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# Change of Electricity Distribution Industry: Drivers and Opening Business Opportunities

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# ABSTRACT

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**Change of Electricity Distribution Industry:**
**Drivers and Opening Business Opportunities**
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As a result of the recent regulatory amendments and other development trends in the electricity distribution business, the sector is currently witnessing radical restructuring that will eventually impact the business logics of the sector. This report represents upcoming changes in the electricity distribution industry and concentrates on the factors that are expected to be the most fundamental ones.

Electricity network companies nowadays struggle with legislative and regulatory requirements that focus on both the operational efficiency and the reliability of electricity distribution networks. The forces that have an impact on the distribution network companies can be put into three main categories that define the transformation at a general level. Those are: (1) a requirement for a more functional marketplace for energy, (2) environmental aspects (combating climate change etc.), and (3) a strongly emphasized requirement for the security of energy supply. The first point arises from the legislators' attempt to increase competition in electricity retail markets, the second one concerns both environmental protection and human safety issues, and the third one indicates societies' reduced willingness to accept interruptions in electricity supply.

In the future, regulation of electricity distribution business may lower the threshold for building more weather-resistant networks, which in turn means increased underground cabling. This development pattern is reinforced by tightening safety and environmental regulations that ultimately make the overhead lines expensive to build and maintain. The changes will require new approaches particularly in network planning, construction, and maintenance. The concept for planning, constructing, and maintaining cable networks is necessary because the interdependencies between network operations are strong, in other words, the nature of the operation requires a linkage to other operations.

*Keywords:* Industry evolution, Market emergence, Business model, Value chain analysis, Outsourcing, Electricity distribution

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# 1 INTRODUCTION

## 1.1 Background

Infrastructure network industries constitute a vital part of societies' basic services. These services include for instance electricity distribution, gas distribution, water and sewage service, and district heating. The services have traditionally been provided by public utilities, but nowadays the ownership structures are more diverse, and also a public private partnership approach is gaining popularity. Infrastructure networks typically constitute natural monopolies in their operating areas. The level of governmental intervention differs from one sector to another. For instance, in energy sector, having a national sector-specific regulator is obligatory under the prevailing EU legislation, and the costs of services are tightly regulated.

Resulting from the recent regulatory amendments as well as other development trends of electricity distribution business, the sector is currently witnessing radical restructuring that will eventually impact the business logics of the sector. Electricity network companies nowadays struggle with more and more demanding legislative and regulatory requirements focusing on both the operational efficiency of the electricity distribution companies, and the reliability of electricity distribution networks. Added to this, there is a serious concern about the lack of skilled employees in the future especially in the Western European countries. All these things together make the future operating environment challenging not only for the electricity network companies but also for the service providers operating in the sector.

This report focuses on the electricity distribution, where the particular emphasis is on development of supporting activities, which in turn create a basis for further analysis of opening new service opportunities in the sector. The research was implemented as a company-driven research project at Lappeenranta University of Technology. The objective of the project was to define characteristics of a competitive service provider in the field of infrastructure network services in the future.

The report is divided into three sections. The first section, which consists of Chapters 2 and 3, describes the analysis process of this study and the tools applied in the process and summarizes the analyzed case. The second part of this study, Chapters 4, 5 and 6, introduces forces that shape the business environment of electricity distribution companies and provides an overview of the present state of value chains. Furthermore, Chapter 6 analyzes potential changes in the structures of network companies in the future. This chapter addresses in brief those potential services to be privatized in short and medium term that will most likely create new market potential for infrastructure service market.

Construction of cable networks has been selected for a closer analysis from the previous research setting in the third section of the study in the Chapter 7. The reason why cable network construction is an interesting area is based on the recent regulatory amendments that remarkably increase the importance of reliable, efficient, and reasonably priced electricity distribution. Cabling has been analyzed from the following aspects: the trends that are driving companies to invest in cable networks; required skills, capabilities, and activities of cable network construction; and future markets of cable network construction. As a result of the analysis, this report presents a proposal for a future cabling concept that could be utilized to improve performance in the network construction. On the other hand, the concept concretizes some of the issues that the distribution network industry will face during an era of changing regulation.

## 1.2 Objectives and research questions

The study is linked with the wider discussion about outsourcing of activities, which in particular emphasizes the potential issues of emerging markets. In this, the focus is on the service markets, which are formed through changes in critical determinants. This change in turn can be described through political, environmental, social, demographical, technological, and economical factors in a particular industry. The factors unavoidably move competitive balance in the industry and may cause radical restructuring of value chains. The previous statement is

commonly found in the strategy literature. However, only a few analytical insights have been provided so far into the interdependence between the environment and the structure of a firm.

Numerous studies have been made about the process on how to outsource activities efficiently, whereas significantly fewer researches have concentrated on the issue of how to focus outsourcing, and how to make right organizational realignments during an era of strategic change. This research provides perspectives to certain questions that arise because of the lacking theoretical literature on operations management in a turbulent environment. The report connects an industry-level analysis to a resource management model, in which outsourcing opportunities can most likely be found. Secondly, the behaviour of public sector has received little attention from the perspective of changing customer needs and operations management in the management literature. The public-private partnership has been in the focus of recent studies that analyze the particular phenomena mostly from the viewpoint of operation costs. These studies have concentrated on the mechanisms of cooperation between public sector actors and private firms, which limits the scope of analysis to a risk-benefit analysis in particular conditions.

The objective of this study is to expand the discussion about outsourcing a single transaction towards the analysis of a resource portfolio of the firm, in which the outsourcing opportunities are formed. The question of the industry change becomes relevant in this connection, because it is the driving force for an architectural change in the firms. This point of view has gained increasing popularity in management research because of the contemporary developments in the general economical environment. Today, new markets often emerge from the re-organization of the value chain as the firms focus on their core competencies, which is evident especially in this case. The report represents upcoming changes in the electricity distribution industry and concentrates on figuring out the factors that are expected to be the most likely sources of fundamental changes in the sector. In this study, the research problem is linked to the

questions: How do new markets emerge and what are the organizational constraints for market emergence?

### 1.3 Method

The practical methodological issues associated with the research had a significant role in determining the research framework. Moreover, the experience of the research group has been of essential importance in interpretation of the materials and establishing the basis of analysis. Therefore, the characteristics of this study would best be described as a constructive research approach complemented with some characteristics of case study research (Figure 1) (Kasanen et al. 1991).

According Kasanen et al. (1991), the theoretical connection and practical relevance of the research problem are the two most important factors in the constructive research, which determine the potential of the research to deliver new outputs. The research potential, on the other hand, guides the researcher to choose a problem that is reasonable to explore. However, the constructive research approach relies on the expected practical solution, which finally defines the real value of the particular research. The quality of the delivered solution can be assessed through market tests, which describes willingness of the management to apply the research findings in practice (Kasanen et al. 1991).

In general, the constructive research approach offers guidelines for research strategies, but it does not give a toolbox for a problem-solving process. Therefore, studies based on the constructive research approach are typically complemented with characteristics from other approaches. It is typical that expedients of case study research are utilized in problem solving in the constructive research because of relative mindsets and shared goals between approaches. In this research, the practical functioning and theoretical contribution were based on a case study approach. The selected research approach allowed investigating a contemporary phenomenon, the boundaries of which cannot be defined clearly in a real-life context (Yin 994). A pattern matching logic was the

mode of the case analysis. In this particular analysis mode, empirical evidence is gathered to support the theoretical findings (Yin 1994).

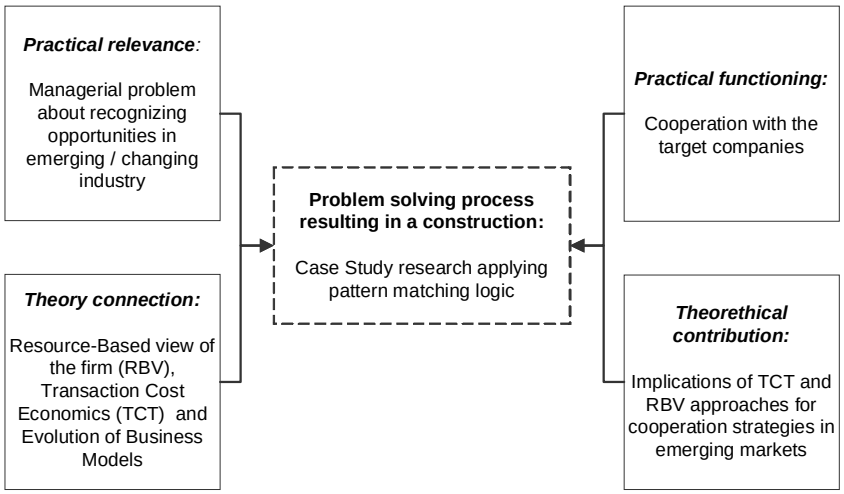


**Figure 1 Framework of the research (Kasanen et al. 1991)**

A professional team made conclusions of the analysis results of the case studies and arrived at two main topics: first, optional future states of the distribution industry that have an impact on the future customer needs were analyzed, and second, behavioural assumptions of the distribution network companies, which limit the occurrence of these options were determined. The above-mentioned topics were interlinked resulting in specified growth options of the service provider. In the structuring processes, the literature review contributes to the analysis of the effects of a changing industry on the valuable resources of the supply industry; these effects are of significance, as they may radically change the competitive basis.

The final result of the research is a construction that describes the characteristics of a cable network construction concept. The description of the concept includes activities that are needed in an efficient service process, interdependencies between parts of the concept, and assessment of network companies' capabilities to develop requisite knowledge and resources. The assessment also includes a description of the future market in cabling. The construction is verified by continuous discussion with professionals in service companies.

# 2 THEORETHICAL BACKGROUND

The theoretical framework focuses on exploring and explaining the creation of new intermediate markets and value-chain reorganization, and later describes how these impact on the capability development and achieving competitive advantage in an industry. Especially, the study aims to increase understanding about the nature of the decision-making process of strategic outsourcing. The applied theories constitute a chain from forces that are shaping the industry to the selection between optional development actions and governance modes of impacted parts of the value chain. Hence, the research contributes to the early levels of recognition process of the strategic options, but also enlightens the challenge to find solutions for reorganization problems in an era of change.

Reorganization is observed from the aspects of market option availability, the strategic value of capabilities, and selection of appropriate governance mode of an activity. The research is based on three independent parts, (1) description of the change in the industry, (2) influence of customer needs on the relevance of capabilities, and (3) developing and assessing optional boundaries of a firm (Figure 2).

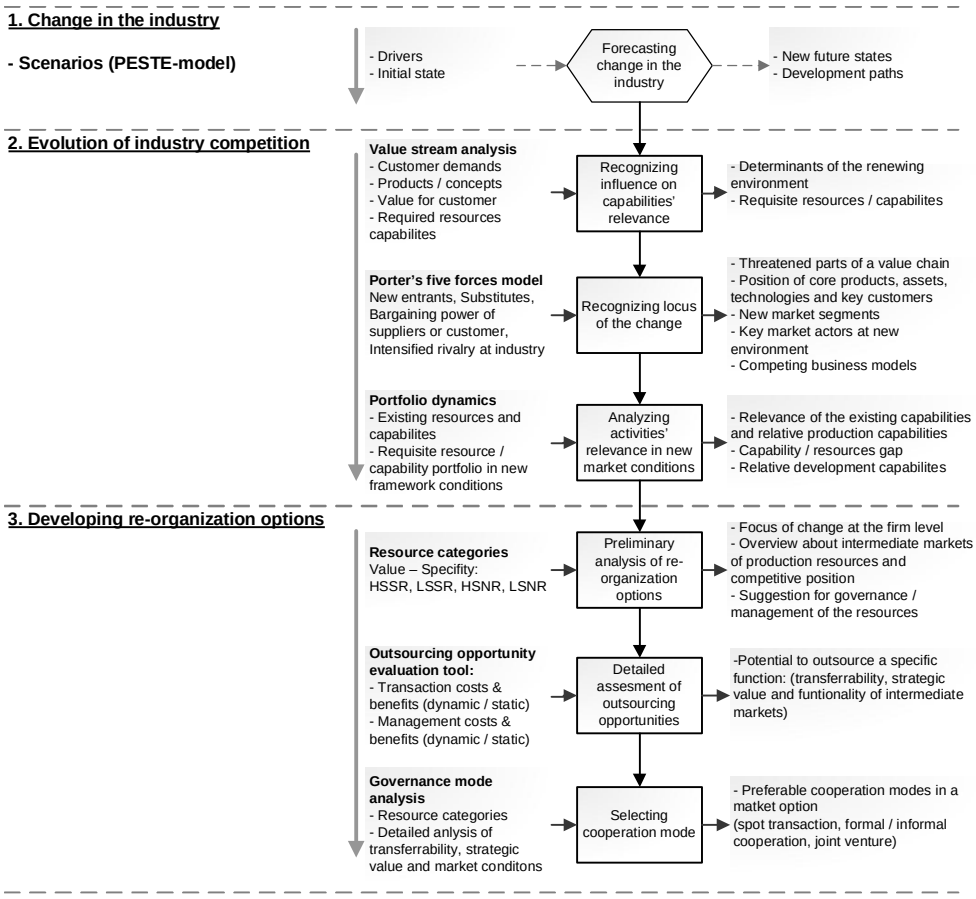


**Figure 2 Summary of the analysis process**

The drivers of the change are at the hub in the first part of the analysis. The drivers of business environment are considered external forces and trends that cannot be changed or radically influenced by actions of a single company. In other words, the drivers shape the framework conditions of an industry in spite of the form of the industry structure, and thus, the industry change may change the requisite capabilities or the combination of valuable resources, and later, create heterogeneity to the firms' performance. Various factors of industry transformation are evaluated through the PESTE model (Barney & Hesterley 2006; Hitt & Hoskinson 2006), which locates the origins of the drivers in several sources; political, economical, social, technological, and environmental factors. The analysis explores the most reasonable changes in the business environment, which are turned into terms of external customer requirements or changes in the customer behaviour and internal requisite competitive factors. Based on the above, new future stages can be figured and the most likely development paths can be evaluated through

scenarios. Appraising the development of market offering assists later in characterising the firms' relative competitive position. In that way, firms' potential to strike options for building competitive advantage can be evaluated.

The last stage of understanding the nature of change is to link the arising requirements with the firm's existing portfolio, which makes it possible to anticipate the impacts on the required management and productive capabilities, and, thus, the firm's ability to adapt its operations to the business environment. According to the previous discussion, the capabilities have to be evaluated at two levels, that is, from the management perspective and applicability of resources. The approach focuses macro-level transformation to the activity level in a firm and guides the later selection of a suitable resource portfolio and governance modes of activities.

