2 Why the Lights Went Out: A Capability Perspective on the Unintended Consequences of Sector Reform Processes

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Abstract

In this chapter we advance the argument that regulatory policies can have a far-reaching impact on the organizational capabilities and, ultimately, on the performance of public utilities. Once capabilities are lost, it may be hard to regain them in the short term. Our insights are based on a qualitative-comparative analysis of capability-losing processes at Eskom, South Africa's national electric utility. South Africa experienced severe power outages between 2005 and 2008, which are commonly explained as having been caused by inadequate generation capacity, badly maintained power plants and insufficient coal supply. In this chapter, we go a step further and examine the underlying reasons at the organizational level. We show that a variety of new regulations led to a substantial loss of critical competences and skills at Eskom. This caused a deterioration of planning, operation and maintenance procedures, and made swift reactions to the crisis difficult. The 'capability perspective' presented in this chapter complements traditional theoretical explanations of utility and sector performance.

2.1 Introduction

Between 2005 and 2008, South Africa experienced a series of major electricity blackouts, with serious implications for residential and industrial electricity customers, and the economy as a whole. Eskom, the national electricity supplier, launched emergency measures, such as scheduled load shedding, and the government set up a task force, new regulations and ad hoc energy-saving programmes. Despite these

interventions, the country still suffers from a poorly performing power sector, with the grid and power plants working at their limits and a high risk of power outages due to a critically tight reserve margin.

Reliable, secure and cost-efficient electricity supply is a central challenge, not only in South Africa (Marquard 2006; National Planning Commission 2011) but also in many other countries (OECD 2006, 2007; UN-HABITAT 2011; Eberhard and Shkaratan 2012; Karplus et al. 2019; Rose et al. 2019). Electricity sector reform processes, including liberalization and privatization, have been initiated in many cases to tackle these challenges. However, numerous infrastructure sector reform processes worldwide are incomplete, were implemented much slower than expected, experienced resistance from sector players, or were even reversed (OECD 2006; Joskow 2008; Gratwick and Eberhard 2008). The underlying reasons for these drawbacks are not entirely clear. Also, sector reforms tend to be confronted with unintended consequences. These developments require a more detailed look into the underlying processes, and a potential revision of the conceptual frameworks energy policy scholars are working with (Gil and Beckman 2009; Künneke, Groenewegen and Ménard 2010; Worch et al. 2013).

In South Africa, the electricity crisis is commonly explained as being caused by insufficient generation capacity, badly maintained power plants, insufficient coal quality and a weak electricity grid (Eberhard 2007a; NERSA 2006, 2008; Hamukoma and Levy 2019). But how did such a situation occur? How could a 40 per cent reserve margin for power generation in 1991 (Eberhard 2007b: 219) turn into an estimated capacity shortfall of 10 per cent in 2008? Why were existing power plants in such bad shape? How could a supposedly experienced company like Eskom buy below-specification coal and allow coal stocks to fall to unacceptable levels? And why is it taking years to ameliorate the situation, despite early interventions by government and management?

The reasons for the power outages and the residual tense situation in the South African power sector are complex and multi-dimensional. Conventional explanations of failures in electricity supply focus on the sector's regulatory framework, and whether it provides sufficient incentives for investments into power plants and the network (Joskow 2002; Gómez-Ibáñez 2003; Armstrong and Sappington 2006; Guthrie 2006). Consistent with these explanations, our analysis shows that the impact of regulatory changes on investments has also played a key role in the South African electricity crisis. However, this only explains one part of the story. In particular, it leaves open why Eskom failed in domains like capacity planning, power-plant maintenance and coal contracting, where we

would normally expect it to succeed thanks to its long-term professional experience.

By focusing on capabilities, we show that electricity sector reforms and the sociopolitical transformation in South Africa led to a loss of critical competences at the firm level, which not only worsened planning, operation and maintenance procedures, but also made swift reactions to the crisis difficult. More generally, we argue that regulatory changes and other external factors can have a far-reaching impact on the organizational capabilities of utilities. Once these capabilities are lost, they may be very hard to regain. With this 'capability perspective', we complement traditional theoretical explanations of utility and sector performance.

In our study, we apply a capability-based framework, which enables us to identify, examine and explain the emergence of capability gaps and the corresponding performance deficiencies in utility firms that occur as a result of policy and regulatory changes (Worch et al. 2013). The term 'capability gap' is defined as an inadequate availability of competences, skills and experiences. In the management literature, capability gaps are an important conceptualization (Lavie 2006; Capron and Mitchell 2009; Dominguez et al. 2009; Worch et al. 2012). Recent research has extended this concept further to include the study of capability erosion dynamics (Rahmandad and Repenning 2016). Our own research has conceptually linked capability-based explanations with the literature on infrastructure sector performance (Dominguez et al. 2009; Worch et al. 2013). The role of organizational capabilities for utility performance is an emerging but still under-researched area (see e.g. Dyner and Larsen 2001; Delmas and Tokat 2005; Delmas et al. 2009; Gebauer, Worch and Truffer 2012; Worch et al. 2012).

The case of Eskom and the South African electricity sector is an ideal, natural experiment–type of setting in which to study causes of incomplete sector reform processes and crisis situations, which go beyond traditional incentive-based explanations; and in which to examine the performance outcomes at the organizational level that result from sociopolitical and regulatory changes. Since Eskom is a dominant national utility, its organizational performance is directly reflected in the quality of power supply in the whole country. This specific situation enables us to examine the impact of changes in the regulatory environment on organizational capabilities, and how this, in turn, affects the performance of the utility and the national electricity sector as whole.

The chapter proceeds as follows:

Section 2.2 presents conventional theoretical approaches that are used to explain performance deficiencies in utility sectors. We also review how the crisis in South Africa has been

explained so far. Finally, the capability perspective is introduced as a complementary conceptual framework with which to study the performance of utilities.

Section 2.3 describes the research design, data collection and data analysis carried out in this study.

Section 2.4 provides a brief historical overview of Eskom and of the development of the South African electricity sector.

Section 2.5 presents our empirical findings on how changes in the policy and regulatory environment changed Eskom's capability structure (related to power-plant operation).

Section 2.6 discusses our results, interprets them in the context of South Africa's power crisis and draws more general conclusions about the unintended consequences of reform processes in infrastructure sectors.

Section 2.7 concludes our chapter.

2.2 Theoretical Framework

2.2.1 Conventional Explanations

Principal–agent approaches and transaction–cost economics have a long tradition of use in the analysis of infrastructure sectors and explanation of performance deficiencies (see Armstrong and Sappington 2006). The two approaches emphasize asymmetric information and the opportunistic behaviour of utility firms as reasons for poor service delivery.

For example, principal–agent approaches argue that an inadequate regulatory framework generates asymmetric information and, therefore, may result in insufficient levels of investment (e.g. Guthrie 2006). Transaction–cost economics maintains that uncertainty and high asset specificity are typical features of infrastructure sectors, which induce hold-up problems (see e.g. Joskow 2002; Spiller and Tommasi 2005). Such hold-up problems occur as different players interact – generators and coal suppliers, utilities and the regulator, and/or the regulator and policy makers, etc. – and lead to sub-optimal performance outcomes from infrastructure services. So, traditional approaches have identified inadequate regulation and contractual issues as the main causes for inefficiencies, and have suggested changes in the incentive structures and institutional frameworks in order to improve performance (see e.g. Joskow 2002; Gómez-Ibáñez 2003, 2007; Irwin and Yamamoto 2004; Armstrong and Sappington 2006; Guthrie 2006; von Hirschhausen, Beckers and Brenck 2011).

