Effects of the introduction of Smart Metering on the company management of medium-sized energy suppliers


Abstract

Particularly affected are small and medium-sized power supply companies and their technical department because they have never faced such fundamental challenges concerning the entire company in the past. The effect of the introduction of smart metering on the company management can be investigated fundamentally by considering the effects on the different perspectives of the company management (institutional, functional as well as activity-oriented perspective).

Key words: smart meter, smart metering, power supply companies, company management

Smart Metering

Directive 2006/32/EC forms the basis of the introduction of smart meters. This directive shall contribute to the fact that an improvement of end energy efficiency and thus end energy savings will be attained. In Article 13 as well as in the appendix III of Directive 2006/32/EC, the recording by smart meters as well as an adjusted settlement as measures for the increase of end energy efficiency are mentioned. According to that, the settlement is to contain a graphic representation of the current as well as past energy consumption, for example (cf. Amt für Veröffentlichungen der Europäischen Union, 2006).

Smart meter and the corresponding smart metering systems are necessary so that these requirements cannot be fulfilled with the currently employed conventional meters (e.g. Ferrari meters for measuring electrical energy). Smart meters must be introduced on a national level according to the European directive 2006/32/EG “soweit es technisch machbar, finanziell vertretbar und im Vergleich zu den potenziellen Energieeinsparungen angemessen ist” (translation: “as far as technically feasible, financially acceptable and appropriate in contrast to the potential energy savings”) (cf. Amt für Veröffentlichungen der Europäischen Union, 2006, p. 9).

It must be kept in mind that these smart metering systems are not (only) used for increasing the end energy efficiency in some countries. By means of an example, the introduction of smart metering in Italy in 2011 can be mentioned. The approximately 31 m. smart meters, which can be read and controlled remotely via the power lines by the electricity supplier Enel S.p.A

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using PLC-technology\textsuperscript{3}, have been installed for two reasons. The smart meters are primarily used for monitoring the electricity grid and performance reduction (by a remote disconnection module in the smart meter) and for protecting the (deficit) electricity grid. In addition, the smart metering technology installed there is considerably simpler and less designed for high (customer) data security in contrast to the technology planned in Germany.

**Energy industry in Germany**

In 1998, the energy market in Germany was liberalised by a revision of the energy economy law to the extent that the markets responsible for the supply of households and companies as well as other parts of the delivery chain are related to one another in complete competition according to a polypoly. Before this liberalisation, there was a monopoly in a network area regarding energy supply, for example. The creation of a market with total competition was to lead to decreasing energy prices and increased transparency with regards to energy supply, among others. In addition, a state regulation of the energy market in Germany was introduced during the years 2007 – 2009 so that the corresponding regulator (in Germany the Federal Network Agency) has to approve the energy prices (or individual components of energy prices) for end customers, as well as determine a profit cap for energy supply companies.

In 2011, the percentage of German households deciding for a new power supplier amounted to about 26\% (cf. Bocholter Energie- und Wasserversorgung GmbH, 2013, p. 18). As an example for the comparably low switching rate in a middle-sized city (about 75,000 inhabitants (cf. Bocholt, 2013), the Bocholter Energie und Wasserversorgung GmbH announces a switching rate in the amount of 5\% for 2011, which is considerably lower than the German national average (cf. Bocholter Energie- und Wasserversorgung GmbH, 2013, p.18).

Due to the medially strongly accompanied bankruptcies of the German private companies Teldafax (2011-06) and Flexstrom (2013-04), it is expected that the switching rates for the years 2012 and 2013 will presumably continue to decrease all over Germany since customers confide more and more in local energy suppliers. For this reason, customers will probably be willing to pay slightly higher energy prices in exchange for a secure energy supply.

Currently, approximately 10-15\% of German households have an annual electricity consumption of $> 6.000 \text{ kWh}$ and must be equipped with smart metering systems (called measuring systems in the German Energy Economy Law) according to the will of the German legislature and as soon as technically available. Additionally, those smart metering systems must meet the requirements of the Energy Economy Law. Due to the fact that all customers of power consumption with an annual energy consumption $< 100.000 \text{ kWh}$ must be prognosticated and recognized via a standard load profile, there are currently no purchase benefits for special (household) customer groups as long as they show $<100.000 \text{ kWh}$ annual energy consumption. Distributors must procure energy at the so-called energy stock exchange \textsuperscript{4} according to the determined standard

\textsuperscript{3}Powerline Communication: Technology for transmitting data via power cables, for example.

