, or “trilemma”) between social, ecological and economic demands (see Fig. 3) [UNESCO 2010]. The balancing of this “trilemma” in practice often leads to paradoxical situations. In addition, energy consultants can have worked in different earlier occupations, so they can solve the same problem (even regarding the same sustainability dimension, e.g. improving ecology by cutting down gas emission) in various different ways.

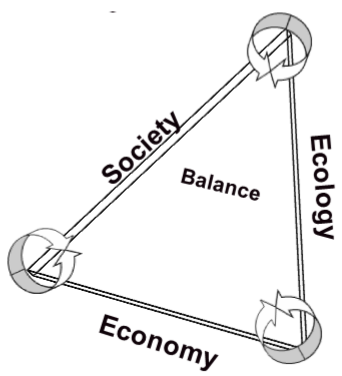

Figure 3: Triangle of sustainability [UNESCO 2010]

Secondly, energy consulting is a form of consulting, i.e. means recognizing and balancing goals and interests of all stakeholders. These dynamic interactions lead to a low level of foreseeability regarding the choice of a concrete acting strategy and the result of the interaction.

Thirdly, the technical aspects of energy consulting also cause conflicts. An energy concept e.g. which is optimized to minimize CO_2 emission, would implement a wood pellet boiler, which produces very high levels of dust. If the concept should minimize the emission of further gases (esp. dust, nitrogen oxides, sulfur oxides), a gas fired condensing boiler with solar warm water support should be proposed.

2.2 Areas of competence

Competence is defined as an cognitive asset used to solve problems, and there is a differentiation between personal, social and professional competence [Erpenbeck and von Rosenstiel 2003]:

- Personal competence is defined as the ability of an individual to act self-sufficiently, proactively and develop his own talent and skill,
- Social competence is described as the ability to cooperatively and constructively interact with different people for mutual benefit, and
- Professional competence is defined as the ability to solve abstract, object-related problems and self-sufficiently design solutions. “Professional competence” is not to be confused with “professional behaviour” (see 2.3).

Because energy consultants should act sustainably, they have to balance economical, ecological and social demands. This not only leads to complex paradoxical situations and open-ended conflicts, but also requires an especially high level of professional competence. Furthermore, a measurement of energy consulting competence should allow assertions regarding the conscious handling of the anticipated conflict situations, which leads to the third dimension of the competence model, namely the level of reflection.

2.3 Level of reflection and professional behaviour

To evaluate the conscious handling of the above mentioned conflict situations, the level of reflection and professional behaviour have to be measured. Professional behaviour is defined as the conscious interaction with paradoxical situations to achieve an acceptable compromise. Energy consultants act sustainably, e.g. they balance economic, ecological and social demands. These constraints frequently lead to paradoxical situations, and energy consultants require professional behavior to handle these conflicts of aims [Schütze 1996].

To assess professional behaviour, the theoretical model for energy consulting includes the reflection mode [Tiefel 2004], which observes how an individual reflects on a certain problem. Tiefel defines a reflection mode as a combination of

- Reflection focus, i.e. how an individual reflects different possible ways to handle a particular subject, and
- Reflection knowledge, i.e. how an individual reflects knowledge and non-knowledge regarding a particular subject.

Tiefel defines both two stabilizing and two innovative reflection modes, which in turn consist of two stabilizing and two innovative reflection foci and reflection knowledge levels (see Table 1). These results allow conclusions regarding the level of professional behavior.

Table 1: Reflection modes and their composition [Tiefel 2004]

Reflection mode	Reflection focus	Reflection knowledge
Very innovative	Flexible/complex focus: parallel integration of several point of views	Reflexive knowledge: Fluid creativity, usage of construction principles to create sth. new
Innovative	Relational focus: sequential handling of several point of views	Structure knowledge: Conscious knowledge and adaptation of construction principles
Stabilising	Hierarchical focus: own point of view preferred	Rule-based knowledge: Situational adaptation of already known solutions
Very stabilising	Dominant focus: only own point of view relevant	Recipe knowledge: Strict adherence to already known solutions

For small scale problems, it is useful to use an innovative reflection mode, so one can consciously merge all technical details, all interests of all stakeholders etc. into a big, streamlined solution. For large scale problems, it may be better to use a stabilizing reflection mode, to consciously reduce the complexity of the task and to remain able to act, instead of being "frozen" by the sheer amount of available data. To effectively use either means, professional behavior is needed.

3 Methodology: "trilemma exercises"

The theoretical model of energy consulting competence was used to develop a competence measurement tool, focusing on professional competence. The following research hypothesis was defined: "If an energy consultant works out a technically appropriate, sustainable and reflected solution, then he is competent." This hypothesis is explored using an empirical-qualitative exploration strategy, which proposes the use of semi-structured interviews and flowcharts consisting of boxes, connected by arrows [Bortz and Döring 2003].

Exemplarily, the field of activity "concepts of energy use and modernisation" (see Fig. 2) often contains paradoxical requirements, especially regarding dimensions of sustainability (i.e. simultaneous fulfillment of economic, ecological and social requirements), which in turn require high levels of professional competence and an innovative reflection mode. This observation also applies for other fields of activity in energy consulting, so results derived from research in this area can be reasonably generalized.