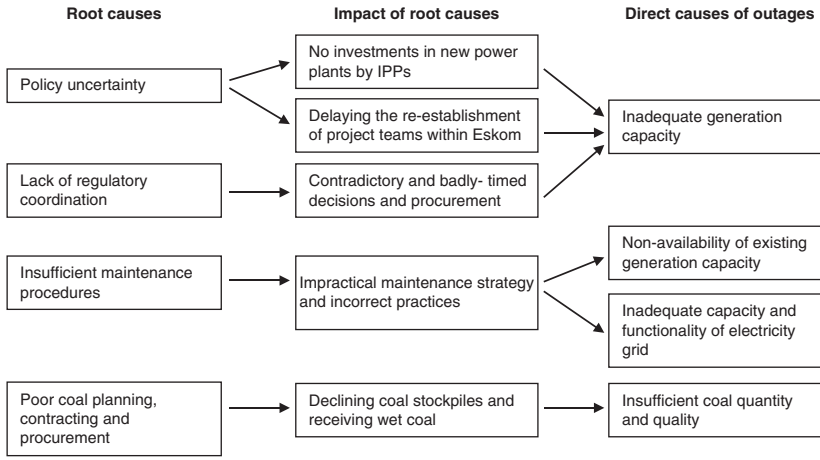

Figure 2.1 Conventional explanation of South Africa's power outages

South Africa's electricity crisis has been analysed in a number of reports and studies (NERSA 2006, 2008; Eberhard 2007a; Public Protector South Africa 2009; Hamukoma and Levy 2019), mainly through the lens of traditional approaches. These reports highlight four direct causes for the crisis:

1) Lack of generation capacity due to under-investment in new power plants
2) Non-availability of existing generation capacity due to insufficient maintenance
3) Insufficient coal quantity and quality
4) Inadequate capacity and functionality of the electricity grid.

The prevailing explanations link these four direct causes to another four underlying root causes:

i) Policy uncertainty
ii) Lack of regulatory co-ordination
iii) Insufficient maintenance procedures
iv) Poor coal planning and contracting.

The first two root causes are located at the policy level, whilst the latter are located at the organizational level at Eskom. Figure 2.1 illustrates the link between the direct and root causes.

Policy uncertainty, as first root cause, is related to the fact that electricity sector reforms in South Africa were not fully implemented. Whilst Eskom was prohibited from building new generation capacity, mechanisms were not put in place to contract independent power producers

(IPPs). When the construction ban on Eskom was finally removed in 2004, capacity scale-up was already far behind schedule. Policy uncertainty also delayed the re-establishment of dedicated project teams and departments within Eskom in order to manage generation capacity expansion. The two impacts of policy uncertainty led to an inadequate generation capacity.

A second root cause was the lack of co-ordination and integration of the different electricity planning, investment decision making, approval and procurement processes between Eskom, the National Energy Regulator (NERSA), the Department of Minerals and Energy (DME) and the Department of Public Enterprises (DPE). This led to contradictory and badly timed decisions and procurement processes, and ultimately resulted in a further setback of the investments in new generation plants.

As a third root cause, the existing studies identify a 'negligence of maintenance procedures' at Eskom for both power plants and the electricity grid (NERSA 2006: 3, 2008: 21). Furthermore, remedial actions were inadequate, protection systems had been operated incorrectly, licence conditions were breached and the maintenance strategy was not practical. As a result, existing generation capacity was unavailable and transmission capacities limited.

Finally, poor coal planning, contracting and procurement led to low coal stockpile levels and poor coal quality (NERSA 2008: 38), which, again, reduced the actual generation capacity of the power plants. This combination led to load losses and to unplanned power-plant outages.

Whilst these explanations seem to be comprehensive and convincing at first sight, they leave a series of questions open. The maintenance deficiencies, for example, were not just a problem in one or a few locations, but emerged as a general issue across most power plants. So why did a systematic lack of adequate maintenance procedures emerge, despite maintenance being one of Eskom's core competences? Why did Eskom suddenly fail in key tasks such as coal contracting, in which the firm could reasonably be expected to have long-term experience? Why did it take Eskom so long to set up teams for new generation capacity expansion programmes after the government reversed an earlier decision that had stopped Eskom building new power plants?

One explanation could be that Eskom was just a case of bad management. Such a view, though, presumes that management and performance problems were unrelated to the sector reform processes, which was not the case, as we will show.

It seems that conventional explanations do not fully account for the processes that unfold at the organizational level and their accompanying challenges. They implicitly assume that changes and adaptations at the

organizational level occur easily and quickly, i.e. that the organizational resources and capabilities necessary to accommodate regulatory changes are readily available. Insights from the management literature, though, suggest that resource and capability development at the organizational level might be complex, ambiguous and time-consuming processes (see e.g. Dierickx and Cool 1989; Barney 1991; Zollo and Winter 2002; Kraaijenbrink, Spender and Groen 2010).

So, conventional explanations for performance deficits in infrastructure sectors have to be complemented by approaches that take processes at the organizational level explicitly into account. The capability perspective we introduce and apply below is a step towards this goal.

2.2.2 A Capability Perspective to Explain Utility Performance

Organizational capabilities have been widely studied in the management literature to better understand the performance of firms, especially in situations where tasks are highly complex or market environments are changing rapidly (Barney 1991; Barney, Ketchen and Wright 2011; Teece, Pisano and Shuen 1997; Eisenhardt and Martin 2000; Winter 2003; Newbert 2007). Organizational capabilities enable a firm to execute tasks such as production, marketing and product development. In the case of electric power producers, key tasks include planning, building, operating and maintaining power plants. Organizational capabilities develop over time and depend on, amongst other things, the competences, skills and experiences of the employees of a firm. Ideally, the organizational capabilities of a firm are well adapted to the key tasks it has to perform.

When tasks change, e.g. due to changes in the market environment, or the capability structure changes, e.g. due to well-functioning teams leaving the firm, a capability gap might occur and negatively affect firm performance (Lavie 2006; Capron and Mitchell 2009; Dominguez et al. 2009; Worch et al. 2012; Rahmandad and Repenning 2016). A major challenge in such a situation is that capability gaps are not always easy to identify, and often take quite some time to be resolved, if at all. This is particularly the case, if the lost capabilities comprise long-term experiences or tacit knowledge.