The options to develop or manage requisite resources and capabilities are explored in the last section of the study. The decision model has been built on two partially overlapping theoretical contingents: transaction cost theory (Coase 1937; Rhiordan & Williansom 1985) and resource-based (and knowledge-based) view (Barney 1991; Wernerfelt 1984; Teece et al. 1997), which guide the selection between governance modes of activities. The transaction cost theory states that first, a market will always offer the lowest costs of production of a good and, secondly, asset specificity is the key explanation of the difference in the transaction costs and it determines their level, and thereby has an influence on the transferability of a resource (Rhiordan & Williansom 1985). The aspect of resource transferability completely lacks the dimension of the strategic value of resources, which describes a resource's potential to gain value for a firm (Arnold 2000; Blomqvist et al. 2000; Jacobides 2005; Jacobides & Billinger 2006; Holcomb & Hitt 2007; Watratjakul 2005). The resources can be defined as assets, capabilities, processes, and knowledge that enable the implementation of strategies to improve efficiency and effectiveness in relation to the market needs. One key

element in the evaluation of the strategic aspect of resources is the relation with the concept of competitive advantage. A firm can attain competitive advantage when its returns are above the normal level of the industry, and the firm can sustain it by valuable, rare, inimitable, and non-substitutable resources. The resources will create sustained competitive advantage by allowing to exploit opportunities in the markets and to neutralize threats from the competitors (Barney, 1991).

By combining the arguments of transaction costs economics with the resource-based view, we can define a two-dimensional framework for the conditions of the boundaries of the firm and value chain re-organization, *Hybrid-features of boundary decision* (Arnold 2000; Blomqvist et al. 2000; Holcomb & Hitt 2007; Jacobides 2005; Jacobides & Hitt 2005; Jacobides & Billinger 2006; Watratjakul 2005). The strategic value of resources create constraints for a firm that is moving activities outside the existing organizational boundaries, owing to the interdependence between resources, products, and firm's abilities to implement strategies, which most completely exploit their individuality and uniqueness (Barney 1986; Wernerfelt 1984). Transferability sets constraints for potential outsourcing proposals both from the supplier's and the firms' point of the view. The resources with a high transferability and a low specificity are common recourses, which have market potential outside the firm boundaries and can be purchased from the markets with a low risk, which might indicate maturity and low attractiveness of markets at the same time. Transferring high specific resources outside the existing boundaries of a firm can be challenging for high complexity of monitoring and contracting. Those factors may decrease incentives of suppliers to increase efficiency, and thus, enable opportunistic behaviour, which lead growing costs of contracting (Rhiordan & Williansom 1985; Holcomb & Hitt 2007).

The complete analysis model for outsourcing can be described by applying hybrid-features of boundary decision to the analysis of (1) a firm's resources (Watratjakul 2005), (2) development of purchasing

options (Jacobides 2005; Holcomb & Hitt 2007) and (3) selection of appropriate cooperation mode (Arnold 2000; Blomqvist et al. 2000). The approach leads to the following implications about the steps of the analysis process.

1. The firm's resources can be divided into four categories based on their value and transferability:

2. Outsourcing has two general objectives, substitution of an activity and enhancing capability basis, which are dependent on the resource category (Blomqvist et al. 2000; Holcomb & Hitt 2007). Substitution of an activity drives outsourcing of non-strategic activities, where a supplier would offer higher flexibility and decreased unit costs. Enhancing capability basis is related to the strategic activities, where using market options may offer remarkable benefits by capability complementarities.

3. The analysis of the outsourcing opportunity includes seven dimensions (Blomqvist et al. 2000; Jacobides 2005; Holcomb & Hitt 2007): asset specificity, numbers of bargaining suppliers, technological uncertainty, capability complementarities, strategic relatedness of suppliers, relational capability building mechanism, and cooperative experience of firm and supplier.

4. Deriving a linkage between resource categories and optional governance modes enables selection of the most viable cooperation mode in each case (Arnold 2000, Blomqvist et al. 2000).

    a. Low specificity non-strategic resources can be outsourced by spot transaction or informal cooperation modes, where cooperation is formal and efficiency is the most powerful decision factor.

    b. Low specificity strategic resources and high specificity non-strategic resources can be outsourced by formal

cooperation or joint venture modes, where cooperation is profound and rather informal.

c. High specificity non-strategic resources (HSNR) are designed for special purposes for a company or utilized in highly specific environments or market segments. Thus, resources have only little value outside company. Potential to build generic business models by a service provider with these resources might be low. Development of the service market should be well understood to avoid hold-up problems and forecasts about future customer needs scouted thoroughly, because of the risk of outsourcing attractive options. It might be advantageous, if the company can sustain an option to resumption of the activity or ascertain goal congruence with the service provider in different market conditions.

d. High specificity strategic resources (HSSR) are VRIN resources, which are essential for the company's long-term success. Thus, there are no options for market use in intermediate markets.

# 3 OVERVIEW TO THE ANALYZED CASE

The ongoing transformation of the distribution sector prepares a fertile ground for creation of new business models or even offers options for the emergence of new intermediate markets. Therefore the research focuses on analyzing the behaviour of distribution network companies in the new environment and identifies arising restructuring options that will lead to attractive business opportunities from both the network companies' and service providers' perspective. As a result of the analysis process, the new architecture of distribution network companies will be determined based on the transferability of activities, their strategic relatedness, and potential capability gaps. The architecture decision, however, not only impacts the behaviour of network companies, but it unavoidably changes the value attributes and rules of customer relationships or requisite business models of the service provider. Thus, the research builds a constructive framework for the analysis of the impacts of transforming strategic customer needs of network companies to valuable resource configurations of the utility service provider (see Figure 3).

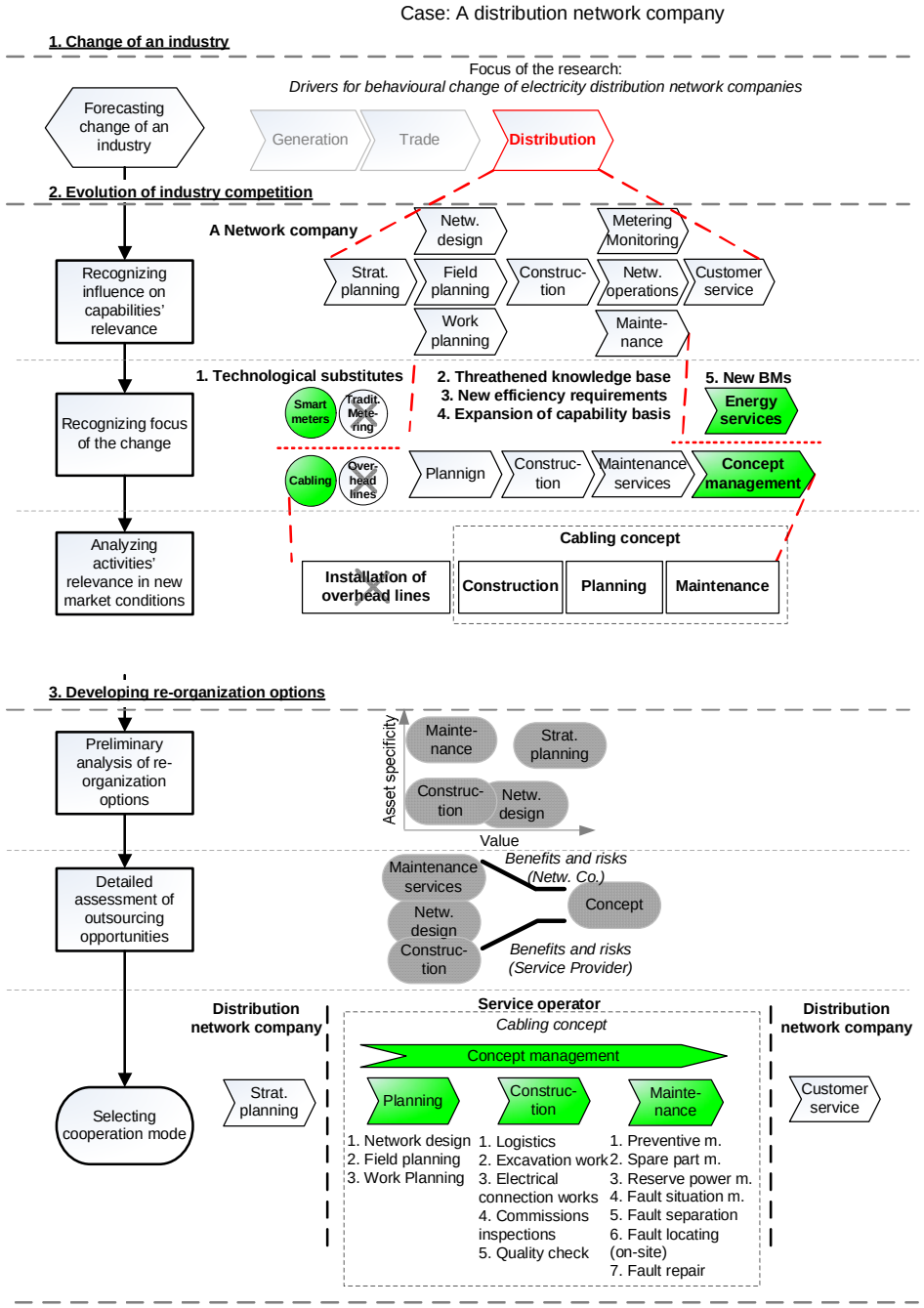


**Figure 3 Analysis of the network companies**

The forces that have an impact on the distribution network companies are illustrated in the Table 1. The drivers can be put into three major categories that define the transformation at a general level. Those are (1) requirement for a more functional marketplace for energy, (2) environmental aspects (i.e. defending against climate change etc.) and (3) security of energy supply. The new targets for network companies are described in the subcategories that define the impacts on the business operations.

**Table 1 Drivers in the electricity distribution industry.**

| |
|---|
| **1. A market place for electric energy** |
| I. Specifically defined efficiency targets in regulation.<br>II. Questions such as "what is the core business."<br>III. End-users should have the opportunity to adjust their consumption behaviour.<br>IV. Need for a truly interactive customer interface. |
| **2. Environmental aspects** |
| I. Improving energy efficiency.<br>II. Promoting the use of renewable energy sources.<br>III. Restricting the use of detrimental chemicals.<br>IV. Landscape protection. |
| **3. Security of supply** |
| I. High interruption costs and compensations for customers.<br>II. Strong signal to build cable networks that are immune to catastrophes.<br>III. Incentive schemes targeted to power quality. |

The drivers in the business environment have divergent influences on the activities of the network companies. For example, one activity may face only incremental changes in the performance requirements, whereas another function may be completely threatened by technology substitutes. Due to the scattered magnitudes of change at the activity level, the management regimes become inconstant, which creates diseconomies to the company. The magnitude of the changes drives the selection of activities to further analyses, because the monopoly companies operate in established positions, where they typically face only incremental changes, and the companies therefore almost completely lack renewing capabilities, which are required during radical changes.

For the analysis, the distribution network company is divided into activities as follows: strategic planning, network design, field planning, work planning, construction, metering and monitoring, network operations, maintenance, and customer service. Of these activities, for instance, construction and metering will face significant changes by the recognized drivers. Construction is chosen for particular analysis, because the changes also have an influence on the service providers' requisite resource portfolios. The competitive changes are driven by technological substitutes (cabling of networks), threatened knowledge

base owing to the transforming technologies, new efficiency requirements for the construction activities, expansion of the capability basis because of new planning standards required by cabling, and construction and maintenance processes and equipment. Finally, the transformation enables the emergence of competing new business models that are built on the new capability and resource portfolio.

In practice, a shift towards cable networks makes knowledge about construction of overhead lines quite worthless because this construction method will be losing significance in the main markets. The technological change does not only have an effect on construction, but it has wider influences on long-term planning of networks and field planning standards, and a radical influence on maintenance practises. The overall analysis of the impacts of cabling shows that it will radically change the behaviour of network companies, which will require a complete service concept from planning of networks to their maintenance in the future. Therefore, service providers should pay attention to the development of concept management capabilities, which makes it possible to conjoin planning to the construction process and delivers critical information of the structures to the maintenance processes.

The previously described development in the distribution network industry drives companies to reconsider their core competences and to redefine the architectures. A resource analysis of the company is the ground for the architectural decision to react to the transformation of the industry. Companies' activities and resources are categorized by their strategic value, complexity, and resource specificity for screening the potential restructuring approaches. The resources, which have very high specificity, complexity, or strategic value in a predicted state of the future, cannot be moved outside the boundaries of the firm. This includes for instance strategic planning of networks. Potential outsourcing opportunities may be found from activities that are not crucial for the long-term performance of the network company, or they may require so

high investments for developing new capabilities or resources that a single company will suffer from significant diseconomies because of the limited market area of the natural monopolies. Based on the above, the outsourcing options in the case of cabling may be found in the construction, planning and maintenance activities. Actually, concept management belongs to the group of previously mentioned outsourceable activities, because of interdependencies between the parts of the cabling concept.

The final decision of restructuring will be made by a bipolar analysis process of the actual business potential of the outsourcing, where benefits and risks are evaluated. The network company focuses on the risk of opportunism, hold-up problems, pricing, and opportunities to reach a complete contract, and finally on the direct benefits and risks for financial performance. In the analysis process, the service provider analyzes the business potential of an activity outside the specific customer, the amount of customer-specific investments, the service provider's competitive position, abilities to revenue gains in generic segments, and long-term dependence on the customer. The research case shows that cabling has potential to be outsourced from both a service provider's and the network company's point of view. The outsourcing can be implemented by moving maintenance, construction, and planning independently to service providers, but, as mentioned previously, management of network information would become complicated in that case and either the service provider or the network company would be able to gain advantages. Therefore, a more efficient approach for outsourcing of the cable network construction is to apply a concept mindset. The cabling concept integrates planning, construction, and maintenance operations into one service system, which guarantees efficient information sharing and quality control over the stages from planning to network operations.

The cabling concept is complex in its entirety, because planning, construction, and maintenance include numerous subactivities (see Table

2), where responsibilities are transferred to the service provider. Long-term partnerships and service agreements are hence required if the network company decides to acquire cable network construction by a turnkey service model.

**Table 2 Activities of the cabling concept**

| ***Planning*** | ***Construction*** | ***Maintenance*** | ***Concept management*** |
|---|---|---|---|
| 1. Network design<br>2. Field planning<br>3. Work Planning | 1. Logistics<br>2. Excavation work<br>3. Electrical connection works<br>4. Commissions inspections<br>5. Quality check | 1. Preventive maintenance<br>2. Spare part management<br>3. Reserve power management<br>4. Fault situation management<br>5. Fault separation<br>6. Fault locating (on-site)<br>7. Fault repair | 1. Purchasing<br>2. Contractor evaluation<br>3. Network information sharing and warehousing<br><br>Etc. |

# 4 BUSINESS ENVIRONMENT IN ELECTRICITY DISTRIBUTION

Electricity distribution in the Nordic countries has traditionally been seen as a public service provided by the municipalities. In addition, it has been subjected to political ambitions. Political motives did not necessarily result in the best practices but rather fed inefficiencies and unsustainable labour policies. With little or no incentives for cost efficiency, individual companies had significant potentials for cost savings. During the mid-1980s, this type of indirect regulation through public ownership described above was discovered to be inefficient and there was a growing trend towards restructuring electricity markets.

From a societal point of view, the franchised natural monopoly positions of electricity distribution companies are a source of concerns, and the question of possible monopoly abuse and inefficiency is often raised. Hence, national sector-specific regulators are often assigned with the tasks of supervising that neither the distribution charges are unreasonable nor the monopoly positions misused. Having a sector-specific regulator in charge of implementing versatile incentive regulation schemes for the regulated companies is thought to protect the customers' rights within the monopoly sector. This approach is, however, accompanied with regulatory risks that may distract the development of the entire electricity distribution sector.