\textsuperscript{4}in Germany: European Energy Exchange AG (EEX), Leizig (Germany)
load profile even if a separate balancing would be possible and even if that brought cost benefits for the customers, and are not able to carry out any prognosis and balancing adapted to the customer behaviour. In addition and as described above, energy prices and maximal profits are state-regulated so that companies subject to the regulation are not able to follow a normal profit maximisation.

Currently, there are no smart metering systems available on the market, which comply with the requirements of the German Energy Economy Law and annexed regulations, (technical) rules and norms since these documents have not yet been (finally) published in some cases. This is problematic because manufacturers are obliged to have themselves certified according to the mentioned documents to be able to produce devices for business operation conformable to law.

The company size of power supply companies influences the strategic and operative opportunities for action regarding smart metering. Large and larger power supply companies may try to actively co-create the framework conditions of the external company environment, e.g. by participating in certification committees and cooperation in (technical) rules and norms. Small and medium-sized power supply companies often do not have these possibilities available due to lacking resources.

In the following, medium-sized power supply companies in Germany shall be looked at. The division of companies into a certain category is done based on the definition in the EU law according the number of employees. That implies that a power supply company falls into the category medium-sized company if it employs between 50 and 249 employees.

**Company and corporate management**

The term *company* is partially also used as a synonym with the terms business and enterprise even if these terms have a different meaning. Furthermore, the varying definitions of the term company can be distinguished by different perspectives (e.g. company as a system, legal system or as an accumulation of resources and/or skills).

**Corporate management**

Company management means making, imposing, questioning and being responsible for decisions, which may have been achieved based on a rational calculus or also intuitively (cf. Scherm, 2013, p. 56-57). According to Koch, Schreyögg and Steinmann, (2013) parts of the company management or the management of companies can be regarded as teachable and learnable qualifications.

According to this understanding, the effects of introducing smart metering on the company management of medium-sized power supply companies shall be scientifically investigated in order to get insights which are usable for the management research.
Comparable with the term *company*, also *company management* may be differently interpreted and considered from different perspectives. As far as the perspectives are concerned, a difference between an institutional, functional as well as activity-oriented perspective can be made depending on the target of the consideration (cf. Scherm, 2013, p. 18-19). Those different perspectives will be considered in the following related to the effects of an introduction of smart metering.

**Institutional perspective**

Rules and structures, which are necessary for the fulfilment of the management task in the company, are taken into account regarding the institutional perspective. In this case, the term management comprises all positions in the company, which have an authority to issue and thus recognize a management task (=manager(s)).

The division into top, middle and lower management can be regarded as classic since it comprises all positions with authority to issue across functions and cross-departmental starting from the topmost company level (=company management) to the lowest level (=group leaders or masters) (cf. Scherm, 2013, p.22). In addition, it can be seen that the concrete requirements, e.g. on performance and behaviour, as well as the side effects from the upper to the lower management are increasing and the given scope is decreasing. In the following, the three management levels, which are shown in figure 1, will be described.

![Management levels](image)

Figure 1: Management levels (based on Scherm, 2013, p. 22)

The formulation of corporate policy as well as the management of the company as a whole is the responsibility of the topmost management level, which also stands for the topmost level of the corporate knowledge creation. The corporate formation of will contains the basic purpose of the company as well as normative (=long-term) targets concerning the company as a whole. The decisions made on the topmost management level, which are among others formulated as strategies binding in the long term, are the basis for the decisions, which are downstream on the lower two levels (cf. Scherm, 2013, p. 23). In a middle-sized energy supplier or public utility company, the topmost management level is represented by the management and board of directors, if necessary.
The allocation to the middle management level, which is obliged to report to the hierarchically higher level as well as bound by instruction and authorized to issue directives to the next level, mostly takes place subjectively and with reference to the individual case. The corporate policy given by the topmost management level first of all concerns the managers or positions working on this (middle) level, which are not involved in the business-political decisions themselves. The implementation of regulations made on the topmost level can be regarded as the principal duty (cf. Scherm, 2013, p. 13). Heads of department can be found in the middle management level in cases of middle-sized energy suppliers.