In this chapter we apply a recently developed capability perspective that explicitly links changes in the regulatory environment to the emergence of capability gaps in utility firms (see Worch et al. 2013). A capability gap is an insufficient availability of competences, skills and experiences for a specific organizational task. The framework suggests that regulatory interventions can directly affect the capabilities of utility firms. A capability gap occurs if

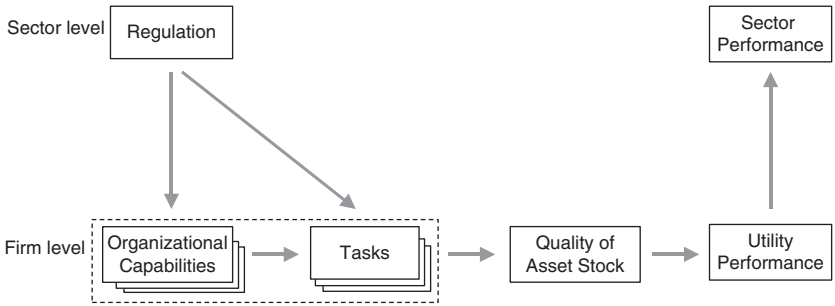

Figure 2.2 Capability perspective on utility and sector performance

existing capabilities are weakened whilst tasks remain the same, or if new tasks emerge for which the capabilities are not yet available (Worch et al. 2013: 5). The two effects can occur simultaneously or independently. Capability gaps tend to be particularly persistent in situations where the adaptation of existing capabilities or the development of new capabilities is time-consuming, complex and poorly understood.

In electricity supply, unbundling is an example in which regulation directly affects the organizational structures of electric utilities with potentially negative consequences for the existing capabilities of the affected organizational units (Pollitt 2008). Market liberalization is an example whereby regulatory changes lead to the emergence of new tasks, such as marketing, power trading or balance group management, for which new organizational capabilities are required.

The result of a capability gap is a performance decline in, or even complete failure of specific organizational tasks, and eventually of the organization as such. If *existing capabilities* are weakened or get lost because of regulatory changes, this may result in a decline of organizational performance. Regulatory interventions can also change the tasks utilities have to fulfil. If tasks change, *new capabilities* will be required, which means that they have to be developed in order to fulfil the tasks. A decline in organizational performance may have repercussions at the sector level, especially if all utility firms are affected in a similar way, or if very critical firms, such as single suppliers, are affected. Figure 2.2 depicts the applied framework.

With this study we provide empirical evidence for the relevance of a capability perspective. We will show how regulatory changes unintentionally affected the capabilities and tasks of a utility company, so that performance deficits occurred at the organizational and sectoral level. The broader purpose of the chapter is to demonstrate the benefits of

a capability perspective as an important complement to conventional approaches in terms of explaining the impact of regulation and other sector developments on organizational performance.

2.3 Research Method

Given the limited understanding of the impact of regulatory changes on capability structures in utilities, we use an inductive case study methodology (Eisenhardt 1989; Miles and Huberman 1994) to understand how capability gaps emerged at Eskom, and what factors caused these gaps.

As a first step, we identified all factors that played a role in changes in the capability structure of Eskom's generation division. We derived a set of six broader context factors that caused capability gaps in generation operations, which resulted in power plants being poorly operated and existing generation capacity being insufficiently available. These factors (see Table 2.1, first column) and the unfolding processes of loss in capability formed the six cases that we then examined in a comparative setting.

In the second step, we analysed and compared the underlying capability change processes for each of these factors. Here we report our findings from the six cases (related to the six factors) of capability change processes within Eskom's power-generation division. The comparative research design enabled us to derive specific insights on the influence of these factors on Eskom's capability structure. It also allowed us to infer some more general conclusions about the emergence of capability gaps in utility firms, and, therefore, to contribute to theory-building in this area.

We conducted twenty semi-structured interviews in 2009 and 2010. Former CEOs, board members and executive managers, and former and current senior-level managers served as key informants for the case study. The interviewees were closely involved at different levels in Eskom when changes in the business environment affected the generation division. They were asked to give a detailed account of the capability processes in generation, with a specific focus on the factors causing capability gaps to emerge and the implications of these for capability structures and performance. They also provided illustrations of how competences and skills changed. Insights into the processes leading to capability losses emerged inductively from the fieldwork. All the interviews were recorded and transcribed; transcriptions of around 500 pages were analysed using standard qualitative data analysis software (MaxQDA 10).

Table 2.1 *Factors impacting on Eskom's generation-capability structure*

External factors	Emerging capability gap as a result of:	Reasons for emerging capability gap (i.e. change in the capability structure)	Factors lacking as a result of the capability gap
Sector reform processes	Loss of existing capabilities	Encouraging early retirements Resignations	Long-term experience
	Newly required capabilities	Running power plants at higher load levels with less maintenance	More experience of how system components interact was required
Sociopolitical transformation	Loss of existing capabilities	Encouraging early retirements Resignations	Long-term experience
Large technological systems with long life-cycles	Loss of existing capabilities	Retirements through cohort effect	Long-term experience
Technological change	Loss of existing capabilities	Encouraging early retirement	Long-term experience
Economic growth and development	Loss of existing capabilities	Highly qualified staff left to start a new job elsewhere (most of these were staff with long-term experience)	Highly qualified engineering, technical and managerial competences and skills
		Reinforcing drain of capabilities, as those who left encouraged other staff members to follow once they were established in the new job	Bias towards those with long-term experience
Changing weather conditions	Newly required capabilities	Running power plants with coal of lower quality	More experience of how system components interact was required
		Running power plants at higher load levels with less maintenance	

In addition, extensive archival material, such as annual reports, internal documents, monographs and company reports, were included in our analysis to enrich our database, triangulate the interview information and so increase the validity of our research.

The data analysis started with a within-case analysis, in which we became familiar with each case – i.e. each identified factor and its unfolding influence on Eskom's capability structure – as a stand-alone entity

(Eisenhardt 1989). The within-case analyses were conducted in three steps. Firstly, we reviewed the data so as to create a basic understanding of each capability-losing process. Secondly, we described the impact of the external factors and established how the unfolding chain of events affected the capability structure in Eskom's generation operation. And thirdly, we characterized the types of competences and experiences that were lost. Once all the within-case analyses were completed, we continued with the cross-case (comparative) analysis (Eisenhardt 1989). Comparing the six processes in an iterative process, we identified similarities and differences across the capability-losing processes. Inferring from this analysis, we identified two distinct mechanisms of emerging capability gaps. We therefore derived a better understanding of the capability gaps' nature and their implications from our data.

Identifying capability gaps was a key aspect of our analysis. The following quote is an example of how we inferred from an informant's description that Eskom's generation division lost capabilities, and that the critical dimension of this loss was a long-term experience:

> People that have not been around long enough, they don't fully understand . . . that if this part of a plant I'm looking at behaves in a certain way, it's going to have a certain knock-on effect on another part of the plant. And it's purely an issue of experience.

In the following section, we briefly describe Eskom's history to provide some context of the empirical case we analyse. After this overview, we present our results.

2.4 Eskom – A Brief Historical Overview

Eskom, founded in 1923, is one of the largest electric utilities worldwide today. It has around 48,000 employees (2018); an installed generation capacity of more than 48,000 MW (2018), predominantly from coal-fired power plants; and generates approximately 95 per cent of the electricity used in South Africa. Eskom has been a limited liability company since 2002, and is owned by the national government.

In the 1970s and early 1980s, Eskom expanded its generation capacity substantially (Conradie and Messerschmidt 2000: 217). As a result of the capacity expansion, Eskom had a need for qualified technical and engineering staff to run its new power stations, and recruited many of those who had been involved in constructing the plants. In the early 1980s, economic growth rates slowed down, as did the need for new generation capacities. However, Eskom's programme to build new power stations could not easily be stopped: orders had been placed and contracts concluded. This led to

a growing reserve margin, reaching almost 40 per cent in 1991 (Eberhard 2007b: 219). In order to facilitate financing of capacity expansion, electricity tariffs increased by as much as 48 per cent in 1977 and by 22 per cent in 1982.