Resulting from the recent regulatory amendments as well as other development trends of electricity distribution business, the sector is currently witnessing radical restructuring that will eventually impact the business logics of the sector. Electricity network companies nowadays struggle with more and more demanding legislative and regulatory requirements focusing on both the operational efficiency of the electricity distribution companies, and the reliability of electricity distribution networks. Added to this, there is a serious concern about the lack of skilled employees in the future. All these things together make the future operating environment challenging not only for the electricity

network companies but also for the service providers operating in the sector.

### 4.1 Legislation and regulation

A fundamental change of the legal framework of the electricity supply industry has taken place in Europe over the past decade. The term "deregulation" is often used to refer to the restructuring process, albeit it does not fully describe the nature of the process. That is, deregulation has seldom meant getting rid of regulation but rather the strengthening of network regulation while opening electricity generation and selling to competition. The reason is that certain characteristics of electricity supply, such as service obligation issues and security of supply, cannot be left to forces of competition alone, because electricity is classified as an essential service. In the restructured electricity markets, the goals of new regulation are twofold: 1) to ensure a fair and non-discriminatory network access in order to promote competition in liberalized electricity markets, and 2) to promote efficient usage of the electricity networks. Hence, new regulation can be seen as both a result of and a necessary accompaniment to market liberalization.

Although the same legislative framework, that is electricity market directives, applies to all EU Member States, there is no common way to implement the directives in national legislation, and the stage of market restructuring still differs significantly from one country to another. In some countries, for instance, sector-specific regulators have already had a powerful role in directing the market development for several years, whereas in others, formal regulation is just taking its first steps. The Nordic countries generally belong to the first category, although there are, again, notable nation-specific differences. Although the practices may differ, the goal is nevertheless uniform: to ensure that the electricity network forms an efficient and non-discriminatory market place for competitive electricity businesses. Because of the absent forces of competition in the network sector, economic regulation is seen as the primary means to ensure that the preconditions for the efficient operating environment are met. The pronounced focus on cost-efficiency is,

however, not without risks since cost reductions may easily lead to reduced reliability of the network services – an outcome that is highly intolerable in modern societies that are dependent on reliable electricity supply. A regulatory respond to this threat is to implement incentive schemes that focus specifically on the quality of network services. Such schemes are being gradually implemented in many countries.

### 4.1.1 Market opening

The first electricity directive (96/92/EC) issued by the European parliament and the council of the European Union set the common rules for electricity market opening. Especially the Nordic countries were among the first to open their national electricity markets. For instance, the Electricity Market Act in Finland was issued already in 1995 (368/1995) in order to prepare the national legislation to comply with the forthcoming EU legislation. The goal of the market opening was to increase efficiency and competition in the sector as well as to prepare the Finnish electricity sector for international competition that would presumably follow from the European wide electricity market restructuring. An exception among the forerunners of the Nordic countries was Denmark, which decided to proceed according to a more conservative timetable in its electricity market opening. The reason for Denmark's reluctance to enter into speedy market opening was that the geographical location was considered unfavourable to competition compared with other Nordic countries in the outskirts of Europe (Olsen 1999). Nevertheless, Denmark opened the electricity markets in 2000 with the Electricity Supply Act.

Although the goal of the market restructuring was primarily to create competition in electricity production and selling, also the electricity network sectors were significantly affected. As the restructuring of the electricity supply sector was enforced, electricity networks were to form a market place for the competitive electricity businesses. In order to secure the non-discriminatory and equal rights of all the parties involved in the market, formal supervision of the monopoly operations was

necessary. Consequently, national regulators were set up in many countries.

A few years after the initial market opening, the need for additional requirements for accelerating market opening became evident. In 2003, a new directive (2003/54/EC) concerning the common rules for the internal electricity markets was issued. The purpose of amending the directive was among other things to strengthen the unbundling of generation and selling from network services and to introduce national regulators with sufficient power in every member country. The role of the regulatory authority was also strengthened. Firstly, the requirements of the directive include ex ante approval of at least the methodologies used for network access charges. This forced some countries, such as Sweden and Finland, to modify their regulation methods already in place. The former regulatory practices prior to the 2003 directive relied on the normative nature of decision; no explicit rules on regulation were made. The role of the regulator appeared to be reactive and guiding, whereas currently the authority has an important role in directing the market development.

### 4.1.2 Establishment of regulatory practices

Electricity distribution companies have franchised monopoly positions in their operating areas. Due to the absent forces of competition, electricity distribution companies do not face the threat of being driven off the market by more efficient new entrants, nor do they have incentives to improve the quality of the services provided over the networks. This puts customers at risk and economic regulation is needed to protect the customers' rights. The short-term objectives of economic regulation are usually twofold: 1) to guarantee that each individual within the society is provided with an access to electricity network at reasonable costs, and 2) to ensure that the services provided over the networks meet the quality requirements of the electricity end-users. In other words, economic regulation aims to direct the operation and development of a monopoly sector in a way that is consistent with the customers' and society's needs. National regulators' task is to find a balance between the expectations of

different stakeholders of electricity distribution. Figure 4 depicts some of the primary concerns of the different stakeholders.

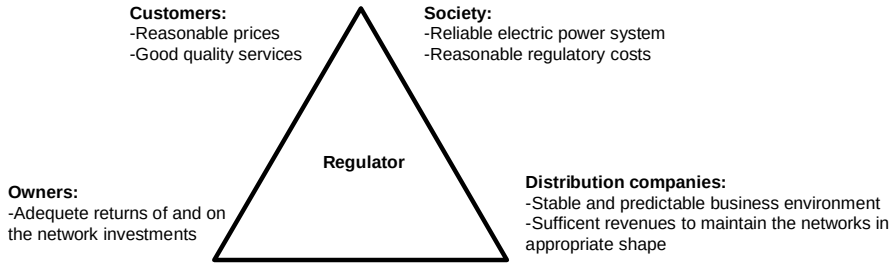


**Figure 4 The expectations of different stakeholders in the regulated electricity distribution sector.**

According to the directive 2003/54/EC, the national regulatory authorities must ensure that transmission and distribution tariffs are non-discriminatory and cost-reflective. Also the distribution tariffs should be sufficient to allow the necessary investments in the networks to be carried out in a manner allowing the viability of the networks. The directive does not, however, give any specific details on how these requirements should be included in the regulation of electricity distribution business. Rather, the directive leaves room for different interpretations, which means that there are large variations in regulatory models in different countries; regulatory authorities have developed regulations based on their unique circumstances. However, some universal requirements for regulation exist for any regulation to be successful:

1) Provide distribution companies with proper incentives to improve their operating efficiency and investment efficiency
2) Ensure that both the companies and the customers benefit from efficiency gains
3) Be acceptable to the regulated companies
4) Maximize the overall social welfare by promoting efficient functioning of the regulated business

Although regulation may not have given particularly powerful incentives for efficiency improvements for network companies, the situation is expected to change as regulation matures. The longer regulation is in

place, the more regulators know about the cost structures of the regulated industry, and setting efficiency targets becomes easier. This is not to say that benchmarking will never be easy but rather that the regulator has more reliable data at hand and perhaps more confidence in defining the efficiency targets. In addition, the first years of regulation tend to form a learning period for both the regulator and the regulated companies, during which the enforced changes may be drastic in paper but tend to be alleviated before they are put in practice. Eventually, once the easy efficiency improvement measures are used up, the regulatory attempts to promote efficiency improvements may start to reshape the regulated industry's structure and have an impact on the way things are done. At least the regulators often argue this to be one of their goals.

## 4.2 Drivers for development

At present, there are three major trends in electricity network industries that shape the operating environment of the electricity network industry throughout Europe: 1) the increasing focus on the network access conditions and charges, 2) the growing importance of environmental factors, and 3) the highlighted role of the security of supply issues. These trends largely originate from the prevailing EU legislation as well as the national legislations in the Member States. The first one arises from the legislators' attempt to increase competition in electricity retail markets, the second one concerns both environmental and safety protection issues, and the third one indicates the societies' reduced willingness to accept interruptions in electricity supply.

### 4.2.1 Electricity network – a market place for electric energy

In its new role, electricity network needs not only to form a non-discriminatory market place for electricity retail but to also contribute to efficient usage of the existing electricity generation facilities. The latter applies to both large-scale centralized generation and small-scale distributed generation. In order to succeed in the above mentioned tasks in an objective manner, transparency of network operations as well as the independence of the network companies from other electricity businesses is highly recommended. Independency of network companies is also

beneficial in the sense that it draws attention to the network related costs and contributes to making them more transparent. This is also in the European Commission's interests: ever since the electricity market opening, the goal has been towards increasing the independence of network companies. While the first electricity directive was not very strict about this, the second one took a much firmer stand on the issue and reasserted the requirements of unbundling.

#### 4.2.1.1 Independence of network companies

The aim of unbundling is to avoid discrimination, cross-subsidization and distortion of competition. Distribution system operator that is vertically integrated must be independent in legal form and in terms of organization and decision-making from other activities not related to electricity distribution. In addition, in today's regulated business environment, network tariffs are increasingly expected to be cost-reflective as such. Furthermore, it is at the hearth of economic regulation to promote the reduction of all network related costs. The mere focus on network operations as an independent part of electricity supply tends to induce more business-oriented thinking in the network industry, even if there are no specifically defined efficiency targets in regulation in the early days of formal economic regulation. As the requirements for operational efficiency become more demanding, inevitably, the network companies are increasingly forced to pay attention to their core competencies and the productivity development in various network-related activities. This immediately raises questions such as what is the core business of a network company and how to manage the network with least costs. The more independent the network industry is from other electricity businesses, the stronger this impact is, and reasserting unbundling drives the network industry towards more independent future. As companies are forced to make ownership and other restructurings, opportunities to introduce new operations models might simultaneously emerge.

#### 4.2.1.2 Spill-over effects of promoting competition in electricity retail

A topical issue in today's open electricity markets is the lack of retail competition. The European Commission has highlighted the importance of the issue in several occasions. While the issue de facto does not directly concern the network industry, the proposals to solve the problem cannot be ignored by the network operators. In its attempt to promote retail competition, the Commission has taken a firm stand that electricity end-users should have the opportunity to adjust their consumption behaviour for instance according to price signals. This is thought to require smart metering because the traditional manually read meters give only little information about the actual consumption patterns. Smart metering is already strongly promoted, or even required, by national legislations in some Member States. At present, the EU legislation strongly suggests that smart meters be used at all customer terminals. The transfer from traditional meters to smart meters makes the development of market place also a concern of the electricity network companies. The reason is that in most European countries the task of arranging the metering operation is assigned to the network companies in legislation. Besides promoting retail customers' activity in competing their electricity suppliers, smart meters are also thought to give opportunities for more sophisticated demand side management measures that are needed to increase the demand elasticity in electricity wholesale markets. This, in turn, would contribute to the functioning of the electricity markets that are presently often characterized by extremely low demand elasticity. Increased demand elasticity in a commercial sense is, however, not the only consequence of better demand side management possibilities but such measures also contribute to managing the reliability of the whole electricity supply system.

In developing electricity networks as a market place for competitive electricity businesses, the need for a truly interactive customer interface has been acknowledged. Figure 5 illustrates possible features of such an interface. In this model, electricity retailers obtain hourly metering data from customer terminals. Customers, on the other hand, would play a

much more active role in electricity markets when compared with their present role, and they would get real-time data, for instance, about the electricity prices. Smart meters that are currently being installed on a large scale in several European countries might be the first step towards increasing customer participation.

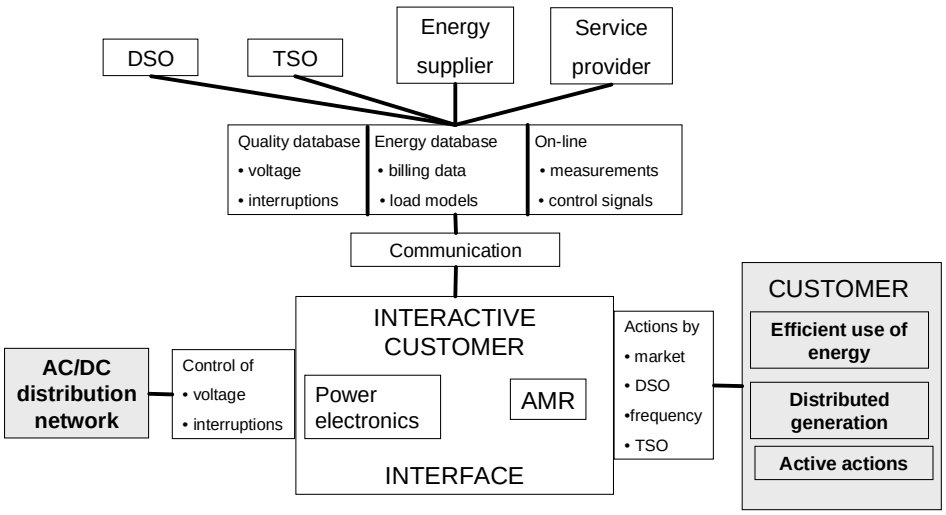


**Figure 5 Illustration of an interactive customer interface in the future electricity market.**

### 4.2.2 Environmental aspects

Environmental aspects are nowadays always present when deciding about energy policies, and the impacts show also in electricity distribution business, either directly or indirectly. Topical questions include issues such as improving energy efficiency, promoting the use of renewable energy sources, and restricting the use of detrimental chemicals. In addition, the landscape protection is nowadays often high on the agenda.

The requirement for overall energy efficiency improvement touches the electricity distribution business because it requires increasing the customers' awareness about their consumption patterns. In addition, customers should be given appropriate price signals that encourage them to reduce their electricity consumption. The solution here is largely the same as that suggested when considering how to promote competition in electricity retail markets: customers should be provided with smart

meters that enable them to acknowledge and react to the given price signals. While the electricity retailers are the natural party to give the price signals, it is often a task of distribution companies to provide the technical facilities for the interactive customer interface. Increased customer activity and the demand elasticity that follows are also prerequisites for efficient use of the existing centralized electricity generation because they reduce the peak power demand.

Recent measures taken to increase the use of renewable energy sources are another environment (climate) related factor that inevitably affects also the electricity distribution networks, because they often result in an increased number of decentralized small-scale electricity generation units in distribution networks. Feed-in tariffs and obligations to connect environmentally friendly electricity generation to local electricity networks are primary means to promote such generation. One possible future scenario is that increasing amounts of electricity will be generated near the consumption sites and even individual households may sometimes sell their excess electricity in the markets. This would require a much more intelligent customer interfaces than those of today. The directions of power flows in a system with a lot of distributed generation are less predictable than in a centralized system, and the requirements for the distribution networks in remote areas are more challenging.

Restrictions to use detrimental or polluting chemicals are a part of the environmental protection that changes the way in which distribution networks are built. Especially prohibiting the use of CCA-treated poles will have significant impacts on the distribution networks. The lack of suitable replacements that would also be easy to work with makes underground cables an attractive alternative to overhead lines, especially since there are also other driving forces that promote the use of underground cables. These include especially the high interruption costs and the strict limitations set to maximum interruption times at any given conditions. In addition, labour productivity in cable network construction is increasing because of the advancements in cable ploughing techniques.

At the same time, the tightening environmental and safety regulations make the overhead lines more expensive to build and maintain. Finally, cable networks are sometimes favoured also because of their invisibility. In Denmark, for instance, landscape protection is mentioned as one reason for building the new distribution networks as underground cable networks.