This lower level, which is more oriented towards the executing employees than towards the middle management level, has its emphasis on controlling the execution process and operative control. The operative corporate management and implementation of strategic standards determined by the middle level is part of the lower management level (cf. Scherm, 2013, p. 23). The lower management level is occupied by group leaders in middle-sized energy supply companies or public utility companies.

Smart metering concerns managers on all three management levels as well as the employees below these three management levels working operatively in the company.

**Functional perspective**

Regarding the functional perspective, the actions for the performance process in the company are taken into account. In doing so, the tasks of the execution process and tasks, which go beyond that, are analysed. At this point, tasks for controlling companies can be mentioned by means of an example. These tasks are called management tasks or management functions and are recognized by several positions in the company. The higher a manager is located in the company hierarchy, the bigger his share of management tasks in his overall task in the normal case, or the lower his share in operational tasks. Following the trend to flatter hierarchies, even managers of lower management levels may be commissioned almost exclusively with management tasks or functions (cf. Scherm, 2013, p. 19).

Operational functions are superimposed by the management tasks and are linked with them, whereby the management tasks have a steering effect on the different operational functions. Operational functions in a company are for example purchase, production, procurement and sales (cf. Koch/Schreyögg, 2007, p. 7). The linking of operational and management functions is graphically represented in figure 2.

Based on this, the company management can be understood as a complex of control tasks, which must be fulfilled within the provision of services in the company (cf. Koch/Schreyögg, 2007, p. 8).

According to Koch’s and Schreyögg’s view (2007), the differentiation of management and operational functions illustrates the relationship of the management and business economics at the same time. Business economics consisting of different (operational) function theories is opposed
to the management theory as a cross-section function theory, which inserts itself as a partial function theory into business economics (cf. KOCH/SCHREYÖGG, 2007, S. 8).

The five management functions according to Harold Koontz and Cyril O’Donnell from 1955 can be regarded as standard within the management theory:

1. Planning
2. Organizing
3. Staffing
4. Direction
5. Controlling

(cf. KOCH/SCHREYÖGG, 2007, p. 8)

Koontz and O’Donnell regard these five management functions in their conception as concessive sequences of phases, which can cohesively be understood as a classic management process (cf. KOCH/SCHREYÖGG, 2007, p. 8). This temporal (linear) context of management functions among one another must be regarded as critical under the aspect that management functions cannot be isolated in practice, as described by Koontz and O’Donnell (cf. KOCH/SCHREYÖGG/STEINMANN, 2013, p. 148 or also SCHERM, 2013, p. 20). According to the critical observation of the classic management process, an adaptive conception of the management process is recommended by Koch, Schreyögg and Steinmann, among others (2013). This system-theoretic approach comprises the relationships of management functions among one another as well as their relationships to adjourning systems (cf. KOCH/SCHREYÖGG/STEINMANN, 2013, p. 148).

The planning can be regarded as initial point of the (modern) management process despite the already mentioned aspects, in which aspects such as the determination of targets and action alternatives are considered. The planning horizon can be short to medium term in this phase and depending on the significance for the company, regarded as operative or even strategic planning (cf. SCHERM, 2013, p. 21). Smart metering offers different chances and risks so that it must be determined which aims should be pursued by smart metering, among others in the course of planning. This way, a difference between the pure fulfilment of legal regulations and the fulfilment of an extensive smart-metering system can be made.
To be able to fulfil the company task based on the division of labour, structures and rules are created through organisation. For this purpose, the overall task is divided into partial tasks, which can be fulfilled through individual organisational units (e.g. positions, departments or divisions). In addition, the processes between organisational units are regulated as well as responsibilities and competences assigned. The establishment of a communication system for providing organizational units with information for the fulfilment of tasks is also the organisation’s responsibility (cf. SCHERM, 2013, p. 21). Changes of business processes have an effect on the organisation itself. The introduction of IT-systems for the operation of a smart-metering system is possibly inefficient for the individual energy supplier so that there is a choice between out- or also insourcing, or even new (modern) forms of organisation lend themselves (e.g. network organisation, virtual organisation or special strategic alliances).