Following customer complaints, the government intervened. The central motivation was to implement an adequate control and management system that aimed to transform Eskom into a more efficient organization. A new organizational structure was introduced in 1985; this was the beginning of a phase commonly referred to as Eskom's commercialization process. Eskom changed over time from being an engineering-dominated organization to becoming a commercially thinking firm. The new strategy highlighted terms such as customer needs, cost-effectiveness, running Eskom as a business and value maximization. Balancing the trade-off between engineering excellence and organizational efficiency had not been part of Eskom's prior thinking and common identity. Similarly, laying off a substantial number of employees was a fundamental deviation from the 'old' Eskom. Between 1985 and 1990, Eskom reduced its staff from 66,000 employees to 50,000, whilst, at the same time, electricity supply rose by 20 per cent. Eskom also introduced a performance management system. The combined result of cutting the number of employees and improving the performance of personnel in the firm significantly increased Eskom's productivity.

With the sociopolitical transformation in South Africa in the 1990s, new policy frameworks were implemented, including employment equity legislation. At about the same time, a reform of the electricity sector was initiated, which included the opening up of the market to IPPs and the establishment of a national regulator. Both the sociopolitical transformation and the electricity sector reform had a major impact on Eskom and the energy sector as a whole.

At the organizational level, Eskom extended its so-called 'space creation' programme to respond to the government's new employment equity policy, which made it mandatory for companies to consist representatively of employees from previously disadvantaged groups. The space creation programme was initially launched in 1988 as part of the efforts in the commercialization process. Starting in the latter half of the 1990s, the programme aimed to hire more qualified black professionals for engineering, management and leadership roles in the organization, whilst employees from more privileged groupings retired. In this sense, the latter created space for a new cohort of employees at Eskom. The number of Eskom's employees declined further still to about 29,000 in 2004.

As part of the sector reform process, the South African government corporatized Eskom in 2001, which meant that the utility became

a company fully owned by the DPE. Furthermore, the government envisaged the introduction of IPPs as a way of increasing investment (Marquard 2006: 187). To facilitate this sector reform, and to ensure that Eskom would not have an unfair advantage over new entries, the government also prohibited Eskom from building new generation capacity. When electricity demand grew remarkably, but not unexpectedly, in the early 2000s, Eskom's reserve margin started to decrease to an extent that supply shortages became more and more likely.

Responding to the looming shortages, Eskom was again allowed to construct new power stations in 2004. However, it became increasingly difficult for Eskom to balance demand and supply. Between 2005 and 2008, South Africa experienced several blackouts and significant load shedding. Moreover, Eskom was unable to keep its existing power plants working adequately. In January 2007, for example, almost 5,000 MW of capacity were not working due to technical breakdowns and equipment failures, in addition to another 5,000 MW of generation capacity out for planned maintenance. The electricity crisis caused costly damage to the economy and a substantial loss of welfare to electricity consumers (Eberhard 2007a). For example, there was an extensive period of power rationing, and even mines were forced to close for certain periods. Although the situation has stabilized since 2008, the status of South Africa's electricity system is still critical, with electricity supply substantially strained in peak hours and an ongoing risk of power outages.

2.5 Results: The Emergence of Capability Gaps

Six sets of factors were identified as having an impact on Eskom's capability structure in electricity generation, and as finally contributing to power outages. These are:

1) Electricity sector reforms
2) Sociopolitical transformation
3) Substantial cohorts of employees close to retirement
4) Technological change
5) Economic growth and an increased demand for qualified labour in the economy
6) Extreme weather conditions

Our analysis shows that there were two distinct mechanisms by which capability gaps were conditioned. Some factors affected the existing capability structure, for instance, by incentivizing experienced staff to leave the utility. Other factors altered the required capability structure by changing the nature of tasks. Table 2.1 summarizes the impact of these factors.

The first two sets of factors, namely electricity sector reforms and sociopolitical transformation after the end of apartheid, will be the focus of the subsequent analysis because they are of prime importance for our conceptual argument, and had a major effect on the capability structure at Eskom. The two factors are related to major public-policy-reform programmes, which were political efforts to improve economic efficiency and implement other public-policy goals in South Africa's electricity sector. More precisely, the electricity sector reforms included the commercialization of Eskom in order to improve the efficiency of power generation in South Africa, and the opening of the electricity supply market for private investment and IPPs. The sociopolitical reform programme included policies to ensure and enforce the implementation of equal-opportunity employment practices in South Africa. The impact of these two public-policy programmes will be elaborated on in Subsections 2.5.1 and 2.5.2.

The remaining four factors are either related to specific technical and natural conditions that characterize the electricity sector, or to general changes in the environment of the firm, e.g. economic growth, and are reported in Subsection 2.5.3. As they do not reflect the impact of regulatory changes on capabilities they receive somewhat less attention in the following.

2.5.1 The Impact of Electricity Sector Reforms

Two major reform processes of South Africa's electricity sector were initiated to ensure a broadly available, secure and efficient power supply. The first was the commercialization of Eskom in the mid-1980s. The second process was the government's reform of the regulatory framework. Begun in the late 1990s, it was intended for this reform to open the wholesale market for more private investment, and was linked to the corresponding cabinet decision that prohibited Eskom from building new generation capacity. The latter move can be characterized as an attempt to partly liberalize the electricity sector. As emerged from our data, the two processes had a substantial effect on Eskom's capability structure and contributed to the aggravation of capability gaps. However, the channels through which the sector reform processes affected the capabilities differed. Whilst the commercialization process decreased Eskom's existing capability structure, the changes of the regulatory framework, and specifically the government decision to stop Eskom from building new capacity, changed the nature of operating power plants considerably. This contributed to the capability gap by generating additional requirements for competences and skills that were already

scarce. Table 2.2 summarizes the results and presents representative quotes.

2.5.1.1 Commercialization

Starting in 1985, Eskom went through a major organizational transition with long-lasting implications (Eberhard 2007b).The aim was to establish a more commercially professionalized organization with adequate management and control structures.

Our analysis showed that the commercialization process diminished Eskom's capability to operate power plants substantially. The emerging capability gaps were persistent and had long-lasting implications, which decisively contributed to Eskom's supply failures between 2005 and 2008. Six factors influenced Eskom's capabilities in the area of generation operation.

First, Eskom introduced an early retirement programme in 1986, to contain medium- to long-term operating costs. The scheme not only allowed operations staff to retire before the age of 65, but also paid out lucrative packages. By setting the early retirement age at 55, Eskom lost cohorts of highly experienced operators and operations managers between 1986 and 2004. And so, existing capabilities that comprised a substantial part of the company's long-term experience were lost.

Second, the commercialization process fostered the appointment of managers with business and financial skills to administer Eskom's business units. As a result, power-station managers with many years of engineering experience (thirty years on average) were replaced by relatively young power-station managers with degrees in business or finance. Similarly, the highly experienced (in engineering) operations managers were progressively replaced by cohorts of less experienced operations managers, most of whom possessed both a business and engineering degree. Over time, a strong financial focus was established at the expense of the engineering mindset. This change broadened the available capabilities within operations, but at the cost of a substantial decrease of the company's access to long-term experience in the engineering and technical aspects of operating power plants.