Energy consultant competence is best measured with situational orientation, i.e. in the context of a hands-on problem [Erpenbeck and von Rosenstiel 2003]. For energy consultants, coping with situations which contain above mentioned paradoxical requirements, especially, the triple dilemma ("trilemma") between the economic, ecological and social demands of sustainability, is relevant. Therefore, competence measurement is done by analyzing how energy consultants deal with these situations.

Following this line of thought, "trilemma exercises" were designed by expert energy consultants, i.e. textual energy consulting exercises centering on the tension between the three dimensions of sustainability. Energy consultants orally deal with a concrete energy consulting situation, in which they have to work out and present a technically viable and sustainable solution to a fictional customer. In this case, the tasks respectively focus on creation of modernization and energy concepts, professional expertise and innovative reflection mode. An example of a trilemma exercise (outtake of the "Aachen anti-pollution zone" exercise):

“A one family house (built in 1986, 200m² area, gas fired condensing boiler from 1986) in the inner city of Aachen -- a city which attracts many tourists from nearby Netherlands and Belgium and where an anti-pollution zone is being proposed – is to be energetically optimised. Develop a heating concept that is economically, ecologically and socially viable.”

Expert energy consultants developed reference solutions and worked out three basic, technically viable solutions, each with a drawback:

- A gas fired condensing boiler is inexpensive, but uses fossil fuel and is plagued by high emissions (especially CO_2), which barely fit the requirements to avoid an anti-pollution zone.
- A wood pellet boiler is also inexpensive, uses natural resources (wood) and is low in CO_2 emission, but dust emissions are 3000% above anti-pollution zone levels. These environmental restrictions would effectively cut off motorised traffic into the inner city, so tourism (a big social factor) would take a big hit.
- A heat pump is cheap, but requires well insulated walls to work efficiently. In this case, the walls (built in 1986) are too old, and replacing them would be too expensive.

They concluded that a gas fired boiler with 60% solar warm water support would be probably the solution which best combines technical viability and adherance to sustainability. They also pointed out that sustainability depends on the interpretation and the scope of the question (e.g. is nuclear energy sustainable?), and that a “perfect solution” was ruled out by definition. As a consequence, measurement and assessment techniques were designed to reflect these lines of thought.

4 Measurement

Two trilemma exercises were dealt with by novice energy consultants. As mentioned above, the empirical-qualitative exploration strategy is used, which proposes the use of semi-structured interviews and flowcharts consisting of boxes, connected by arrows [Bortz and Döring 2003]. The measurement is done with the help of the Heidelberg structure formation technique, which includes a semi structured interview, the construction of a card/arrow-network based on the interview, and the opportunity of reflect on the solution [Scheele and Groeben 1988].

4.1 Semi structured interview

The participating energy consultant reads the exercise text, and then is given time to take down notes and to prepare a spoken response to the interviewer. Then, a semi structured interview is conducted, in which the participant presents his technical solutions. The spoken answer is mainly free-form, but by posing appropriate questions or remarks, the interviewer ensures that the answers stay near to the actual hands-on problem. During the interview, the interviewer writes down each relevant thought on a separate card, resulting in a stack of written cards.

4.2 Structure formation network

The stack of cards resulting from the previous step is used by the energy consultant to construct a card-arrow-network, a.k.a. structure formation network. As a means of assistance, he also gets additional cards from the research in sustainable development. Following his line of thought, he pins the cards on a flipchart and connects them with arrows, resulting in a coherent card/arrow-network. For each technical solution, the chains of cause and effect, as well as goals and means and general thought structures, become visible.

4.3 Pyramid of sustainability

After finishing the network, the energy consultant is presented with a sheet of ten indicators for each of the three dimensions of sustainability. Respectively, only five of these ten indicators are relevant for the solution of the problem, the other five are red herrings. In the "Aachen anti-pollution zone" trilemma exercise for example, the five correct indicators are "CO_2 emission", "SO_x emisson", "NO_x emission", "Dust emission" and "Resource consumption", because they directly impact the main problem (reduction of the pollution level), whereas e.g. "animal protection" is not, because there is no direct connection in this particular problem. However, "animal protection" could be a relevant ecological indicator in a different trilemma exercise.

The participant must find out the correct five indicators, evaluate each technical solution according to these economic, ecological and social indicators with marks from "A" to "F" and weight each indicator according to importance. Each technical solution found in step 2 is evaluated using this technique: for each dimension of sustainability, an average weighted mark is scored. From this triple evaluation, a "pyramid of sustainability" can be formed, the length of the edge corresponding to the respective mark. This pyramid visualizes both the fulfillment for each dimension of sustainability, and also the mutual dependency of economic, ecological and social demands.

The solution is chosen, which best satisfies technical demands and demands of sustainability. An exemplary pyramid for the solution "gas fired condensing boiler with 60% solar warm water support" (see section 3) is seen below (see Fig. 4). According to the indicators, this solution is correctly evaluated with a "B" in ecology, a "B" in society and a "C" in economy, resulting in a slightly slanted B/B/C cut through the pyramid.