### 4.2.3 Security of supply

The quality of electricity supply is generally considered to be at a sufficient level in the Nordic countries. Long-term overall statistics show even a decrease in the interruptions. Still, the quality aspects have gained an important role in economic regulation. There are several reasons explaining this tendency. Firstly, the incentive for cost efficiency can result in deteriorating quality levels. Although the quality levels are currently rather sufficient, the incentives for cost efficiency in regulation have been carried out for several years already. One of the regulator's tasks is to maintain the continuous development of the networks in the long term, and should the quality of supply be overlooked, the consequences may be long lasting. Incentives for cost efficiency usually have been set for the interval of a single regulation period, typically 4–5 years, as they are generally more accessible. Quality improvements however may require extensive network alterations. Several countries have introduced some form for the security of supply, power quality, and customer service regulations. In time, this could lead to some degree of harmonization of regulatory practices, but this kind of development is not conceived in the near future. The last, but not least, contributing factor is the public opinion. Large disturbances in the past few years have raised public awareness and debate over the acceptable level of continuity of supply and the compensations paid to customers when this acceptable level is not met. The debate has not only concerned large disturbances but also the general level of reliability of electricity distribution. Societies have found themselves more dependent on electricity supply, and therefore the pressure to assign regulations on the continuity of supply has become evident.

#### 4.2.3.1 Reactions to large disturbances

Nation-specific experiences on large disturbances that reveal the modern society's vulnerability to interruptions in electricity supply may sometimes accelerate the implementation of reliability-related declarations and regulations on a national level. In Finland, for instance, the reliability of electricity supply became topical after two autumn storms Janika and Pyry in 2001 had caused severe interruptions in electricity distribution. The storms received an enormous amount of attention in the media. Consequently, the idea of standard compensations for long (≥ 12 h) interruptions was introduced in the spring of 2002, although the continuity of electricity supply had previously been considered to be of high level. During the summer of 2002, another storm Unto reminded the legislators about the issue, and in the autumn of 2003, a law amendment concerning standard compensations came into force. The goal of the amendment was to ensure the rights of an individual customer, and to give incentives to the network companies to improve the reliability of electricity supply. The Electricity Market Act had granted price reductions (and damage compensations when necessary) to customers, should the quality of electricity supply not correspond to what can be considered to be agreed upon or the quality does not correspond to the standards adhered to in Finland. Such a declaration alone was now considered insufficient.

In Sweden, it was the devastating winter storm Gudrun in January 2005 that started the public discussion concerning the reliability of electricity supply. The outcome was standard compensations for a long interruption and also a requirement that under no circumstances should interruptions last for more than 24 hours. The real-life consequences have been drastic for the electricity distribution industry as a whole since the new requirement has been interpreted as a strong signal to build cable networks that are immune to catastrophes.

Similar to Finland and Sweden, Denmark has also experienced large disturbances during the past few years, but the response has not been as intense as in the other two countries. Some quality aspects are planned to

be introduced in the regulation at the start of 2008, but these do not include compensation payments to customers. The trend toward quality regulation is, however, strong also in Denmark.

#### 4.2.3.2 Power quality in economic regulation

Unlike the public debate sometimes seems to signal, reliability of electricity distribution is not just about managing the networks during large disturbances, because such disturbances only occur rarely. The goal of strict limitation, for instance, to maximum interruption times is targeted to protect the customers during extraordinary operating conditions. Equally important, however, is to ensure the reliability of electricity supply in normal operating conditions. This is where economic regulation steps in with incentive schemes that focus specifically on the quality of monopoly services. A typical way is to define the target level for quality as the reasonable level of interruption costs. The actual interruption costs over a regulatory period are then calculated and compared with the predefined reasonable interruption costs. If the actual interruption costs exceed the reasonable costs, the company is obliged to reduce prices (revenue) according to the difference. Similarly, if the actual interruption costs fall short of the reasonable costs, the company can collect extra revenue worth the difference from the customers. The above-described mechanism puts a price tag to every interruption in electricity distribution and highlights the importance of service quality. Regulators in many European countries, including the Nordic countries, have either already implemented incentive schemes targeted to power quality, or are planning to do so in the near future. The higher the interruption costs, the more tempting it is to replace the fault-sensitive overhead lines with more reliable underground cables.

### 4.2.4 Conclusions on driving forces

Electricity distribution business today experiences many strong driving forces that arise from either the EU legislation and/or national legislation. Because of the industry's nature as a natural monopoly, it is also subjected to economic regulation. In fact, regulation is the primary

means to promote societies' common goals regarding the electricity distribution business. These focus on developing electricity networks as a market place for competitive electricity businesses, and promoting the efficiency and quality of the network related services. For instance, increasing competition in electricity retail market is thought to require smart meters at all customer terminals, and network companies are usually the responsible party to manage the metering operations. Smart meters are, however, just the first step towards transforming the present passive customer interfaces into more active ones. In the long-term, one scenario is that every electricity end-user that uses energy sources other than the public network could also be a potential electricity seller.

The prevailing EU legislation already clearly states that all electricity end-users should be given an opportunity to follow and adjust their consumption in order to fulfil the requirements of efficient energy usage. However, since this requirement is often poorly understood, the European Commission is currently considering whether further actions are necessary to promote smart metering. Some countries have already made declarations of their own considering the metering activity, and the trend is strongly towards changing the manually read meters into remotely read meters. Smart meters do not only service the electricity end-users but also provide the network operators with means to carry out more sophisticated demand-side management. This is an extremely useful tool in reducing the need for peak power in today's electricity markets that is criticized of having extremely low demand elasticity. The increased demand elasticity benefits all electricity users because it helps to reduce price peaks. In addition, it enables the more efficient use of the existing generation capacity – an action that is necessary to fulfil the requirement of increasing the overall energy efficiency that originates from environmental concerns. Another environment-protection-related goal is to increase the use of renewable energy sources, which often means an increased amount of small-scale distributed generation connected to the local electricity distribution networks. This, in turn,

makes managing the networks different from what it used to be because the power flows become less predictable.

In addition to increasing customers' awareness on their consumption patterns and enforcing the pass-through of price signals from retailers to electricity end-users, also the need for legal actions has been acknowledged in order to promote competition in the electricity markets. Tighter rules concerning the unbundling operations have been seen as a necessary action to prevent or reduce the possibilities of cross-subsidization, and to ensure non-discriminatory network access conditions and charges to all electricity market participants. The goal of legal unbundling is to increase the independence of network companies from other electricity businesses. In some plans, even ownership unbundling has been suggested but final decisions have not been made yet. The larger EU Member States with state-owned large vertically integrated energy companies often strongly oppose ownership unbundling. The emerging protectionism in the whole energy sector may cause some Member States to fight against any actions that would threaten the existence of their national champions. However, even the requirement of the prevailing EU legislation forces structural changes to be made in many vertically integrated energy companies regarding their legal form. As such, changes are carried out to reorganize the legal structures; also opportunities for other structural changes may emerge.

Besides the unbundling of network operation and the increased independence of network companies that is expected to follow, also economic regulation draws attention to the network-related costs in particular. It does this by requiring that the network charges are cost-reflective, and often also by stating that there shall be a declining trend in the network charges. Bringing efficiency requirements into the monopoly business increases the knowledge of cost structure of different network-related operations. This is eventually likely to affect the way in which the network operations are organized.

A current trend in economic regulation is also to take into account the reliability of the electricity distribution networks. More and more regulations are being planned in order to achieve and maintain an acceptable level of supply. Once there is a price tag attached to every interruption that takes place in the distribution networks, the resources available for the network company to achieve new standards may be limited. One solution is to seek partners, for instance, specialized service providers that are better equipped to provide the required quality of service to customers. Another security of supply related issue is the actions taken to reduce the impacts of natural catastrophes to electricity end-users. In Sweden, for instance, this has led to a situation in which the distribution companies increasingly see the underground cable networks practically the only alternative when considering the future network construction. Indeed, the requirement for more reliable electricity networks that also tolerate catastrophes may sometimes make the underground cable network superior to the traditional overhead lines. Obviously, however, this significantly affects the maintenance of the networks, especially in rural areas where the networks are built as radial networks – if and when faults occur, they are more difficult to locate and repair. At the same time, any interruption in electricity distribution is extremely costly to the network company because interruption costs are directly linked to their regulated revenues. Nevertheless, when rebuilding the aging networks, underground cable networks appear to be a more and more tempting solution. This trend is further strengthened by the tightening environment and safety regulations, which make the overhead lines more difficult to construct and maintain.

Many of the above-mentioned driving forces are promoted or strengthened by regulation because it is the primary means to enforce the various societal goals regarding the price and quality of electricity distribution. In addition, regulatory actions may also be applied to give the distribution companies incentives to develop the networks to meet the market-oriented expectations; that is, to provide the electricity end-users with adequate consumption data, and to enable the pass-through of

price signals from electricity retailers to customers. In the next section, a closer look is taken to the development of the regulatory frameworks in the Nordic countries.

### 4.3 Regulatory developments in the Nordic countries

Some EU Member States have a long history of formal regulation of the electricity supply sector, whereas others have just quite recently started sector-specific regulation. At present, there are still differences between one country and another regarding the level of sophistication of the applied methods of economic regulation. However, the development pattern of economic regulation has been similar in most Member States. In Figure 6, the observed development pattern is illustrated at a principle level. For more detailed information about regulation in the Nordic countries, see Appendix II.

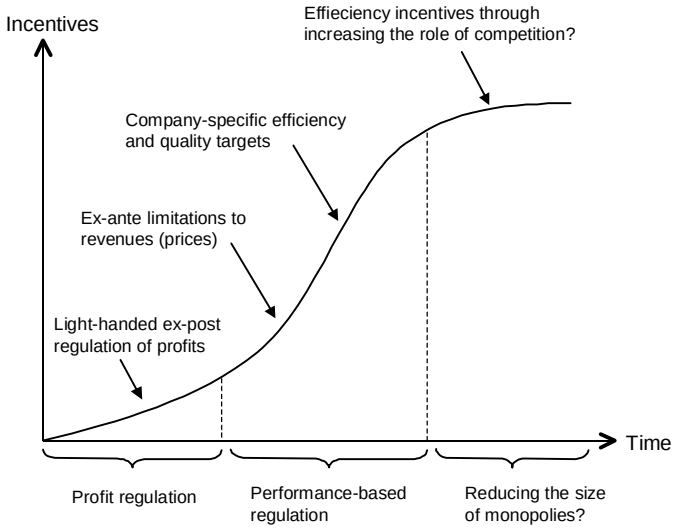


**Figure 6 Development pattern of economic regulation at the principle level.**

The experiences from the Nordic countries have shown that there are several influencing factors regarding the direction regulation takes. The seemingly similar starting point in profit regulation has led in the Nordic countries to four different regulation models. In Sweden, the regulation has just taken effect after almost a decade of development work on the regulation model. The difficulties are not always technical by nature, but rather political. A conflict between the industry and the regulator has

been evident in Sweden, and it has delayed the implementation of the regulation model under development. In Denmark, the conflict has led to time-out in regulation which enabled the regulator to produce a regulatory model on which both sides can agree. In Norway and Finland, the regulation has been more straightforward in introducing incentives. Norway in particular has been considered to be one of the leading countries in regulation. Indeed, the Norwegian regulator is increasing pseudo-competition through efficiency benchmarking in the ongoing period.

Introducing new regulatory practices always generates uncertainty for the industry, which can shift to a source of risk or opportunity, depending on the individual company situation. The purpose of the regulatory review is nevertheless to address issues raised by the public concern, general development of the industry or perceived drawbacks in the former regulation model. In the next paragraphs, the development of regulation of electricity distribution business in the Nordic countries is discussed.

Despite the fact that all of the Nordic countries are subject to the EU legislation, there are distinctive features in regulation in each country. Political pressure, public debate and even electricity network industry's opposition have left a mark in national regulation practices and have even derailed regulation from the generally recognized development path that has been witnessed in the past (see Figure 6). One of the most dramatic incidents was between the Danish network industry and the energy regulator that finally led to abandonment of the former regulatory model. A full-scale turnaround in regulation is very difficult to carry out in order to maintain integrity of the regulatory authority and regulation itself; also it would be difficult to abandon a regulation model in which considerable time and resources have been invested. Nevertheless, a viable regulation model should be the goal for every party involved and in some degree, reassessment may sometimes be necessary. For instance in Finland, efficiency benchmarking was planned to be included in

regulation, but because of problems in the model, it was omitted in order to allow further development of the model. Sustainable development of a regulation model is a key factor in creating a stable operating environment for the network companies. Regulation and regulatory reviews are always a source of risk for the distribution companies, and therefore systematic development in gathering data for regulation and introducing incentives in regulation. Norway has been considered an exemplary case in the regulatory development.

Regulation is never the only factor that has an influence on the network companies, but it is accompanied by legislation and industry standards and guidelines that can be more demanding than the economical regulation. In some cases, legislative changes may be more straightforward than the regulatory ones. For instance, reactions to large disturbances at the beginning of 2000 led to speedy adaptation of standard compensations to customers affected by long interruptions. Another example of forceful legislation guiding the industry is the Swedish constraint on the maximum interruption time starting from 2011. Network cabling has gained importance because companies want to guarantee that their networks are weatherproof, thus anticipating the future development. At the same time, the economic regulation perhaps has a less significant role as a guiding tool in the business because of problems in the implementation. Amendments to national energy market legislation have occurred in rather short time period, whereas regulatory changes and the initial development of regulation have required some time. It would be difficult to make rapid alterations in the regulation in the middle of the regulation period. The Finnish electricity distribution industry however has been active in defining its own guidelines. Regarding long interruptions (> 3 min), the industry's recommendations concern the durations of a single interruption in normal operation conditions. In addition, different recommendations are applied depending on the cause of the fault. Industry recommendations are stricter in the sense that compensations are recommended to be paid for

shorter interruptions than the standard compensations set in the Electricity Market Act.

Despite the different approaches, certain common features do exist in regulation. The most obvious goal when introducing regulation is to make electricity distribution business more efficient. Indeed, efficiency benchmarking studies have been carried out in all of the Nordic countries, and subsequent efficiency requirements have been enforced for the companies to be met. Efficiency benchmarking is one of the most controversial fields in the regulation, not only because of its complex nature but also because of the problems relating to models used. Lately, emphasis in the regulation has been on the security of electricity supply issues. Increased expectations on the quality of supply and the recent supply interruptions caused by unusual weather events have undoubtedly been the most influential factors. Both the society and network industry recognize the importance of quality regulation as a key element of regulation. The quality schemes aim to improve the overall level of quality in the networks as well as to compensate individual customers for loss of electricity supply.

Regulation has been a part of electricity distribution business for several years and has been accepted as a part of the business. The responses to the regulatory incentives have been versatile; some network companies have made substantial improvements in their performance as required by the regulation, whereas others may have cut the profits in order to meet the regulation targets. Nevertheless, when the regulation has been in force for several regulatory periods, even those companies are forced to make real efficiency improvements and not merely cut profits. Economic regulation inevitably has a long-term effect on the capital-intensive business such as electricity distribution, and therefore the question whether a company chooses to be a forerunner or a follower is a difficult one.