Third, as a result of this commercialization process, the identification of employees with Eskom as a long-term employer faded away, especially amongst engineers. As a mindset shift was required towards more commercial thinking, many engineers decided to leave the company. Furthermore, those engineers who were better qualified and who performed better tended to leave the company in larger numbers, because it was easier for them to find other positions

Table 2.2 *The impact of sector reform processes on the capability structure*

Impact of sector reform programmes	Description of the impact	Impact on the capability structure	Skills lacking as a result of the capability gap	Representative quotes
		Commercialization of Eskom starting in 1985		
Introducing early retirement programmes	Lucrative early retirement packages for staff between 55 and 65 years in order to contain operation costs	Loss of existing capabilities through retirement	Long-term experience in operating power plants	'.. we allowed a lot of experience [operators and operations managers] to move out of the organization . . . you know, with early retirement packages, etc.' ' . . . the lack of skilled operators is a problem . . . I have operators that have put in water too fast in the boiler, or have dropped temperature too fast in a boiler or have fired the boiler too fast. Those [operating errors] affect . . . the generating plant'
Increasing managerial competences	Appointment of managers with business and financial skills	Loss of existing capabilities through the replacement of managers with extensive engineering and operation experience	Long-term experience in operating power plants	'[We] introduced a lot more business competence. We started to employ chartered accountants; we started to get exposure in management to financial people and commercial people other than engineers'

Resignations	Commercialization required mindset shift amongst engineers from engineering excellence to commercial thinking, i.e. focus on cost minimization and strict performance criteria	Loss of existing capabilities as a result of engineering personnel leaving	Long-term experience in operating power plants	'I think the level of rigour with which people appreciate the importance of running those systems in a certain manner; I think that must have changed' 'From 2005 onwards we reinforced the need to maintain . . . the systems, thinking in terms of maintenance and so forth, because we saw it going downhill'
Implementing a leaner organizational structure	Reduction of personnel to save costs, e.g. spare shifts that operated power plants when regular operators underwent training	Loss of existing capabilities as a result of reducing number of personnel in operations	Long-term experience and possibilities for younger personnel to gain experience decreased	'It was John Maree [Eskom's Board Chairman between 1984 and 1998] who said: "There are too many people working here! Our job isn't to supply jobs. Our job is to supply cheap electricity and then, other industries will supply jobs." And so . . . some power stations were closed and all the staff moved on' ' . . . on the operating side of the plant, we used to have, what we call the spare shift. I don't think there's many stations these days which have got a spare shift anymore' '..with cost-cutting the [power] station would not be able to afford to have [an] additional shift [and] . . . to make sure that the people [operators] are being retrained continually'

Table 2.2 *(cont.)*

Impact of sector reform programmes	Description of the impact	Impact on the capability structure	Skills lacking as a result of the capability gap	Representative quotes
		Commercialization of Eskom starting in 1985		
Decreasing training budgets	Number of instructors and operators in training progressively reduced as Eskom considered outsourcing power-plant operations	Loss of existing capabilities through reducing training personnel and personnel in training	Long-term experience and possibilities for younger personnel to gain experience decreased	'. . . the money [training budget] . . . allowed a limited number of experienced instructors to sit [remain in the organization]. So, even if we wanted to do training, maybe we did not have enough instructors available for that'
		Changes of the policy and regulatory framework starting in 1998		
Running power plants harder	Operating the power plants at higher load levels in response to the diminished reserve margin	Additional capabilities required	Disproportionately high inputs for managing, operating and controlling at the operator and operations management level was required	'. . . [The operation regime is] not the same animal that we had ten years ago . . . it's a different animal. It was a lazy donkey then, this is a wild horse now' '[To] move from 65 per cent to 70 per cent load factor means I probably don't work 5 per cent harder, I am actually working 15 per cent harder to achieve the same thing . . . ' 'As you get closer to the maximum [levels] of driving the plant . . . and also, trying to overcome other limitations . . .

				within that, poor coal quality, increased emissions . . . those type of things . . . by trying to operate your plant [at higher load levels], you [the operations manager] are actually putting it under more stress than what you would think'
Re-commissioning power plants	Operating previously decommissioned power plants as response to the diminished reserve margin	Additional capabilities required	Experience in operating the old power-plant technologies was required	'. . . if you have older people [operators] with newer technology, that, that in itself is a mismatch . . . ' '. . . in terms of technology . . . that environment is changing . . . because now most things are monitored [computerized monitoring] . . . most of our plants [are] now condition monitored'
Running plants with less maintenance	Operating power plants with limited maintenance as response to the diminished reserve margin	Additional capabilities required	Broader knowledge about the interactions of the different parts of a power station was required	'I [as an operator] cannot operate the plant as I was taught to do, because the plant is no longer the same'

in the job market. The implication was not only the loss of competences and skills, but also that the average qualifications and experience of the remaining engineering staff declined.

Fourth, in an attempt to improve financial viability, Eskom adopted a leaner organizational structure. One example of re-organization was to phase out the cohort of experienced – and more costly – operators that made up the spare shift in the power stations. The purpose of the spare shift was to keep the power stations operational when the less experienced operators were undergoing training. Usually, operator training in Eskom's power stations takes a long time, and requires the combination of training during plant operations with training through simulations at the Eskom College in Johannesburg. Phasing out the spare shift of experienced operators substantially diminished the training opportunities available for the next generation of operators. Both experience and the possibility to gain experience decreased, with the consequence of inadequate plant operation.

Fifth, Eskom's new management decreased the power stations' training budgets. As a result, the number of operators in training decreased progressively. Some of Eskom's more experienced operator instructors were forced to retire as a number of training facilities were dismantled and replaced with a more centralized operator training structure (the Eskom College and Academy of Learning). The diminished number of instructors resulted in insufficient training opportunities for less experienced plant operators.

Sixth, and finally, in an attempt to further reduce operating costs due to low electricity demand and an increasingly idle generation capacity, Eskom's management started to decommission some of its older and more labour-intensive plants in the mid-1980s. This also resulted in many experienced operators and operations managers retiring early.

2.5.1.2 Changes in the Policy and Regulatory Framework

Part of South Africa's democratic transformation in the 1990s was a new energy policy. A key element of this new policy was to establish a competitive wholesale electricity market (see Energy Policy White Paper of 1998). To foster this process, South Africa's government enacted a moratorium, in 2000, forbidding Eskom from building any power stations in the future, whilst a Nordpool-style power exchange and market was being designed. The thinking amongst policy makers at the time was that this was an essential prerequisite for creating a competitive wholesale electricity market. It was assumed the

moratorium would stimulate the private sector to enter the electricity supply market and undertake a substantial part of the required generation capacity expansions in a more cost-effective manner. However, the proposed power pool was not implemented and the moratorium failed to attract significant private-sector investment in the four years that it was in effect. No procurement or contractual arrangements were put in place to attract IPPs. Consequently, South Africa's electricity generation capacity remained stagnant.