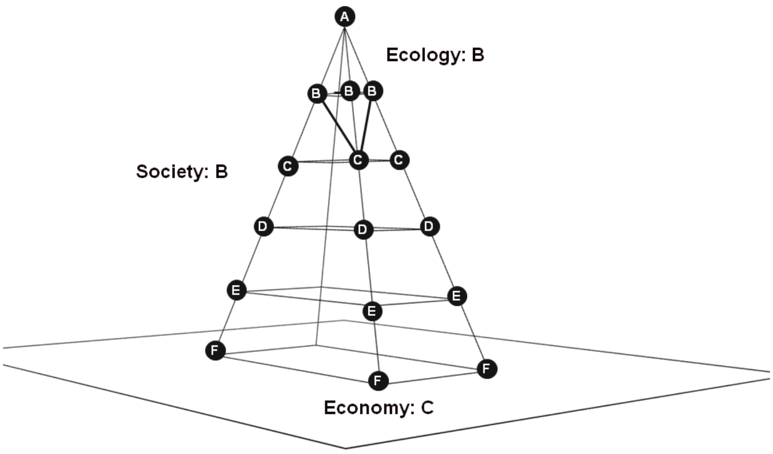

Figure 4: pyramid of sustainability (gas fired condensing boiler with 60% solar warm water support)

4.4 Reflection

After choosing the solution he favours the most from a combined technical and sustainable point of view, the energy consultant gets the opportunity to reflect on his solution and on his line of thought. He is also confronted with several alternative solutions (provided by the interviewer) and comments on these. These two steps allow conclusions regarding the reflection mode and the level of professionalism.

4.5 Performance evaluation

After finishing the above mentioned steps, the interviewer is provided with a multitude of data of the energy consultant, on which the performance can be evaluated and the competence measured. Quality, quantity and completeness improve the score. The evaluation contains four phases, of which the first two explicitly measure professional expertise.

In step 1A, the proposed passive measures are analyzed. Before thinking of a particular heating concept, an energy consultant has to use professional expertise to consider the state of the walls, the roof, the windows etc. Taking costs, utility and feasibility into account, he can improve the isolation, which in turn minimizes the needed heating energy. In this case, roof and windows must be replaced, but not the walls, because it is too expensive. Reproducing this line of thought brings a first high “professional expertise” score.

In step 1B, based on these results, the active measures are evaluated. Using his professional expertise, the energy consultant is expected to find all possible technical solutions (wood pellet boiler, heat pump, gas fired condensing boiler, solar support) and describe advantages and disadvantages regarding this particular trilemma exercise. Again, a detailed, complete report of feasibility, heating quality, environmental impact etc. for each solution produces a high score for “professional expertise”.

In step 2, the pyramids of sustainability are analyzed. For each technical solution, the interviewer checks whether the energy consultant chose the correct indicators, used a valid weighting and came to plausible results. In the context of this exercise, the importance of the anti-pollution zone has to be shown, so that not only $CO_{2,}$ but also NO_x, SO_x and dust as well are vitally important, and therefore have to be weighted accordingly. The pyramids are expected to conform to the validated pyramids constructed by the expert energy consultants.

Finally, in step 3, the reflection mode is tested. From the reflection of the own solution and the confrontation with the 3-4 alternatives, the interview can analyse if the reflection mode of the energy consultant was rather stabilizing or innovative. In this relatively small scale exercise, it is expected to use an innovative reflection mode to deliberately expose oneself to all aspects of the problem and best enforce professional behaviour.

From these four scores, a general score is derived. At the moment, several algorithms are being tested for validity. According to current research, energy consultant competence is closely related to professional expertise, so steps 1A and 1B are expected to be more important than the other two. Also, it is currently undecided whether “knockout scores” are to be established, e.g. if an energy consultant scores an “E” in both steps 1A and 1B, even two “A”s in steps 2 and 3 will not prevent the final mark being “E”. Lastly, it must be examined whether there is a certain coupling between several scores, e.g. whether you can only work out a technically viable solution if you have a certain reflection mode, and if yes, how to deal with this challenge.

5 Conclusion and outlook

A theoretical model for energy consulting competence and professionalism was defined, consisting of the three dimensions areas of competence, fields of activity in energy consulting and levels of reflection. From this model, a concept for measurement of energy consulting competence was developed, focusing on professional competence.

Current results suggest that the general approach, i.e. the combination of a “trilemma exercise” solved with help of the Heidelberg structure formation technique seems viable. The research hypothesis, that energy consultants show competence by working out a technically appropriate, sustainable and reflected solution, can be effectively analysed, and it seems that especially professional competence regarding the solution of paradoxical requirements (esp. requirements of sustainability) is a driving factor for the assessment of energy consulting services.

Using these findings, the competence measurement can be effectively refined. Future research will incorporate the development of measurement tools which also cover other areas of competence and other fields of activity, and a validation of the entire measurement concept. Further work is necessary, but up to now, workshop results are encouraging.

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