### 4.3.1 Efficiency benchmarking and efficiency targets

Distribution companies have operated as natural monopolies for decades with only little or no incentives for cost efficiency, which has resulted in individual companies having significant potentials for cost reductions. Therefore, one of the first objectives of the regulators when implementing economic regulation has been to introduce targets for promoting cost efficiency. Three out of four Nordic regulators have used the DEA (Data Envelopment Analysis) benchmarking in order to study the cost efficiency. It is one of the most commonly used benchmarking methods in the electricity distribution regulation, despite the fact that it has some well-known drawbacks. Nevertheless, especially in countries with a high number of companies, such as in the Nordic countries, it gives the regulator an opportunity to observe relative efficiency and engage companies in pseudo-competition. The Swedish regulator has used the DEA benchmarking method only as an advisory tool. Denmark used the COLS (Corrected Ordinary Least Square) method to determine company-specific efficiency targets in the initial regulation.

The major concern in efficiency benchmarking is the reliability of the model. To minimize the disadvantages, there seems to be two methods: the Norwegian regulator has reduced the impact of efficiency scores for a predetermined amount, whereas the Finnish regulator uses an additional benchmarking method in order to diminish uncertainties related to the individual model in addition to using a margin of error. Especially the Finnish regulator has had problems regarding the correct operation of the benchmarking model, which has prevented the full-scale use of the benchmarking results in the past. The past problems are now dealt with, and by using a complementary efficiency benchmarking model to reverse the problems of the DEA model, the model should be more reliable. Another interesting feature of the Finnish model is that a fully efficient state is expected to be reached in eight years. Normally, efficiency targets have to be met in a single year or a regulation period.

The Norwegian efficiency benchmarking has a significant role in the regulation; half of the allowed revenue is determined based on the efficiency study. Efficiency benchmarking has been developed and used in regulation for over ten years, and so a level of confidence for the benchmarking model has been gained. Usually, the target for efficiency improvements is the revenue, which is logical if the regulation model chosen is the revenue regulation. Finland has focused the efficiency targets on operational expenses. A logical target for efficiency improvements is based on the corresponding input parameters of the benchmarking model. In Finland, this does not realize because of data availability issues.

### 4.3.2 Quality incentive schemes

Quality incentive schemes are becoming a recognized part of regulation; both the regulatory authorities and the industry acknowledge the importance of quality improvement measures. The growing dependency and increased expectations on electricity supply have made quality issues more important than ever. Moreover, quality regulation has a key role in compensating the effects of efficiency requirements on the quality of supply. After all, efficiency requirements have been present for decades. Norway introduced its quality incentive scheme in the economic regulation in 2001 and Sweden in 2003; Finland and Denmark will have schemes of their own at the beginning of 2008. Quality incentive schemes have so far been similar; a company's performance against a predetermined target level is set to adjust the allowed revenue. A company's target and performance are usually measured in cost of interruption to the customer. There has been evidence of increase in cost estimates in the last ten years: according to customer surveys, the figures have doubled or even tripled. This increases the importance of quality incentive schemes.

Measures to ensure the rights of an individual customer are also needed. Standard compensations were introduced to complement overall quality incentive schemes. This meant naturally that specific limits to reliable

electricity supply had to be determined. In Finland, Sweden, and Norway, the electricity distribution companies are to pay compensations to their customers on interruptions longer than 12 hours. The Danish regulator has on the other hand considered the quality level in Denmark to be sufficient and no standard compensations are needed.

The costs of regulating quality will be quite substantial to the distribution business, and more regulations are planned in order to achieve and maintain acceptable level of supply to society.

### 4.3.3 Regulation incentives on outsourcing

A long development process in regulation and regulatory reviews may cause some amount of uncertainty, and major restructuring of business, such as outsourcing of services on full scale, might have been a gamble. As regulation was introduced in Finland, the regulator applied rate-of-return regulation on case-specific terms so that the majority of companies only faced the threat of regulation. The model encouraged investments and had little incentives for cost efficiency. The light-handed approach to regulation did not force any consequential efficiency improvements. When deciding for internal business models, companies have used practices most convenient to them with little external forces influencing the decision-making process. There was some outsourcing of network services, such as construction, to external contractors, but the rest of the operations were handled in-house. Denmark has also had long traditions of public ownership in the distribution sector, and the outsourcing of activities has been less active than in Finland. The fact that regulation is a rather new phenomenon in the business in Denmark may be a contributing factor. The requirement to make operation more efficient is quite recent, as is the business-oriented thinking in the electricity distribution business. As present and future efficiency targets take fully effect, one outcome can be the reorganization of the electricity network business.

### 4.3.4 Regulatory risk

The introduction of economic regulation has challenged the business to pursue efficiency while maintaining profitable operation within a predetermined framework of the regulation. Electricity distribution is considered a natural monopoly, and therefore it should be relatively risk-free. Regulation itself does affect the risk-free nature of the monopoly status; however, it redefines the profitability of the electricity distribution business. Economic regulation is a relatively recent addition in the electricity distribution business, and requires new type of expertise from the network companies.

The major change in the regulation occurs during the regulatory reviews. Some studies have reported on the change in the risk levels of the network companies listed in the stock market during regulatory reviews. The most pessimistic projection would be that the regulatory model is reformed after every regulation period. A typical regulation period lasts about five years, which is a short time-span for network business investments. If the incentives are dramatically altered during the regulatory review, the financial input made by the company will be endangered. This would require intensive follow-up of the regulatory incentives by the company, that is, the company would have to re-evaluate and change its entire strategy according to the regulation after every review. Long-term goals in regulation are essential in order to achieve meaningful results through regulation.

The company's own contribution to its financial outcome in regulation is also evaluated through penalty/reward systems. In these schemes, the company's performance is compared with its own historical or peer group performance, and so the importance of data accuracy is emphasized. Missing or distorted data can have an unexpected result for instance in benchmarking. Especially the DEA efficiency benchmarking model is vulnerable to data imperfections. Also large annual variations are common in electricity distribution and can cause misrepresenting initial data. Using sufficiently long time series can be one solution to discard the yearly variations.

The financial outcome of the company depends on the company's ability to understand the incentives of the regulation and adapt its own operation accordingly. The results of past regulation period from Denmark and Finland suggest that not nearly all electricity distribution companies have made use of the opportunities provided by the regulatory framework. On the other hand, a delay strategy can be effective when there is some discontinuity in regulation. Past experience has shown that companies, who have made significant efficiency improvements early on, may later bear the consequences as new efficiency targets are set; these companies have less potential for efficiency improvements. However, these companies perform well in efficiency benchmarking. To fully account for these kinds of disadvantages in regulation, there should be more detailed investigation and target setting for each company. Usually, regulatory authorities seek for practices that are adaptable for a large number of companies with little resources.

The financial outcome of a company depends not only on the manner in which the regulator appreciates the asset base and the appropriate cost items of the distribution company, but how risky the business is perceived to be in comparison with other industries. Regulation defines the attractiveness of the business to investors. The regulatory process has created a degree of uncertainty to the electricity distribution business when considering regulatory reviews. Increasing risks should be rewarded through increased profit opportunities for the companies.

# 5 VALUE CHAIN IN ELECTRICTY DISTRIBUTION

Electricity distribution networks constitute a vital part of a society's infrastructure. Yet, when considering the functioning of a deregulated electricity market, their role is sometimes neglected to some extent because of the adequacy of electricity production and transmission capacity, and the functioning of the electricity wholesale markets as a whole are often much more important sources of societal concerns. From the electricity distribution industry's point of view, this is not unambiguously a negative feature since it may sometimes prevent the distribution companies from being drawn into the games of national politics, and leave them to carry out the basic tasks assigned to them: to provide the electricity end-users with reasonably priced and quality services, and to form a market place for competitive electricity businesses.

A unique characteristic of electricity networks is that practically all citizens are customers of local electricity distribution companies, and that faulty operation of the networks immediately affects the electricity supply of numerous customers. In order to guarantee the short-term and long-term availability and accessibility, network companies are expected to develop and maintain their networks in accordance with the societies' needs. This includes managing electricity networks that are able to deliver the desired quality at reasonable costs, and servicing the electricity market participants in a non-discriminatory manner. A simplified illustration of the network-related operations is shown in Figure 7.

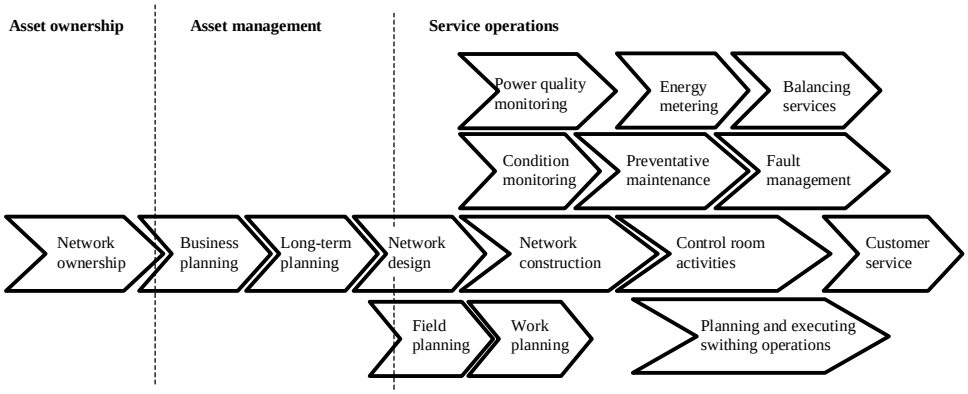


**Figure 7** **Simplified illustration of operations related to managing electricity distribution networks.**

## 5.1 Network construction

By definition, network construction means building new electricity lines or re-building the existing lines. A key success factor of the operation is the efficient management of the field work and technicians. When considering electricity distribution business as a whole, network construction is the area in which service markets have developed the furthest. In addition to actually building the lines, network construction services may also include certain network planning activities such as field planning and work planning. The rapid development of service markets in network construction is largely explained by the nature of the activity; network construction projects are easy to define and separate from other network-related operations. Furthermore, the strategic importance of network construction is low to the network company. By contracting out network construction, the network company neither loses knowledge that is vital to its core business nor does it threaten critical information flows that enable efficient management of the network business.

Service markets in network construction have mainly developed as network companies have separated their own construction business units into independent companies. The separation, however, is not enough but the separated companies also need to be given the opportunity to immediately start to live their own lives. A common mistake appears to be that the separated construction companies are protected by their former owners by guaranteeing them certain amount of construction

contracts. When practically the only customer is the former owner and the working habits need not change, the company culture of the new construction company is slow to change. This does not prepare the company to survive in the fiercely competed service markets. If the separated company is from the outset made to compete in the markets like any other service provider, it seems to be quicker to adapt to its new operating environment.

### 5.2 Operating the network

Operating the electricity distribution network consists of functions such as the management of network switching operations, control room activities, preventive maintenance, and fault situations. The last two, that is, the preventive maintenance and managing fault situations, are the areas in which functioning service markets already exist. A key to success in these operations is timely and efficient management of the field operations and workforce, and access to sufficient resources in the case of severe fault situations. In these areas, the competencies of specialized service providers can add to those of network companies. One explanation to the emergence of service markets in these operations is that they typically utilize the same field workforce than network construction. Consequently, if a network company contracts out network construction, it is left with little or no workforce to efficiently carry out the maintenance and fault repair activities. Another issue is that the desired service level and the content of services regarding these activities can be defined quite clearly in advance. Finally, from a strategic perspective, maintenance and fault repair are not the most important factors in the network company's revenue creation. Their importance lies, however, in the increase because societies are becoming more and more intolerant to interruptions in electricity supply, and regulators have started to define reward/penalty schemes to promote the reliability of electricity distribution networks. The basic idea of the targeted quality schemes is to make the regulated revenues dependent on the observed performance of network companies.

Contracting out control room activities is not as straightforward task as contracting out, for instance, the labour-intensive maintenance and fault repair operations. From a small network company's perspective, performing control room activities in-house is a resource problem because it requires a 24/7 standby. The transaction costs of the activity are relatively high because the number of alerts (faults) in normal operating conditions is typically low. In addition, the costs of network data systems are high. Operating in a monopoly sector, costly activities as such are not a problem for the electricity distribution companies. However, regulatory requirements have forced, or are starting to force, the network companies to consider the costs of each network-related operation separately. In particular, this speaks for combining the control room activities of small network companies. The synergies of having just one control room to supervise several networks are obvious; the costs of arranging a 24/7 standby would then be divided between several companies. In addition, a shared control room might enable small network companies to have access to systems and knowledge that would otherwise be out their reach. In theory, operating a shared control room of several networks could make a business case for a specialized service provider. In practice, however, utilizing the potential synergies might prove an extremely difficult task because of the heterogeneity of the network companies' data systems; in many cases, the data systems are either of different brands or they represent completely different generations. A service provider might easily end up struggling with integrating different network data systems with little or no benefits to gain from the process.

### 5.3 Network planning

Network planning in a wide context includes activities such as business planning, long-term planning of the networks' development, short-term network design, and field planning and work planning related to specific network construction projects. Business planning acknowledges the owners' strategic long-term goals regarding the networks business. This includes issues such as what kind of business do the owners want to be

involved in and what is the primary operations model applied within the company. Long-term network planning focuses more specifically on investments, for instance by answering questions such as what kind of investments need to be carried out and when in order to meet the stakeholders' future expectations in the network business. Network planning is expected to react to signals that come outside the industry, for instance from town planning authorities. The actual network design is about finding technically and economically optimal network configurations (routes, network type and strength, materials, etc.) for arranging electricity distribution in specific areas. Field planning defines how the planned network is actually placed in the given surroundings for instance to meet security requirements. Finally, work planning determines the details of carrying out the network construction project.

When considering network planning as a whole, most of the outsourcing potential appears to be in field planning and work planning. The reason is that the outcome of these planning activities is very concrete and they are closely connected to the actual construction of the networks. At present, field planning and, even more typically, work planning, are sometimes included in the construction projects. In network design, there is also some potential for outside contractors, but service markets are slow to emerge, perhaps because the network companies worry about losing their own knowledge regarding the activity. On the other hand, the applied new network construction techniques and regulatory requirements tend to complicate the traditional network design task. At some point, this may drive the network companies to search for new competencies outside their own organization. Of other network-related planning activities, business planning and strategic long-term development of the networks are at the heart of network business; if a network company itself did not carry out these activities, why would it exist? In addition, the information required in long-term strategic planning is often at least partially gathered through informal information networks, from both inside and outside the network sector. Consequently, the network companies are concerned that contracting out

strategic planning activities might jeopardize the existence of such informal information networks, and eventually leave the companies with insufficient information about their future development needs and requirements.

### 5.4 Customer relations management

Customer relations management has quite a different role in a monopoly sector than in competitive businesses. In practice, electricity network companies cannot lose customers because they have a franchised monopoly position, and there is no real substitute to electricity. Yet, network companies may still consider customer relations management as their core business. One reason is that many network companies today belong to larger energy concerns. Consequently, a network company's customer satisfaction affects the whole concern's image. In addition, since disturbances in electricity supply mainly result from failures in the local medium- or low-voltage network, the role of local network company is anything but minor. Disturbances tend to attract wide attention in the media, so it is in network companies' interests to minimize the inconveniences caused to customers by network failures in order to maintain good company images. Formal regulation also highlights the importance of good service quality in the network sector, but so far it has rather been the spill-over effect of competition that explains the importance of customer relations management and good service quality to network companies.