The vacancies created by the organisation are filled in line with demand through the process of staffing. Any consecutive securing of requirements on the personnel as well as further aspects of staffing (among others appropriate working conditions, personnel evaluation and payment) is also part of the management function of staffing (cf. SCHERM, 2013, p. 21). The staffing is affected since the introduction and the operation of a smart-metering solution puts special requirements on the staff. For example, it can be assumed that in the future fitters in energy suppliers must have knowledge regarding communication systems since the data of meters installed at the customers must be transferred via communication networks to the data-processing IT-systems. At the same time, more customers will soon be able to check their energy consumption online, which will surely lead to increased questions. Regarding to that, service personnel and customer service agents must be trained.

The management function management comprises the alignment of employee behaviour to company goals since employer goals may deviate from company goals. Instruments of management within a clear framework are motivation and behaviour management by the managers (cf. SCHERM, 2013, p. 21). The introduction of smart metering will concern some organisational parts more than others. For example, it may be that some employees won’t be able to get along with the new metering technology (or do not want to) or even feel threatened by it. All employees must be qualified (=management function: staffing) and motivated (=managerial function: direction) to be able to introduce and operate smart metering successfully.

The function of controlling, which is in a constant interactive relationship with other management functions is assigned an extensive reflection task. The decisions made within the functions planning, organisation, staffing and direction as well as the coordination of decisions among themselves are reflected, questioned and examined by controlling right from the beginning (cf. SCHERM, 2013, p. 21-22). In order to successfully manage the extensive challenges in introducing and operating a smart-metering system, a reflection function (=management function) as well as information function (=management supporting function) of controlling is necessary.

The functional perspective enables the systematic analysis of the bundled tasks of the company management and the managers commissioned with it, even if the practical jobs of managers deviate from the theoretical activities (on the first glance) (cf. SCHERM, 2013, p.22). The examples mentioned in connection with the description of the five management functions show that the management functions are influenced by the introduction of smart-metering systems.
Activity-oriented perspective

Different studies on the activities by managers identified the (1) permanent problem solution, (2) complexity and uncertainty, (3) random and short working processes, (4) large share of conversation and (5) manifold contacts as the five typical characteristics of manager activities in companies (cf. Koch/Schreyögg/Steinmann, 2013, p. 14-15).

In dependence of the allocated task, the hierarchic classification, the company individual circumstances as well as internal and external restrictions, managers are subject to limitations of their scope to different degree, in which they are able to organize their activities freely. The activities to be observed among managers do not say anything about the job contents or management tasks without the densification to manager roles. The role concept developed by Mintzberg, which differentiates between three role groups with altogether ten differentiating roles, can be regarded as a standard within the management theory (cf. Scherm, 2013, p. 25). Regarding the role groups it is about interpersonal roles, informational roles as well as decision-related roles. The ten management roles according to Mintzberg are generally valid for each management position, such as the already described management functions (cf. Scherm, 2013, p. 25).

Provided the described management functions and roles, which are in a company-individual context, are not realized by a manager, it must be assumed that this manager does not attain a good company-related result. The management functions and roles represent ought statements to be fulfilled. The classic management process is not affected by it (cf. Koch/Schreyögg/Steinmann, 2013, p. 21-22). The introduction and operation of smart metering now requires the fulfilment of all management roles to a considerably increased extent by managers of the technical department(s), which were little affected by (technical) changes during the past years.

Manager’s abilities

The tasks derived from management functions and roles can only be fulfilled by managers provided they have certain preconditions or respective abilities for solving tasks successfully. Technical, social and analytical/conceptual competences could be identified as key-competences (hard skills) for the successful accomplishment of management functions.

Technical skills comprise the task-related application (theoretical) of management skills and respective methods (e.g. knowledge about project management, cost calculation). Social skills contain capabilities concerning the person-related task-fulfilment, e.g. conflict management, willingness for cooperation, intercultural understanding. The realisation of complex and unclear problems fields as well as their structuring for deriving action concepts, which are easy to handle are among the conceptual skills. Recognition of (strategic) contexts is an example of conceptual skills (cf. Koch/Schreyögg/Steinmann, 2013, p. 23-24).

In contrast to social skills, the meaning of technical and conceptual skills is not identical on each management level. On the topmost level, high requirements are put on conceptual skills
as well as low requirements on technical skills. On the lower level, on the other hand, high
requirements are put on technical and low requirements on conceptual skills. Figure 3 represents
this relationship graphically.