The robust growth in electricity demand, and a fixed supply of electricity, severely depleted Eskom's generation reserve margin from 27.1 per cent in 1999 to 5.1 per cent in 2007. In an attempt to meet the escalating demand, Eskom responded in three ways. Firstly, it ran its power plants at higher capacity factors. Secondly, the utility recommissioned and ran some of its very old, and previously mothballed, thermal plant fleet. And thirdly, Eskom had to operate its power plants whilst carrying out less maintenance work on them because of the tight reserve margins, which made scheduled maintenance more difficult. As we will demonstrate in this section, and as presented in Table 2.2, all three responses changed the nature of operating power plants and affected their required capability structure, and also contributed to the emerging capability gap. In effect, changes in power-plant operation would have required a different – or at least adjusted – capability structure.

Regarding running its power plants harder, Eskom had historically run its thermal plant at load levels below 60 per cent. In fact, it was only in the years of severe crises in the mid-1950s and early 1980s that Eskom's thermal plants ran at maximum load levels in excess of 60 per cent. In all other years until 1995, the thermal plants ran at load factors of 53 to 58 per cent. After 2003, the load profile of the thermal power stations changed considerably. Whilst the load factors were about 61 per cent in 1999, they were between 74 and 78 per cent in 2008. The increased stress from operating the thermal plant at such high load levels not only altered the reliability of the plant by making it more vulnerable to failure, but also increased the level of capability required in order to perform operational tasks at the managerial and operator levels. One interviewee illustrated the changed nature of performing generation operations in this way: ' ... [the operation regime is] not the same animal that we had ten years ago ... it's a different animal. It was a lazy donkey then, this is a wild horse now.'

Running the plant harder required a disproportionately great increase in human and material input. For example, one interviewee explained that a 5 per cent increase in the load factor required about 15 per cent more work input to manage, operate and control the process. In addition

to the changed requirements at the operator level, an increase of capabilities was also required at the operations manager level. Managers had to facilitate more cautious operation of the highly stressed plant. They also had to adapt its operating systems to the increasing complexities. This entailed re-assessing and redesigning various aspects of the thermal plant operating regime; in fact, no one at Eskom had experience of running the plants at these higher load factors.

The second internal Eskom process that was initiated in order to respond to the crisis was the re-commissioning of power plants that Eskom had decommissioned when it had excess generation capacity, and as a result of the commercialization process. Running a fleet of aged and re-commissioned thermal plants represented a new and complicated task for Eskom. Between 1980 and 2000, Eskom procured and commissioned six new, technologically advanced, coal-powered plants. The utility also modernized its thermal fleet's operating regimes and staff complement as a precursor to computerizing its plant operations process. Simultaneously, it phased out its older and more labour-intensive fleet of thermal plants, along with a large section of the plant staff (Conradie and Messerschmidt 2000).

By 2005, this situation had changed considerably, as Eskom's excess capacity had expired. Eskom attempted to modernize its previously decommissioned thermal plants, but it proved difficult to completely overhaul all of the old plant's operating systems because they were premised on old engineering designs and technologies. As a consequence, only older operators and operations managers were able to operate these old plants. The younger, and better formally educated operators, found themselves at variance with the old plant technologies and systems. According to one interviewee, the cohort of operators and operations managers around the mid-2000s were not familiar with operating a thermal plant without 'bells and whistles', which is a reference to the ability to run a power plant without adequate IT operational controls.

A third implication of the diminished reserve margins was that Eskom had to run its plants with less maintenance. This was a significant change, because operating a power plant that is regularly maintained according to a schedule is a different process from operating one that is not maintained. The maintenance staff would have needed broader knowledge about the interactions of the different parts of a power station in order to understand which parts required priority observation and treatment when not maintained according to schedule. Given the tightened windows of opportunity to take the power stations off the grid for planned maintenance, project management know-how was required to ensure project

procedures carried out the necessary maintenance strictly within the defined timelines.

In sum, the commercialization process and changes in the policy and regulatory framework ultimately resulted in tightened reserve margins. This had a substantial impact on Eskom's generation capabilities, as highly experienced personnel left the organization. The personnel's long-term experience in operating power plants diminished. As a result, operators and operations managers were not able to operate the plant adequately. This already critical situation was further exacerbated when sector reform processes led to a moratorium on Eskom investments in new generation capacity, and declining reserve margins. As an unintended consequence of this policy, the plants had to be run harder, which in turn required additional capabilities. This widened the capability gap even further.

2.5.2 The Impact of South Africa's Sociopolitical Transformation

Sociopolitical transformation further amplified the high employee turnover caused by the sector reform processes. Accelerated retirement and resignation of key staff affected Eskom's generation capabilities critically. Power-generation-related capabilities diminished. The transformation in South Africa impacted on Eskom's capability structure in generation through three underlying specific factors. Table 2.3 summarizes the results and presents representative quotes.

One crucial factor was the government's employment equity policy and Eskom's response to it, which it described as the 'space creation' programme. In the early 1990s, Eskom started to promote a few selected individuals from previously disadvantaged backgrounds into the previously all-white middle and higher echelons of power-station management as part of the space creation programme. Although it was implemented in a piecemeal manner in the beginning, the programme focused on filling operator and operations-manager positions that had become vacant as a result of retirements and resignations.

This initial response to political and social change, e.g. to the release of Nelson Mandela in 1990 and the commencement of constitutional negotiations, was followed up in the late 1990s with the acceleration of the early retirement programme. Following the democratic elections in 1994, the ANC-led administration enacted the Reconstruction and Development Programme (RDP) of 1995 and Employment Equity Act of 1997, which set very stringent targets for companies in South Africa to achieve demographically representative staffing profiles. In an attempt to

Table 2.3 *The impact of sociopolitical reform programmes on the capability structure*

Impact of sociopolitical reform programmes	Description of the impact	Impact on the capability structure	Skills lacking as a result of the capability gap	Representative quotes
Government policy on employment equity and Eskom's response of implementing space creation				
Extending the early retirement programmes	Retirement age was further decreased, with lucrative early retirement packages offered to staff aged between 45 and 65 years to create space for a new cohort of engineers and managers	Loss of existing capabilities through retirement	Long-term experience in operating power plants	'The young engineers [operations managers], they are probably technically qualified and they [are] trying their best to be there [operate the plants], but there are certain aspects that they can't inherit from me [older operations manager] or, from you or, from anybody else, they've got to learn it themselves. And with the power stations being in a more stressful operating environment they don't have the time to learn. They are expected to understand immediately and probably to know better than the old engineers [operations managers] knew because the conditions are now tougher [diminished reserve margins]'
Resignations	Following the sociopolitical change in South Africa, a substantial number left Eskom as a state-owned enterprise or even the country	Loss of existing capabilities as a result of the loss of personnel	Long-term experience in operating power plants	'. . . a lot of people have gone to Australia. I know good people [operators and operations managers] that have gone to Australia. The demand there is huge.'