In principle, network companies themselves often see no objection to contracting out customer service, or even the whole customer relations management, but concern strategies may prevent this. For a network company itself, the strategic importance of customer relations management is low, but network companies nevertheless often end up servicing the strategic purposes of the whole electricity or energy supply concern. The reason is that the difference between electricity selling and electricity network operations is not always clear to customers, and electricity supply companies take the advantage of this by acquiring retail customers through owning local electricity distribution networks.

In this respect, network companies' significance is notable because they own the physical customer interface, and almost without an exception all the inhabitants in their operating areas automatically belong to their customer portfolios. In addition, network companies do not need to acquire customers or convince them about the usability of the offered service. Instead, customers come to the network companies, and will continue to do so regardless of the quality of service. Obviously, national energy regulators would eventually react to poor service quality, but as mentioned earlier, so far the competition-related factors have guaranteed the present level of service quality, not regulation.

### 5.5 Energy metering

Metering activities in electricity distribution networks are in a state of change. During the next 5–10 years, almost all energy meters will be smart meters. The expectations and requirements set to new meters mainly contribute to promoting competition and functioning of electricity markets. Besides electricity network companies, the main beneficiaries are other electricity market participants. This is not to say that network companies would not also benefit from having more accurate information about the power flows in their networks, but rather that the processing of the improved metering data might better suit for specialized metering companies or some other electricity market participants than for the network companies themselves. It is, however, not yet clear how metering services will be organized in the future. The next few years will reveal what kind of new requirements will be assigned to the metering activity regarding for instance the functionality of new meters, the way of representing the metering data, and organization of the metering service. If and when new requirements come into force, they will change the nature of the activity that used to be simply an act of reading energy meters manually once a year. The strategic importance of energy metering to network companies is low, and thus it may not be in their interests to develop the service, unless they are legally obliged to do so.

## 5.6 Balancing services

Balance settlement is an example of an activity that has its origins elsewhere besides the needs of the networks. Balance settlement in electricity distribution networks became mandatory as competition was introduced in electricity retail. In Finland, this was in 1998. Network companies principally had two options: to educate their own people to carry out the balance settlement procedure, or to buy the balance settlement service from specialized service providers. Many network companies chose the latter option. Similar development is possible also for the development new metering services; a network company may simply accept an outside contractor's offer instead of building an in-house organization to carry out the activity.

# 6 OUTSOURCING ACTIVITIES OF AN ELECTRICITY DISTRIBUTION NETWORK COMPANY

## 6.1 Organizational restructuring

Distribution companies have operated in natural monopolies for decades with only little or no incentives for cost efficiency, which has resulted in individual companies having significant potentials for cost reductions. The introduction of regulation has dramatically changed the situation, although the strongest incentives or requirements for efficiency improvements are yet to be seen. So far, when deciding about internal business models, companies have used practices most convenient to them with little external forces influencing the decision-making process. In some cases, this has led to contracting out a network-related service such as network construction and maintenance, whereas in other functions no visible developments have taken place.

The real-life impact of the recent developments has been that instead of doing everything in-house, network companies' operations models are nowadays more diverged. However, business-oriented thinking has often been slow to emerge in the electricity distribution sector. A possible explanation is that the dynamics of the sector is strongly influenced by public ownership as well as the sector's nature as a sustainable natural monopoly. In this regard, electricity distribution sector differs from industries that are characterized by the presence of both private ownership and forces of competition. Consequently, the drivers for the efficiency improvements in electricity distribution sector are different from those seen in other industries. In particular, deregulation of the formerly closed electricity sector has often been the first initiator of the many organizational restructurings observed. It is, however, noteworthy that deregulation as such does not create competition in the electricity network sector because it leaves the natural monopolies in electricity distribution untouched. Rather, it has been the re-regulation of the sector that has brought the costs of network-related services into the focus.

Although the natural monopoly position of electricity network companies is not threatened, there are certain elements of competition present even today. First, economic regulation itself aims to mimic the forces of competition in a monopoly industry and, thus, it drives efficiency improvements. Second, the development of service markets brings the actual forces of competition into the monopoly sector, although the mechanism through which the effects of competition spread across the whole sector again relates to economic regulation. Regulators usually compare electricity distribution companies with each other for instance with respect to the companies' operational efficiency and service quality. Thus, if specialized service providers help their customers to perform more efficiently and/or to provide better quality to electricity end-users, the improved performance level is reflected in benchmarking. Regulation reacts to the improved performance levels by making them the new benchmarks that also the less efficient companies are soon expected to achieve. In deciding how to pursue performance improvements, companies need to understand the potentiality and nature of competition in each network-related operation. This requires looking at each operation separately and identifying the forces that affect that specific operation. If we take the metering activity as an example, we may conclude that the activity is in a state change, and that the coming changes are likely to be revolutionary. In other words, in the near future, legislative and/or regulative requirements will change the nature of the activity altogether from being an act of measuring energy consumption on an annual basis into active management of the metering data. An essential question is whether the network companies decide to develop the necessary metering data management systems and the related services for other electricity market participants in-house, or whether they choose to rely on the expertise of specialized service providers instead.

As regulators proceed with setting more and more demanding performance targets, regulation will at some point force efficiency improvements even in those companies that do not necessarily consider

themselves as profit-maximizers. One outcome might be that network companies increasingly start to consider their core competencies and streamline their organizations in order to reduce operational expenditures. This, in turn, could lead to a situation in which more and more network-related operations are produced in competitive service markets by independent service providers, as shown in Figure 8 At present, however, the in-house operations model is still dominating in most network-related operations.

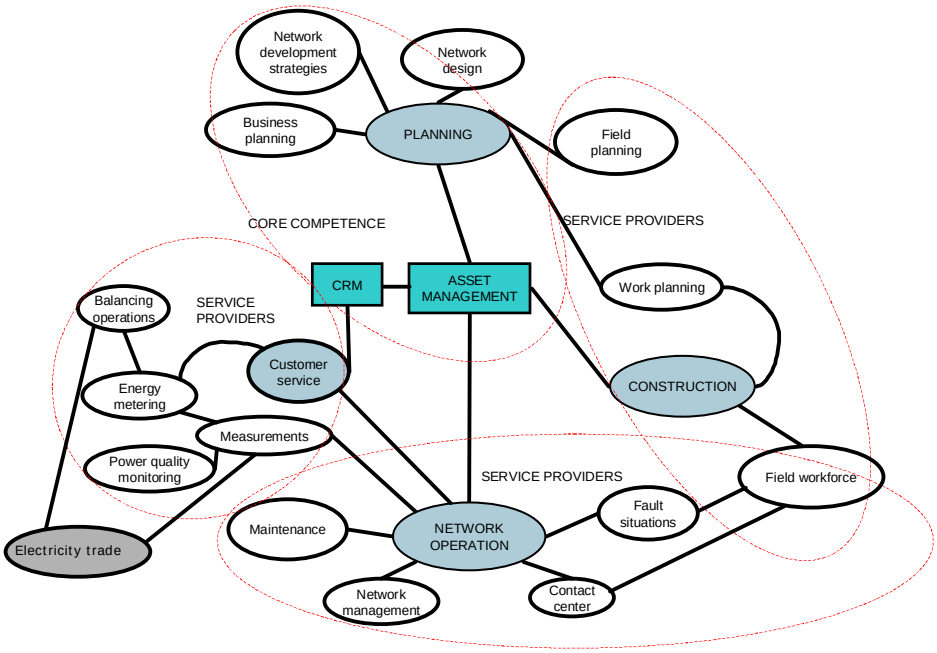


**Figure 8** **Possible value network of a future electricity distribution company.**

The estimation about outsourcing opportunities of electricity distribution companies' activities has been made through two stages. The first action was to categorize resources based on their strategic value and to determine linkages between other activities, estimated asset specificity, and availability of market governance option. The preferable governance modes have been developed by a careful analysis of the activities' impacts on performance and conjectural estimates on the market efficiency. The analysis gives the most attractive opportunities for the emergence of new services during the following years.

## 6.2 Developing renewed architectures

A distribution network company was analyzed in order to find out the strategic importance of the functions and transferability of resources. The analysis has been made in the expert group. The resources or activities were divided into following four groups:

1. **HSSR** (*high specificity strategic resources*) are core competencies, which are essential for sustained competitive advantage and could not be transferred outside the company without high transaction costs.

2. **LSSR** (*low specificity strategic resources*) are core-close activities, which complement core activities and support building long-term competitive advantage, but the asset specificity of which is low. Outsourcing the activities may be possible in specific conditions.

3. **HSNR** (*high specificity non-strategic resources*) are usually supporting activities, the asset specificity of which is high or markets undeveloped. Outsourcing these activities is challenging because of the low market value for service provider, or potential hold-up problems and transaction costs are high.

4. **LSNR** (*low specificity non-strategic resources*) are general resources or supporting activities. Acquiring these resources from the market is easy, the risks are low and markets usually exist.

Asset management is stated to be the key activity in the network companies, which steers also this analysis. Long-term business planning and long-term network development are core competences of network companies, because capital investments steer profitability and network information is widely utilized in the operations and short-term planning phases. Network design is categorized to be a low-specific resource, but its strategic meaning is significant. It is not a core competence, but it offers a link from the operational level to the strategic development activities. Thus, network design is close to the core activities. Balancing operations, fault management, and preventive maintenance are common activities that are acquirable from the markets. However, their strategic importance has been increasing because of regulation. The regulator's demand for secured and high-quality power supply has driven the development of these functions. A stricter requirement for general efficiency is also one explanation why the strategic significance of these

functions has increased. High-specific, but not strategically significant activities are control room operations, energy metering, power quality monitoring, and planning of switching operations. These activities are supporting ones, and they are typically quite company specific; these functions have only a loose connection to the long-term profitability. Activities related to field work management, customer service and network construction are typical low-specificity supporting activities. The connection to a monopoly company's long-term performance is quite weak and there are effective markets for acquiring resources. Figure 9 illustrates an example of the distribution of a distribution network company's resources in the 'Transaction complexity – Strategic importance' –framework.

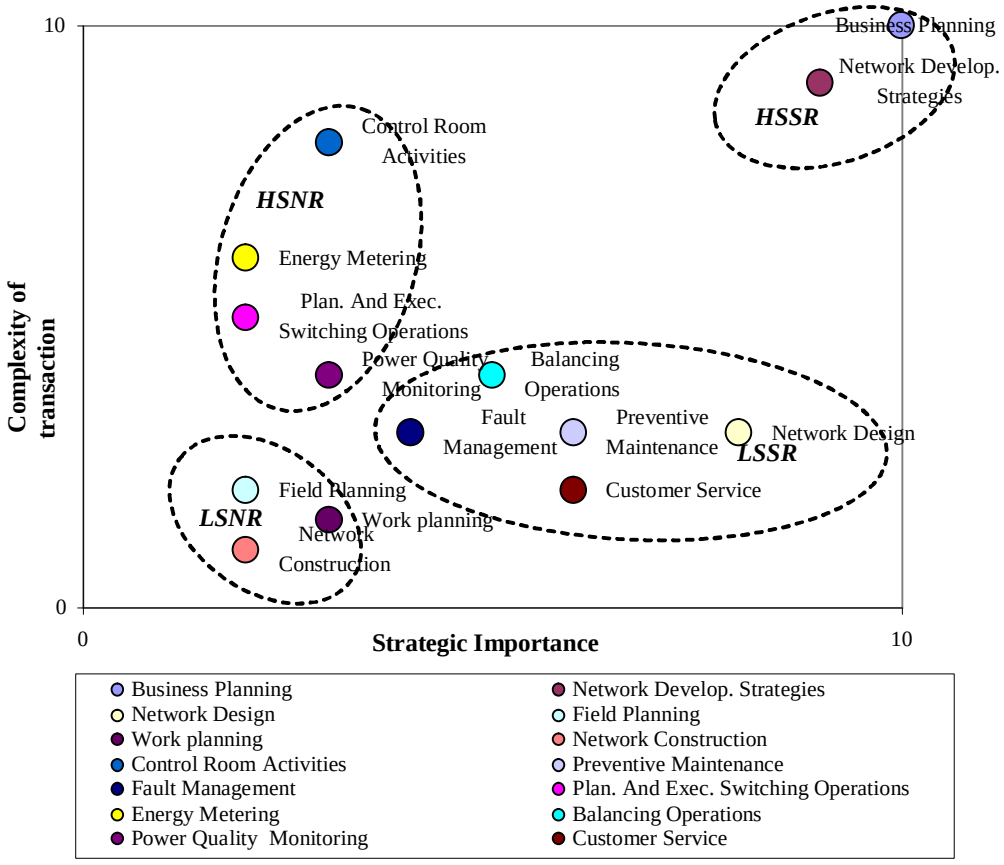


**Figure 9 Resource analysis of an electricity distribution company**

Categorization of the resources is derived based on the previous analysis, and it is illustrated in Table 3. The categories are developed in the research team.

**Table 3 Resource type analysis**

| | *Activity* | *Category* |
|---|---|---|
| *Asset Management* | Business Planning | HSSR |
| | Network Development Strategies | HSSR |
| | Network Design | LSSR |
| *Construction* | Field Planning | LSNR |
| | Work Planning | LSNR |
| | Network Construction | LSNR |
| *Network Operations* | Control Room Activities | HSNR |
| | Preventive Maintenance | LSSR |
| | Fault Management | LSSR |
| | Planning and Executing Switching Operations | HSNR |
| *Supporting* | Energy Metering | HSNR |
| | Balancing Operations | LSSR |
| | Power Quality Monitoring | HSNR |
| | Customer Service | LSNR |

For developing the preferred governance modes, the activities are divided into three groups, based on the information gathered from the previous analysis. The groups are: (1) core competences that are connected to the company's existence, (2) core-close activities that have a direct linkage to the core competences, but they are general capabilities, and (3) supporting activities, which have only a loose connection to the long-term success (Arnold, 2000). Approximations of the impacts of the distribution networks company's resources on the future performance and the most efficient governance modes for activities in the present market situation have been represented in tables below (Table 4; Table 5; Table 6; Table 7).