![Figure 3: Management levels and the different requirements on the management skills (based
on Scherm, 2010, p. 30)](image)

If few (technical) innovations were introduced in (middle-sized) energy supply companies in
the past, smart metering puts considerable requirements on managers. In addition to high
requirements on technical abilities (among other due to the new metering technologies and IT-
technology), the analytical (e.g. effects of the introduction of smart metering) and also social
capabilities (for example through motivation of employees to manage the innovation task) of
concerned managers are requested.

**Corporate culture**

On a macro-organisational level, corporate culture has some significance for the decision proces-
ses in the management. It represents a non-graspable phenomenon and comprises the entity of
dominating patterns of thinking, value orientations and behavioural norms in a company. They
represent the result as well as medium of social interaction in a company, which is subject to a
constant change of forms and cultural content. The development of subcultures of the corporate
structure with different norms and value patterns, which may also concern individual sections/
divisions as well as groups, is possible too (cf. Scherm, 2013, p. 40-41).

Since corporate culture influences manager’s perceptions and preferences, it has an action-
guiding effect. As a result, there is interdependency between strategy and corporate culture.
Thus, the corporate culture plays a meaningful role for the strategic management. This way
corporate culture causes an unconscious selection of present information for example, which
may mean major effects on the strategy formulation (cf. Scherm, 2013, p. 43).

At the same time interdependences between corporate culture and corporate structure must
be taken into account since structures may either form and/or prevent culture, as well as an
existing corporate culture have effects on the entrepreneurial leeway (cf. Scherm, 2013, p.
44). This way corporate culture also has an effect on the introduction and operation of smart
metering systems.
Conclusion

Smart metering is introduced because it is desired by the legal organs of the European Union and Germany.

Most potential customers (households as well as companies) are not familiar with the possibilities and thus the possible benefit of smart metering. As a result, there is currently (almost) no demand for a possible smart metering product. The expected high costs of a smart metering product will additionally deter many potential customers from consumption so that there will be hardly any voluntary consumers. To save energy, smart-metering users will have to change or adapt their energy consumption pattern, which is not always possible or desired. Besides (possible) energy savings and thus connected costs savings (e.g. energy which has not been consumed, does not have to be paid), there is also the possibility that consumption shifts may lead to cost reductions. However, this makes a suitable rate with at least 2 different price zones necessary (example: energy costs 0.10 € more per consumed kWh between 12 and 2 pm than between 2 pm and 12 pm.

Another possibility would be that customers receive a reward by power supply companies if they save energy (e.g. bonus payments if the energy consumption can be reduced in a certain period of time). Cost-decreasing effects are additionally possible by exchanging devices with a bad energy efficiency class, also without using smart metering (e.g. using LED technologies when it comes to lighting).

Even if smart metering increases the transparency concerning the energy consumption of one’s own, only a very small number of customers will be interested in it in the medium to long run. Most customers will ascribe little or no benefits to possible energy efficiency increases, and therefore reject smart metering. This particularly applies if (behavioural) changes do not considerably decrease the costs of the obligatory smart metering.

On part of the power supply companies it must be kept in mind that there had been no larger and more extensive changes of the framework conditions of the German energy market for many decades. That implied that the liberalisation and regulation of the German energy market confronted power supply companies with bigger problems (conditioned by sales). Through the change of the (German) energy market, power supply companies had to learn to adapt to the new requirements.

Considering the explanations regarding the different perspectives of company management, the manager skills as well as company culture make clear that smart metering has effects on the company management of (medium-sized) power supply companies. Further research may be able to show which perspectives or special partial areas of company management are particularly affected by the introduction as well as operation of a smart metering system.

Another aspect is that smart meters in Germany must be exchanged more frequently in contrast to Ferrari meters for example, and require smart metering systems for the use of electrical energy (e.g. for data transfer, processing and visualisation). For example, there is the possibility that
the development and operation of the smart metering infrastructure requires more energy than assumed during the planning of legal standards. The view is supported by the fact that energy savings by smart meters in the amount of up to 15 % have been assumed until about 2009. However, current studies take energy savings in the amount of 1.5 % on average as a starting point (ERNST & YOUNG GMBH, 2013). On the other hand, smart metering could be the basis for future energy supply due to the fact that this technology first of all enables the usage of regenerative energies or supports it comprehensively.

To sum up it can be said that the introduction of smart metering is a big challenge for the European Union offering both chances and risks for the different parties involved.
References