				‘ . . . overseas companies, targeted specific skills like plant operators. . . . It just meant that we [Eskom] had less spare capacity [on the operating side of the plant] . . . ’
Pursuing multiple goals	Managers lost focus by pursuing demographic transformation in addition to engineering excellence in power-station operation	Loss of existing capabilities as a result of loss of engineering personnel	Long-term experience in operating power plants	‘ . . . the organization had a more focused engineering mindset prior to 1994. After 1994 it became more politically conscious. When it became more politically conscious it started driving the transformation agenda [tackling the demographic imbalance within Eskom’s organizational structures] more than the engineering agenda . . . . which was fine, but it didn’t . . . let’s say, it didn’t sufficiently in my mind . . . at least, recognize the importance of the engineering agenda. So, we sort of changed priorities along the way’ ‘I would say the next generation of management [operations managers] wasn’t as forceful [in enforcing engineering excellence], they were more transformational leaders [focused on demographic transformation within Eskom]’ ‘ . . . we had these chaps operating [the thermal power stations] here, that really made bad mistakes, and we could not understand. Then, they [the power-station operators] had supervisors working who really were not experienced. They [the power stations] had inexperienced supervisors supervising inexperienced operators . . . ’

achieve approximately 60 per cent representation for black individuals from previously disadvantaged backgrounds in middle to top management levels between 1996 and 2000, Eskom scaled up its space creation programme. Eskom reduced the retirement age for experienced white operators and operations managers from 55 to 45 years in an attempt to create space for affirmative action appointees, and achieve national affirmative action targets. At the same time, a larger number of operators and operations managers from previously disadvantaged backgrounds were appointed or promoted into these positions, based mainly on potential (as opposed to years of specialist engineering experience) and within a context of limited succession planning.

A second factor was that a wave of resignations affected the cohort of experienced operations staff that were well below the retirement age. There were various reasons for this; within this cohort, one stream of (mainly white) operators and operations managers resigned from Eskom because they did not want to work under black management (supervisors, managers or executives). Another stream of experienced operators and operations managers resigned from Eskom and left South Africa on account of perceived uncertainties of life in the post-apartheid political dispensation.

Finally, managers lost focus whilst pursuing multiple goals, thus further aggravating capability gaps. The primary focus shifted from managing the attainment of engineering excellence in operations to administering organizational-level demographic transformations. As a result of the progressive decline of experience in Eskom, subsequent cohorts of less experienced technical supervisors and operations managers failed to adequately supervise their subordinates in plant operations, and thereby caused operator errors.

In sum, transformational factors such as the adoption of employment equity policy and pursuit of affirmative action as an additional organizational goal impacted on the existing capability structure of power stations by resulting in the loss of experienced labour at the operator and operations-manager levels. In making this observation, the authors do not wish to convey the impression that these policies were not necessary. Indeed, they most certainly were; apartheid had systematically blocked opportunities for black South Africans. We merely note that the way these employment equity and affirmative action policies were implemented exacerbated an already perilous problem within Eskom around operational experience. As the power stations had an already limited cadre of experienced operators and operations managers due to high employee loss as a result of the commercialization process, the remaining staff were partly replaced with less experienced operating staff from previously

disadvantaged backgrounds. Consequently, the level of available experience for the performance of operations tasks diminished further in this second wave of lost critical competences and skills. The subsequent promotion of young and relatively inexperienced operators and operations managers further eroded the level of experience available, and ensured that the operation performance remained persistently low over time. It is important to highlight that it was less the engineering qualifications that were lost, more the engineering experience. Regarding qualifications, the incoming young cohort of engineers were highly qualified and brought modern engineering knowledge into Eskom.

Summing up, the policy-induced reform programmes created persistent capability gaps within the utility, which ultimately resulted in severe performance deficiencies. Certain positions within the power-station operations departments could no longer be filled and as a consequence, the operations managers were increasingly unable to understand the technical complexities across the integrated generation processes. Therefore, operators failed to strictly adhere to the plants' specific operating procedures.

2.5.3 Further Factors Contributing to the Loss of Capabilities in Electricity Generation

In addition to the two public-policy programmes presented above, technical, general economic and natural conditions affected the capability structure of Eskom in a negative way. We identified four additional factors that contributed to a loss of capabilities in electricity generation (see Table 2.1 for a summary).

Firstly, electricity sectors represent large technical systems with long lifetimes (Markard 2011). As a consequence of Eskom's power-generation capacity expansion in the 1970s and 1980s, a large number of engineers and technicians involved in the construction of power stations were hired to operate the plants. A considerable part of this cohort faced retirement in the late 1990s and 2000s. In these years, Eskom lost a highly experienced group of staff with intimate knowledge of the specificities of the various power plants. This caused a significant gap in the company's existing capability structure.

Secondly, new technologies in electricity generation contributed to the emergence of capability gaps. In order to reduce over-capacity, older power plants were decommissioned and mothballed, i.e. shut down and put into long-term storage, and power-plant staff were offered jobs at other, newer Eskom plants. Many of these newer plants were operated with technologies that were much more IT-based than the older power

stations; staff members close to retirement, in particular, showed little enthusiasm for learning about new generation technologies. Therefore, they accepted early retirement offers or decided to leave Eskom. This development generated a capability gap with a loss of long-term experience in generation, which became relevant later on when formerly decommissioned power plants had to be put back into operation due to dwindling reserve margins.

Thirdly, strong economic growth after the fall of the apartheid regime in 1994 resulted in an increasingly competitive labour market, with a high demand for skilled professionals – particularly in the engineering and technical area. This created pressure and a novel situation for Eskom, which had been one of the top employers for engineers for a long time. The favourable situation in the labour market led to many employees leaving Eskom. Once established in new private companies, they encouraged former Eskom colleagues to join them. Moreover, the loss of capabilities had a bias in the sense that the better-performing employees, who often also had more experience, left because their chances of finding attractive positions outside Eskom were higher. At the same time, there was an increasing exodus of experienced professionals out of South Africa to utilities in Europe, North America and Australia.

Finally, exceptional weather conditions during the years of the major blackouts, coupled with increased demand, contributed further to the loss of capabilities. Unusually heavy rainfall in January and February 2008 decreased the quality of coal. Handling and processing the wet coal at power stations altered the nature of the task. Wet coal had lower net calorific values per unit mass and power plants had to be run harder; i.e. with higher load factors and fewer opportunities for maintenance. Because of the uncertainty of operating these plants under unexpected and largely unknown conditions, more experience was required; i.e. there was a need for more engineers and technicians with an intimate understanding of the affected power plants, and of how their various components interacted under a tight operating regime.

2.6 Discussion

Our empirical findings suggest that a central underlying reason for the inadequate operation of Eskom's power plants was a dramatic lack of operation-related competences and skills. We identified six factors that either caused the loss of highly experienced engineering, technical and managerial capabilities, or significantly changed the nature of the tasks Eskom had to perform in generation operations. Two public-policy-reform programmes had particularly severe unintended effects on

Eskom's capability structure. They caused a loss of capabilities due to experienced personnel leaving the utility, and due to changes in the various tasks that required staff to have new capabilities that were not readily available. This explains why power plants were not operated to an adequate standard, which contributed to the power outages. Other factors, such as technological change, economic growth and extreme weather conditions, reinforced this effect and therefore aggravated the power crisis.

In addition to the immediate impact on the capability structure, the loss of experienced staff had long-lasting consequences. Many positions remained vacant because the acquisition and build-up of professional experience takes time in this sector. Succession programmes have to be planned and implemented over considerable time spans. Thus, the long-term experience of operating power plants, which the ex-staff had accumulated, could be replaced neither by young professionals nor by externally hired experts in the short term. Furthermore, little emphasis was placed on programmes to ensure capabilities were maintained at the beginning of the reform processes. This was because policy makers did not expect the changes in the policy and regulatory environment to have a relevant and negative influence on Eskom's capability structure and performance.