**Table 4 Description of the opportunities to outsource asset management activities**

| *Activity* | *Resource category & Preferred governance mode* |
|---|---|
| Business Planning | *Resource category: Core Competence.*<br>*Preferred governance mode: Keep in-house*<br><br>Long-term success of a distribution company depends on these key activities. Outsourcing is not possible without a significant risk of losing vital knowledge and capabilities. Outsourcing of these activities will have a wide influence on other business functions at the same time. |
| Network Develop. Strategies | *Resource category: Core Competence.*<br>*Preferred governance mode: Keep in-house*<br><br>Long-term success of a distribution company depends on these key activities. Outsourcing of these activities will influence planning of the investments and other asset management activities. Hence, outsourcing is not possible without a significant risk of losing vital knowledge about network. |
| Network Design | *Resource category: Core-Close Activity*<br>*Preferred governance mode: Keep in-house*<br><br>Outsourcing is a possible option, but there are risks of hold-up problems and losing valuable information about network. Special attention should be paid to quality aspects and contract terms if the function is planned to be outsourced. Transaction costs may be high because of the complicated monitoring approach. |

**Table 5 Description of the opportunities to outsource network construction activities**

| *Activity* | *Resource category & Preferred governance mode* |
|---|---|
| Field Planning | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource, Strategic partnership*<br><br>Outsourcing is possible and there is an effective market. In small utilities, advantages can be reached in capability development by moving the function to a vendor. Specialized vendors have better access to the latest technology. |
| Work planning | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource, Strategic partnership*<br><br>Outsourcing is possible and there is an effective market. In small utilities, advantages can be reached in capability development by moving the function to a vendor. |
| Network Construction | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource*<br><br>Outsourcing is possible and there is an effective market. In small utilities, advantages can be reached advantages in capability development by moving the function to a vendor. Network activity is a typical disposal activity, where the purchase price is the critical argument. |

**Table 6 Description of the opportunities to outsource network operations activities.**

| *Activity* | *Resource category & Preferred governance mode* |
|---|---|
| Control Room Activities | *Resource category: Core-Close Activity (Supporting activity)*<br>*Preferred governance mode: Keep in-house (conditionally)*<br><br>Outsourcing is challenging owing to specific systems (high asset specificity) and possible hold-up problems. The function also has a close relation to quality and management activities. Thus, special attention should be paid to the contract terms and co-operation model if the function is planned to be outsourced. Services are also challenging from a vendor's point of the view because of high heterogeneity of information systems between companies. |
| Preventive Maintenance | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource, Partnership*<br><br>Outsourcing is an attractive option if a market exists. Outsourcing enables the company to reach advantages in the usage of HR, adapting capacity and efficiency improvements. |
| Fault Management | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource, Partnership*<br><br>Outsourcing is an attractive option if a market exists. Outsourcing enables the company to reach advantages in the usage of HR, adapting capacity and efficiency improvements. |
| Planning and Executing Switching Operations | *Resource category: Supporting activity*<br>*Preferred governance mode: Keep In-house*<br><br>The activity is closely related to control room activities. Thus, outsourcing the activity may influence the operations management. Outsourcing is not preferable or it should be planned under a wider service agreement. |

**Table 7 Description of the opportunities to outsource metering, monitoring, balancing, and customer service activities**

| *Activity* | *Resource category & Preferred governance mode* |
|---|---|
| Energy Metering | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource*<br><br>Outsourcing is an attractive option if a market exists. Moving measurement assets and operations outside company is an attractive option, because specialized vendors have better access to the latest technology and capabilities to develop business processes. |
| Balancing Operations | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource*<br><br>Outsourcing is an attractive option and there is a market available. |
| Power Quality Monitoring | *Resource category: Supporting activity*<br>*Preferred governance mode: Outsource*<br><br>Outsourcing is an attractive option if a market exists and there is no high asset specificity. The activity is closely related to energy metering activities. |
| Customer Service | *Resource category: Core-Close Activity (Supporting activity)*<br>*Preferred governance mode: Outsource*<br><br>Outsourcing is an attractive option if a market exists. Customer service needs capabilities at the system and personnel level, which a specialized service provider can develop more effectively. Suitable vendors/partners can be found within the companies that offer call centre services or applications. |

All LSNR functions, similarly as maintenance and fault repair activities can be outsourced without adverse effects on long-term financial performance or quality functions. The functions are quite distant from the core functions, and the management style differs from asset management, which is the most important function as a whole. In the new market conditions, it is preferable to acquire the functions from a service provider. The service provider is likely to have capabilities to develop HR management activities and to invest in business process development and volume in its business to fully utilize the field work force capacity. In small utilities, it is difficult to increase the effectiveness of these HR intensive functions. Hence, in these cases, a major challenge for a vendor is to develop field workforce management and increase profit per person. This is possible, if the vendor has a larger market area and volume of operations than the customer has. The vendor also has to be capable to invest in the latest technology and continuously develop its business process as its key success factor in the competition environment. Therefore, transferring maintenance and construction to a daughter company is an inadequate operation in most cases, because it cannot grow fast enough compared with the efficiency demands. The network construction activity has similar challenges in small distribution network companies.

The significance of customer service will increase in the future, and distribution network companies have to develop their business processes to correspond to the changing demands. Therefore, outsourcing the customer service resources would be an attractive choice. An effective customer service process requires new infrastructures, which can be purchased from the existing market actors from other businesses. Outsourcing the customer service actions can be implemented in two ways: purchasing service infrastructure and using own staff for service production, or outsourcing the complete process to a professional call-centre service provider.

Power quality monitoring and metering processes are independent processes, which could be outsourced, if a suitable partner is found. There is a technology risk in the measurement equipment, and capital investments are needed to develop these activities. A specialized service provider has better access to the technology providers, and the business process development can be made effectively in an independent company, which has enough volume in its business. The present markets of these services are rather undeveloped but opening up. There are market actors that already have launched pilot services, and the services will be become more common in the future. Thus, hold-up problems will decrease in the future, when the services are standardized and markets established.

# 7 CHANGE OF NETWORK CONSTRUCTION

The most definitive aspects in network construction business are understanding and reacting to the two leading principles in the modern regulatory regime, namely the increasing reliability requirements and economical regulations concerning quality of delivered energy, and the incentives for efficient cost usage. Cabling has proved an effective way to secure electricity supply and to minimize extensive disturbances, in which case the regulatory cost for quality can be expected to decrease. The decision to use underground cables has commonly been a question of land use; cables are used in places of high importance as well as high aesthetical value. Cabling is also an efficient way of using land in urban areas as network infrastructure does not need expensive and extensive line paths.

The reliability issues further cabling, and at the same time, underground cabling is coming more accessible. Improvements in the cable manufacturing and accessories together with more efficient installation methods have lowered the construction costs. Still, cabling is more expensive than building an overhead network, especially in medium/high-voltage networks. If the ploughing costs for cable networks continue to decrease, cabling will be an even more attractive alternative. Networks are reaching the end of their lifetime all around Europe, which is one of the reasons for the recognized investment needs. The problem is more topical in rural areas, where the quality of electricity distribution does not necessarily meet the quality standards.

## 7.1 Technology developments

Investments make up the majority of costs in underground cabling. The increased use of underground cables has partly been made possible by cost reductions resulting from improvements in cable manufacturing and installation techniques. The technology advancement such as development in solid insulations, optimization in cable design, and the use of pre-moulded cable accessories have reduced the cost of underground cables. With more frequent use of underground cabling

outside urban areas, the cost for network construction becomes even more relevant. Today, ploughing has become a cost-efficient way of building distribution network in rural areas.

Ploughing is mostly done in low-voltage networks; in rural areas, ploughing low-voltage cable is approximately 50 % cheaper than digging trenches. In fact, ploughing has made low-voltage cabling in rural areas more profitable than using traditional overhead-line structures (AMKA), and it is used whenever possible. Ploughing in medium voltage has not attained this kind of position although there seem to be no major obstacles in switching from low voltage to medium voltage. Rather, it has been restrained on account of lacking experience and suitable cable types. Medium-voltage cables are heavier and more robust, and some have too soft sheathing for ploughing purposes (AHXAMK-W) (Ilves 2007). For this reason, ploughing medium-voltage network is considered more expensive and requires often preploughing. It is expected that by developing medium-voltage ploughing techniques and cable types, cabling can be made cost-effective in more general terms.

Principally, ploughing can be done in most locations that do not require extensive land processing. However, uneven surface or indirect routing can cause strain on the installed cable. Stony or rocky soil can also cause difficulties to cable durability. Ploughing is easily performed alongside roads or in the road bed. Preploughing without a cable is recommended in the case of uncertain soil conditions as it eliminates some of the minor obstacles in the soil.

Developments in substation technology have also helped in using less expensive network structures in rural cable networks. Medium-voltage transformer substations are more expensive than the pole-mounted transformers, and are not therefore cost effective in sparsely populated areas. Also, traditional transformer substations can have too elaborate features for rural purposes such as disconnectors and MV switchgear. Manufactures have developed transformer substation that has a lighter structure; the substation has been stripped from the MV switchgear and

the cable to and from the transformer is connected directly to the transformer. This means that the cables have to be disconnected to isolate faults. These transformer substations also have to be fully changed in the case of malfunction.

### 7.2 Changing network needs

Increasing the use of underground cables especially in rural areas does not always have only positive impacts. In terms of load growth, different areas vary significantly; from areas with a heavy load growth to areas with little or no growth. By laying cables underground, network companies may face risks of load changes or relocations, and further, changing the network topology is more challenging in underground cable networks. In an urban environment, networks are rebuilt in some occasions to facilitate changing city foundations, but for a radial network in the suburban or near rural area, this is not cost effective. The effect of increasing distributed generation has to be also noted. Another consideration is the growing popularity of holiday homes in rural areas, where the number of new connections is rising. These dwellings are also more frequently used for round-the-year living.

### 7.3 Safety and environment

Presently, there are two major concerns in using open wire structures in electricity distribution; open electricity wires represent a health risk in the case of accidental contact with them, and there has also been concern over the electromagnetic radiation transmitted by the lines. Also employee safety concerns have been raised; overhead lines require climbing up the poles for construction and maintenance. For example Sweden has restricted pole climbing to promote employee safety, and new working methods have been introduced. There are existing regulations that deal with the safety issues, but both of the mentioned risks can be noticeably reduced by underground cabling; cables transmit weaker electromagnetic fields compared with overhead lines, and the risk of electric shock is smaller.

Landscape protection has traditionally been one the main reasons for underground cabling. In addition to the unaesthetic appearance of overhead structures, the right of ways for overhead lines disturb nature, require constant pruning, and have increasingly high acquisition cost. Another cost item for the distribution companies is the replacement and treatment of impregnated, aged wooden poles; the use of certain toxic chemicals in poles has been prohibited for human and environmental safety reasons. Finding suitable replacements for poles that have to be treated as toxic waste is a cause for concern. The matter affects greatly the Nordic countries that have a great portion of distribution networks still as open wire.

Restrictions concerning safety of distribution networks may well be one of the decisive factors for the future of overhead lines, especially as the restrictions are anticipated to tighten in the future. There already are regulations for electricity network safety, but the ultimate issue is to recognize the long-term trends for network design. Safety and environment protection will be required of the structure of the networks.

### 7.4 Present state in cabling

The scale of new investments needed in the European electricity sector is significant. Eurelectric has estimated that in the EU-15 countries, the sum is of the order 600 billion dollars up to year 2030, most of which is needed for distribution networks (Eurelectric 2004). The nature of investment needs reflects strongly on the present state in the distribution networks; to what extent underground cabling is concerned, is a matter of the present state in the cabling policy and the nature of the driving forces in effect.

The process for increased underground cabling has started with various degrees, depending on the magnitude and nature of the driving forces in particular countries. Some countries, such as Denmark, have encouraged distribution companies in cabling for a long time on account of land usage or network reliability. Another group of countries will also increasingly cable electricity distribution networks to ensure better

reliability, but the present state of cabling is rather moderate and there is no particular incentive for a dramatic increase in cabling. These cases commonly include Eastern European countries. The third distinctive group is the countries that have initiated plans to cable basically all networks in the near future. Sweden is a primary example of massive cabling and also serves as a good example of what can be expected when the social atmosphere towards the appropriate level of interruptions changes rather quickly. Thorough understanding of the prevailing trends helps to prepare an action plan for the future challenges.

Increased interest in underground cabling has meant that the ability to construct an underground network in a cost-efficient manner, and in timely fashion, will be most crucial. In these situations, a comprehensive concept for cable networks becomes a key success factor, especially for a services provider. On the threshold of a revolutionary event, to be able to provide a solution for network companies may prove to be successful. From a service provider's point of view, responding to customer needs is of course important for selling the concept idea. In comparison to keeping operations in-house, probably the two main reasons for employing service providers in the distribution business are to achieve cost reductions and better service quality in a straightforward manner in network-related operations.

The interdependencies between network planning, construction, and maintenance are stronger in cabling than in the traditional overhead networks. For instance, success in cable ploughing relies much on field planning in finding routes where ploughing can be utilized. Therefore, developing a concept has to be carefully considered. The revolutionary phase of network construction will only last for some time before the skills needed for cost-efficient and reliable cabling are attained by all, in other words, network construction will eventually transform back to a stable state of operation.

### 7.4.1 Reasons for cabling

Once the need for increased cabling is established, the question is whether the tools available for required network development are sufficient. Revolutionary forces, such as quality incentives in regulation, can require a quick and effective response from the distribution companies. In some cases, traditional methods in cabling do not offer realistic solutions to speed and quantity needed, and thus one of the key-factors in achieving cost efficient solutions has been ploughing.

Ploughing techniques decrease investment costs compared with excavation, but may shorten the lifetime of the cable. Development of both cable design and ploughing techniques will decrease this uncertainty of lifetime. In some areas, ploughing or excavating may remain too expensive a solution. In forest areas, the standard technique will probably be using underground cables or finding an alternative route outside the forest. In a mixed area (i.e. forest and cultivated areas), the use of covered conductors or aerial cables could be the best solution. The use of underground cables in rural areas calls for new solutions in system design. It also stresses earth fault systems; therefore, larger compensation reactors equipped with automatic regulation may need to be installed in the primary substations (Eurelectric 2006).

For MV grids, the cost of underground cables is around 40 €/m to 80 €/m, close to that of overhead lines (except in hard ground). However, the overall cost can become notably higher with the cost of installing the MV/LV substations (transformers) and LV outputs on the ground, up to 60 €/m to 200 €/m (Eurelectric 2006).

### 7.4.2 Overview of the European cabling situation

The present state of underground cabling in the selected countries illustrates different undergrounding strategies, even in seemingly uniform operating environments. The present state and growth rate of cabling in the selected countries is demonstrated in Table 8 and Table 9

below. The first table illustrates the status of low-voltage network and the latter medium-voltage network.

**Table 8 Electricity network statistics from selected countries in low-voltage networks (principal source: Commission 2003, where LV = 200–400 V)**

| | Length of LV network km | Length of network (m/habitant) | Percentage of underground | Rate of undergrounding/ year in 1999/2000 | |
|---|---|---|---|---|---|
| | | | | km | % |
| **Netherlands** | 145 000 | 8.9 | 100 % | | |
| **UK** | 377 000 | 6.4 | 81 % | 9 000 | 1.4 |
| **Germany** | 926 000 | 11.3 | 75 % | 40 000 | 4.3 |
| **Sweden**[1] | 295 000 | | 70 % | | |
| **Denmark** | 92 000 | 17.6 | 65 % | | |
| **Belgium** | 108 000 | 10.6 | 44 % | | |
| **Finland**[2] | 225 600 | | 41 % | | |
| **Norway** | 185 000 | 41.3 | 38 % | | |
| **Italy** | 709 000 | 12.1 | 30 % | 11 000 | 1.6 |
| **France** | 632 000 | 10.5 | 27 % | 20 000 | 3.1 |
| **Portugal** | 112 000 | 11.9 | 19 % | | |
| **Spain** | 241 000 | 6.0 | 17 % | | |
| **Austria** | 65 000 | 8.0 | 15 % | | |

[1]Svensk Energi 2006; [2] EMA 2007.