Surprisingly, during the electricity crisis, many actors with an intimate knowledge of South Africa's electricity sector acknowledged the relevance of capabilities and the significance of losing them. But they failed to develop a collective perception of the cumulative effect that the public-policy programmes had had on the capability structure, and of how that had affected organization and, ultimately, sector performance. More generally, the trade-off between the necessity of sector reforms and transformational policies on the one hand, and the impact on organizational capabilities on the other, has received hardly any attention.

Inferring from these insights, we draw two conclusions. First, the capability dimension is an important, but neglected and little-understood, dimension of infrastructure sector regulation in both research and practice. Second, and as a consequence, there is little knowledge of the specific challenges that emerge at the organizational level due to sector reforms and regulations, and how these affect the performance of utilities and other firms in the sector. Our results are, therefore, a strong call for more research to gain a better and more detailed understanding of the causes, mechanisms and implications of infrastructure sector reform processes as they relate to capabilities, and to examine more thoroughly the specificities and time lags of these processes.

Moreover, our analysis adds a further root cause to the existing list of causes (see Figure 2.1) for South Africa's power outages between 2005

and 2008. Power plants were not only maintained to an insufficient level (NERSA 2006, 2008), but also inadequately operated, which was an additional reason why the existing generation capacity was unavailable. This is an important finding, because it reveals that sector reforms influenced Eskom's operational capabilities critically. Even if sufficient generation capacity had been built and maintained, inadequate capabilities in operations, due to unintended consequences of the sector reform process, would have jeopardized secure electricity supply. Thus, our findings show, more generally, that policy and regulatory changes not only influence the level of investment in a sector but have – through their impact on capabilities – a substantial effect on organizational-level processes such as operations and maintenance.

This argument is corroborated by the examination of other causes commonly listed as explanations for the power failures in South Africa in 2005–2008. Our in-depth analysis of Eskom's capacity expansion, maintenance and coal-contracting processes suggests that similar mechanisms could be identified across power-plant operations. In other words, the different public-policy reforms caused a substantial loss of competences and skills across all organizational functions within Eskom. And these were important factors explaining why the blackouts occurred, and why they could not be remedied within an acceptable time span.

However, whilst our study looked into the consequences of changes in policy and regulation, other factors may also have negatively affected organizational capabilities. For example, there is evidence of significant attempts at political capture of Eskom's corporate governance, which may have led to management decisions that undermined necessary organizational transformation and restructuring efforts. Politically driven governance dynamics may also have resulted in management decision making that gave limited attention to cost and efficiency implications, and therefore contributed to performance deficiencies. Finally, the findings do not recommend slowing down or even reversing the efforts to reform South Africa's electricity sector. On the contrary, they suggest that policy, regulatory and management decision makers take the crucial role of capabilities in these reform processes more carefully into account.

To what extent can these results be generalized beyond the specific context of the selected case study? An obvious specificity of our case is the sociopolitical transformation process that South Africa accomplished after the end of the apartheid regime. However, South Africa's transformation can be understood as a particularly broad case of a changing policy and regulatory environment. Examples of less far-reaching policy changes may still show similar impacts on capabilities. For instance, if a government's energy policy aims at promoting new electricity

generation technologies, there is a need to take into consideration the emerging trade-off between the achievement of an intended policy goal and its unintended effect on the capability structure, and to actively manage this trade-off. In this sense, the broad transformational and regulatory changes in this study reflect and illustrate policy-induced situations, in which utilities might be confronted with the loss of qualified personnel and struggle to attract employees with the required experience.

South Africa also represents a special case in the sense that Eskom dominates its national electricity supply. This situation is by no means unique. But it has been a key advantage for us in that it has allowed us to track the immediate consequences of capability gaps at the sectoral level, and comprehensively study the impact of public-policy reform programmes on the nationwide failure of the electricity supply. It might be argued that a sector with more power generators would have been able to adjust faster to the challenges posed by regulatory and transformational changes. This is because a greater number of firms would have enabled the initiation of different trial-and-error processes to cope with, and respond to, those challenges. Ideally, other utilities could have imitated the best practices. Conversely, one might also argue that several small utilities, which were very similar and relatively homogeneous in their structure and function, would not have been able to develop an adequate response to the emerging complex challenges in the way that a large organization such as Eskom could. Therefore, further research is needed to understand the role that sector structure plays in the response processes of utilities to policy and regulatory reforms.

2.7 Conclusions

In this chapter, we applied a capability perspective to the analysis of the performance of utilities and other strongly regulated firms in order to better understand the unintended consequences of sector reforms. Analysing South Africa's electricity sector and the causes that led to Eskom's poor performance between 2005 and 2008, the findings exemplify how the complex interaction of various factors influences a firm's capability structure and, in turn, determines its performance. Electricity sector reforms and other public policies may, in fact, affect the capability structure of utility firms in a fundamental and sometimes even irreversible way.

On the one hand, regulation can have a direct impact on the structure of organizational capabilities. This is the case when capabilities are split into different organizational entities or when organizations lose know-how. A typical example of the first case is the unbundling of generation,

network operation and sales in the electricity sector. An example of the second case from this study is Eskom's space creation programme, which was triggered by electricity sector and sociopolitical reforms in South Africa, and as a result of which Eskom experienced a substantial loss of experienced staff.

On the other hand, regulation can have an indirect effect on organizational capabilities due to changes in the tasks and requirements an organization has to fulfil. Changing tasks and requirements necessitate new capabilities that may not be readily available. An example from this study is the decision to re-commission previously decommissioned power plants. This required know-how in operating old power-plant technologies, which was not sufficiently available. The capability effect of this decision became even more problematic as power plants operated under limited reserve margins.

More generally, we can expect that many electricity utilities will have difficulties in adapting to a more competitive market environment, or to technological changes related to decentralized renewable power generation, which are mostly stimulated and accompanied by new regulations. The direct and indirect effects of these factors on organizational capabilities may lead to severe and persistent capability gaps. The impact of regulation on organizational capabilities is certainly an under-researched topic, both in the literature on regulation and in the field of management studies.

Traditional explanations of utility sector reforms have neglected the role of capabilities and have, instead, primarily focused on incentive structures and contractual concerns. The prevalence of these explanations may have contributed to our finding that there was hardly any perception at the sectoral and organizational levels of the relevance and importance of capability losses. We showed that the capability perspective provides a complementary explanation for the unfolding of an electricity supply crisis. Our findings suggest that, in addition to establishing adequate incentives and contracts, the impact of policy reforms on organizational capabilities decisively determines the success of the reforms themselves. In other words, even if the incentive structures are sufficiently established, the loss of substantial capabilities may undermine the intended outcome of such programmes. Thus, reform programmes need to implement adequate measures to track and mitigate any negative influence they might have on organizational capabilities.

Summing up, we have laid out the basic argument that reform processes have a fundamental impact on the capability structure of utility firms and, therefore, influence the performance of public service delivery. It is critical to recognize the importance of organizational capabilities,

especially when there is a runoff of experience due to ageing out, processes of organizational restructuring and changes in the political, regulatory and economic environment. Furthermore, if a technical or organizational system goes into stress, the required capabilities tend to be higher and so require even more careful attention. With these results, we add the capability dimension to the literature on regulation, sector reform and the governance of utilities. The findings from applying this perspective suggest that capability-related processes, and their impacts, need to be taken much more seriously in order to achieve successful utility sector reforms.

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