**Table 9 Electricity network statistics from selected countries in medium-voltage networks (principal source: Commission 2003, where MV = 10–50 kV)**

| | Length of MV network | Length of network (m/habitant) | Percentage underground | Rate of undergrounding/ year in 1999/2000 | |
|---|---|---|---|---|---|
| | | | | km | % |
| **Netherlands** | 101 900 | 8.9 | 100 % | 2 000 | 2.0 |
| **Belgium** | 65 000 | 6.4 | 85 % | 2 000 | 3.0 |
| **UK** | 372 000 | 6.4 | 81 % | 5 200 | 1.4 |
| **Sweden**[1] | 182 000 (10–20 kV) | | 63 % | | |
| **Germany** | 475 000 | 5.8 | 60 % | 12 000 | 2.5 |
| **Denmark** | 55 000 | 10.5 | 59[2] % | | |
| **Italy** | 331 000 | 5.7 | 35 % | 5 100 | 1.5 |
| **France** | 574 000 | 9.5 | 32 % | 8 000 | 1.4 |
| **Norway** | 92 000 | 20.5 | 31 % | | |
| **Spain** | 96 448 | 2.4 | 30 % | | |
| **Finland**[3] | 134 600 (1–70 kV) | | 22 % | | |
| **Portugal** | 58 000 | 6.1 | 16 % | 950 | 1.6 |
| **Austria** | 57 000 | 7.0 | 15 % | | |

[1]Svensk Energi 2006

[2]Dansk Energi 2004

[3]EMA 2007

The rate of undergrounding is given for one year, and therefore it does not necessarily reflect the true nature of recent growth. In Sweden, the rate of undergrounding has had a steady increase of ca. one percentage unit annually, but the effects of the recent increase in cabling are not evident here. According to the tables, particularly The Netherlands, The UK, Belgium, Germany, Denmark, and Sweden have a large portion of

underground cable networks whereas Austria, Portugal, Spain, and Finland have a less moderate share of network cabling.

### 7.4.3 Country-specific examples

It is relatively easy to observe the degree of cabling in different countries. However, understanding the decisive factors that drive cabling requires good knowledge of the legislative and regulatory directing signals, and even social atmosphere, on a country-specific basis. Below, some examples of country-specific categorization on decisive factors for cabling are given. The developing trends leading to cabling are mainly similar from country to country, but their significance and form of realization is the differentiating element resulting in various cabling schemes.

In *Sweden*, protection against natural catastrophes is strongly emphasized; interruptions over 24 h are prohibited be the law after 2011, which basically means that cabling is the only viable option for MV networks for the network companies to consider. The storm Gudrun and the resulting abrupt social reaction towards acceptance of electricity supply interruptions is one obvious instigator for the ongoing radical changes. In Sweden the rate of undergrounding has had a steady increase of ca. one percentage unit annually.

In *Finland*, cabling is not enforced in the same sense as in Sweden but it has nevertheless recently become an attractive solution also in rural areas. Economical regulation of electricity distribution business has been a strong driving force. In the regulatory scheme, the regulator defines a certain reliability level that the network companies are expected to meet, and failing to meet the target is sanctioned in economic regulation (similarly, there is a bonus for beating the target). In addition, network companies have to pay standard compensation for customers for long interruptions (>12 h). So far, there are no legislative or normative limits to interruption durations or numbers, but there has been discussion about introducing such limits. Network companies themselves decide whether

or not to build cable network taking into account the economic and other incentives provided by regulation.

In *Estonia*, the nature of economic regulation is different from that in Finland or Sweden because there is practically only one company that needs to be regulated. Economic regulation is more or less characterized as a negotiating process between the largest energy company and the regulator; if the company is able to demonstrate the need to build cable networks, or the regulator itself requires reliability improvements, then cabling can easily be made the most attractive solution to build the networks. At present, there seems to be a strong willingness to build more MV cable network (the present cabling rate is approximately 15 %), which indicates that both the largest energy company and the regulator favor cabling over the traditional overhead lines.

The distribution network in *Poland* is in need for modernizing investments because of the high level of depreciation of rural networks (up to 70% on the LV network). It is believed that external financing is required in addition to involvement of the 33 distribution companies, mainly because of bad economical circumstances in the area. External funding sources should include regional development funds (e.g. EU funds) (Commission 2003).

In *Denmark*, nearly all of the construction and renovations in electricity distribution networks is done underground. Cable networks are favoured because of their reliability, aesthetical, and environmental reasons. Especially in Eastern Denmark, there has been investment in low-voltage network undergrounding as cabling in that area has been low. In 2004, almost 86 % of the distribution network (0.4–20 kV) was underground.

Heavy snow storms and windstorms often occur in *Latvia* but without major interruptions. In rural areas with favourable soil, LV underground cable lines have been installed using ploughing, but such a technique is not applicable to MV cable lines. On the existing overhead lines, forest maintenance procedures have to be developed further. The Ministry of

Economy is reviewing the protective zones for power lines in legislation, prioritizing consumers as regards supply restoration, increasing the role of the energy regulator and improving cooperation between some institutions in crisis situations (Eurelectric 2006).

*Belgium* has invested in underground cabling after the government policy to restrict the construction of new overhead lines (Commission 2003). In 1992, Electrabel decided to restrict the construction of overhead lines in urban areas. Similarly in 1999, the *French* authorities gave new policy in undergrounding cables in distribution networks; 90 % of all new medium-voltage networks (or 6000 km per year) and ⅔ of all new low-voltage networks (or 8000 km per year) is to be made underground or protected. In France, the regulations were a direct consequence of large disturbance in 1999, the damages of which extended to the high-voltage network.

Quality of electricity supply in *Hungary* is mainly characterized by a large number of disruptions. Both medium- and low-voltage networks show a high number of failures (316 min/a) and also the time to solve disruptions is longer than in Western Europe. Large numbers of network components have exceeded their normal lifetime and cause a significant number of disruptions. In addition to age, several units are particularly sensitive to failures but cannot be replaced in time because of a lack of resources. Majority of LV network is overhead line and the lack of maintenance, in particular tree pruning, easily leads to interruptions. Theft of network components also occurs; it is the reason for at least 10 % of interruptions (Konermann & Funkert 2003).

### 7.5 Summary of the present state

When considering cabling strategies, there is no common European practice. According to their cabling strategies, the European countries can be roughly divided into three categories as follows:

1) Cabling is the state-of-the-art method in network construction

Decisions that have led to building cable networks at the MV level may have been made years, or even decades ago. For instance, The Netherlands has commenced cabling of distribution networks to a large extent; almost 100 % of the LV and MV networks are put underground. Also France and Denmark have extensive cabling process underway. Typical explanatory factors in these cases have been land usage and/or network reliability. As the network development has been gradual, there also has not been a need for radical working methods in network-related activities, even despite compelling authority regulations limiting open-wire structures. These countries are most likely facing challenges of renewing aged cable networks and optimizing network operation, maintenance, and fault repair activities at the most. Should there be any driving forces for improved network reliability, the solution is not in changing network topology, but in more effective ways to execute network-related operations. Similarly, changes in the business environment or environmental conditions do not create unknown risks or challenges when renewing the networks.

2) Cabling will increase but utilizing others' experiences is possible

In another group of countries, the share of cable networks will increase but the prevailing driving forces do not entail unknown challenges regarding speed or skills in cabling. For instance, most of Eastern European countries have aged network structures and somewhat poorly implemented network design. The quality of electricity supply may also in some cases have deficiencies and the investment need in the distribution networks can be so large that authorities cannot require rapid improvements in reliability. The need to reform networks is therefore evident, but the tools required for the task are not necessarily revolutionary. This fact does not exclude the advantage gained through superior working methods, such as ploughing. In fact, there is an opportunity for a service provider to offer full-service from construction to network operation.

3) Cabling will increase and the impacts are largely unexplored

Finally, there are countries, where the ongoing trend to build the MV cable networks in rural areas will completely change the business environment in network construction and maintenance. In these countries, the challenges of significantly increased cable network construction cannot be efficiently resolved using traditional resources. The challenges include, for instance, sparsely populated areas, radial distribution networks, and frozen ground during winter time, which restrains underground cabling to summer time, and unlike in the previous group of countries, require revolutionary methods in order to be handled in a cost-efficient manner. Presently, the networks are combinations of overhead and cable networks that have been based on both technical and economical considerations. Sweden, Finland, and Estonia all fall into the third category, but it should be borne in mind that within each country, the final decisive factors in the end are always country-specific.

### 7.6 Need for new capabilities

Presently, both in cabling and in the related activities, the basic functions of network operations are performed by the network companies as a part of daily routine. Cost-efficiency of cable network construction is largely determined by whether ploughing technique can be used. Ploughing is significantly less expensive when compared with excavating cables underground. The routing is decided in network planning, which therefore contributes to whether or not ploughing can be used. Further, radial underground networks cannot be maintained according to the present reliability requirement unless they are taken into account already in network planning – this kind of thinking is not yet a part of network companies' everyday operation and could conceivably prove productive for a service provider. A comprehensive concept for planning, constructing and maintaining cable networks is necessary because the interdependencies between network planning, construction and maintenance are strong, that is, the nature of the operation requires a linkage to other operations. Some of the linkages between the activities are illustrated in Figure 10 below. The activities are divided into three entities. Network planning entails the chain from general guidelines for

network development (network development strategies) to detailed line structures. Network construction includes assignments to control workforce and equipment according to the necessary work plans, to provide activities with material, construct the networks and, finally, to inspect the completed networks for use. Maintenance activities include preventive maintenance and responding to fault situations by repairing faults, arranging reserve power and finally restoring electricity supply. To keep the illustration simple, the linkages between individual activities are not shown.

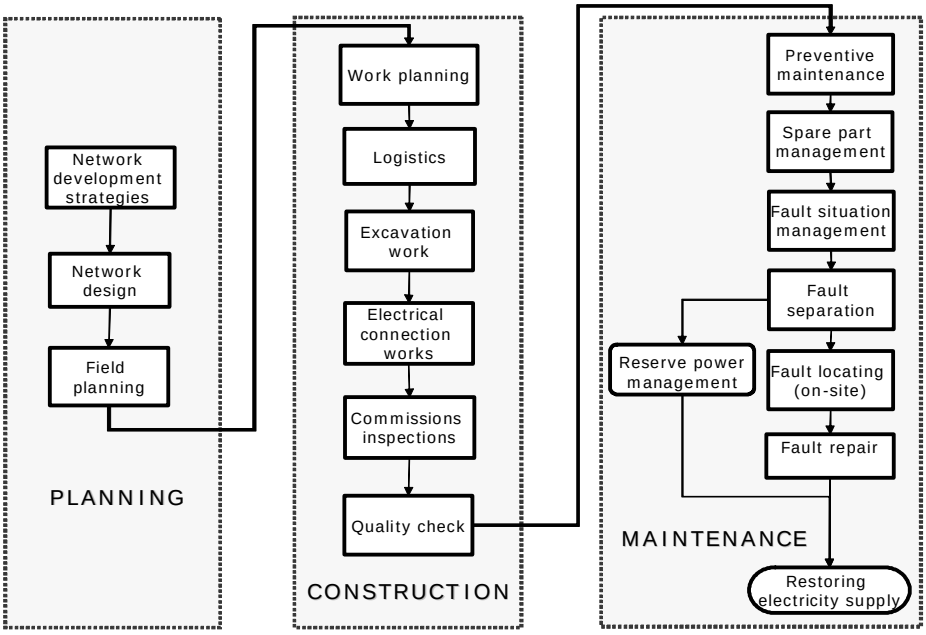


**Figure 10 Linkages in network-related activities in the cabling concept.**

Now, as cabling is becoming profitable also in rural areas, network companies can find themselves in a problematic situation when necessary competence may not be available. Rural cable networks require a specific planning approach that is not yet well-established in the network sector. Network companies are not familiar with the full potentials or disadvantages of ploughing, which can delay the implementation of new technology. If a service provider is able to guarantee the level of quality in the network construction and network operation, the decision to use the service provider will become easier. The ability to plan operations in such a way that will both enable

efficient use of resources and guarantee the quality of service is crucial, as every step is designed to cater the needs of supporting operations.

In cable network construction, there are a number of local entrepreneurs, but the scale of operation for them is typically small. Network companies have not yet built an efficient process for cable network construction that would utilize on a larger scale the local sub-contractors that have the knowledge on regional conditions necessary for successful usage of ploughing. By incorporating in the cabling concept the efficient use of local entrepreneurs that already may have acquired knowledge on ploughing may eventually lead to a new approach to network construction.

# 8 CONCLUSIONS

The forces that have an impact on the electricity distribution network companies can be divided into three main categories that define the transformation at a general level. These include: (1) the requirement for a more functional marketplace for energy; (2) the environmental aspects (i.e. defending against climate change etc.); and (3) the considerably emphasized requirement for the security of energy supply. These trends largely originate from the prevailing EU legislation and the national legislations in the Member States but also from the technical advancements. The first point arises from the legislators' attempt to increase competition in electricity retail markets, the second one concerns both environmental protection and human safety issues, and the third one indicates the societies' reduced willingness to accept interruptions in electricity supply.

The drivers in the business environment of electricity distribution have divergent influences on the activities of the network companies. For example, one activity may face only incremental changes in the performance requirements, whereas another function may be completely threatened by technology substitutes. In the future, for instance, the identified drivers are likely to lower the threshold to build the electricity networks more weather resistant. This, in turn, means increased underground cabling. This development pattern is reinforced by tightening safety and environmental regulations that ultimately make the overhead lines more and more expensive to build and maintain. The future development in underground cabling will expand the focus of undergrounding to semi-rural and rural areas. Increased cabling requires skills that in many respects are not yet fully employed. The changes will require new approaches particularly in network planning, construction, and maintenance. The concept for planning, constructing, and maintaining cable networks is necessary because the interdependencies between network operations are strong, that is, the nature of the operation requires a linkage to other operations.

The changes in the network construction activity force the network companies to reconsider their core competences and to redefine the architectures. A resource analysis of the company is the ground for the architectural decision to react to the transformation of the industry. Companies' activities and resources are categorized by their strategic value, complexity, and resource specificity for screening the potential restructuring approaches. The resources, which have very high specificity, complexity, or strategic value in a predicted state of the future, cannot be moved outside the boundaries of the firm. This includes for instance strategic planning of networks. Potential outsourcing opportunities may be found from activities that are not crucial for the long-term performance of the network company, or they may require so high investments for developing new capabilities or resources that a single company will suffer from significant diseconomies because of the limited market area of the natural monopolies. Based on the above, the outsourcing options in the case of cabling may be found in the construction, planning and maintenance activities. Service providers, on their behalf, should pay attention to the development of concept management capabilities, which makes it possible to conjoin planning to the construction process and delivers critical information of the structures to the maintenance processes.

The final decision of restructuring will be made by a bipolar analysis process of the actual business potential of the outsourcing, where benefits and risks are evaluated. The network company focuses on the risk of opportunism, hold-up problems, pricing, and opportunities to reach a complete contract, and finally on the direct benefits and risks for financial performance. In the analysis process, the service provider analyzes the business potential of an activity outside the specific customer, the amount of customer-specific investments, the service provider's competitive position, abilities to revenue gains in generic segments, and long-term dependence on the customer. The research case shows that cabling, for instance, has potential to be outsourced from both a service provider's and the network company's point of view.

In order for a service provider to obtain competitive advantage, it has to exceed the quality of service that the network companies are accustomed to. The superior concept to plan, construct, maintain, and repair cable networks can deepen the relationship between the service provider and the network company, because the network company itself may not necessarily have sufficient knowledge concerning cable networks.

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