Prepayment Metering in Bangladesh
How to Improve Electricity Delivery and Eliminate Theft

In Brief
- **Development Challenge:** High levels of theft of electricity in Chittagong, Bangladesh's second-largest city, prevented the utility from operating and maintaining the system properly or making new investments. Insufficient power generation to cover demand and low plant efficiency resulted in erratic power supply and blackouts.
- **Program Solution:** The utility installed prepaid meters, which prevented users from receiving electricity they did not pay for.
- **Program Results:** The program completely eliminated theft of electricity, gained acceptance by groups that originally felt threatened by the program (customers and meter readers), built the capacity of the utility, and ended up costing less than originally estimated.

Executive Summary
What can a utility company do to prevent the theft of electricity, a major problem in many developing countries? This case examines how the public utility in Chittagong, Bangladesh's second-largest city, completely eliminated the theft of electricity that had plagued its operation since the early 1990s by installing prepaid meters.
The Bangladesh Power Development Board (BPDB) used to lose millions of dollars a year to electricity theft, a practice facilitated by corrupt meter readers and metering technology that made it easy to illegally tap power lines. These losses prevented the company from operating and maintaining the system properly or making new investments. Insufficient power generation to cover demand and low plant efficiency resulted in erratic power supply and blackouts, which reduced the quality of life of the city’s residents both directly and indirectly (by making manufacturing uncompetitive).

BPDB lacked the institutional, technological, and human capacity to deal with the problem. To address the challenge, in 1999 KfW, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), launched a pilot cooperation project with BPDB that replaced regular power meters with prepayment meters (meters that must be charged through payment in advance and automatically disconnect once the paid amount is exhausted) in three areas of Chittagong.

The project was enormously successful: It did not just reduce theft, it eliminated it entirely. It also ended up costing less than the initial estimate.

This case study examines the organization and implementation of the project and its outcomes. It yields several important lessons:

- Acceptance of the prepayment metering system was achieved and resistance from meter readers, their union, and electricity consumers was overcome through a holistic approach that focused not just on installation and operation but also addressed the concerns of those who could be negatively affected.
- The implementation consultant played a significant role in supporting BPDB, closing capacity gaps and assisting with successful implementation of the project.
- Outsourcing operation of the prepayment system to a private company contributed to the efficiency and success of prepayment metering.

Introduction

In the early 1990s, the power sector of Bangladesh was characterized by massive supply deficiencies. Power outages occurred daily, and the electrification rate was low. On the demand side, the major problem was the high level of electricity losses at the distribution level caused by theft, which accounted for 16 percent of total electricity generation. According to the Bangladesh Power Development Board (BPDB), which was solely responsible for operating the power sector at the time, losses of 1 percent amounted to lost income of $5 million a year; therefore the estimated loss per year at that time was $80 million. These losses made it difficult to finance new investments or maintain and repair existing works, exacerbating the deficiencies in power supply.

Overcoming the problem and improving the power supply were critical to reducing poverty and enhancing the quality of life of the Bangladeshi population. Doing so required political reforms; regulatory, organizational, and technological changes; and new investments in the power sector. Corrupt meter readers and metering technology that made it easy to illegally tap power lines facilitated the theft of electricity. BPDB lacked the institutional, technological, and human capacity to deal with the problem.

In 1995 BPDB, together with the German Development Bank KfW, decided to investigate the concept of prepayment as an option to reduce system losses and reverse the financial drain on the utility. Feasibility studies incorporating site surveys, financial analyses, and tariff impact studies were prepared. Based on these studies, KfW, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), launched a cooperation project with BPDB that aimed to replace regular power meters with prepayment meters (meters that must be charged through payment in advance and automatically disconnect once the paid amount is exhausted) in three areas of Chittagong, Bangladesh’s second-largest city. These technical measures were to be accompanied by organizational and institutional changes aimed at reducing the high level of power theft. The project was designed as a pilot; if the pilot succeeded, the approach was to be extended to other areas of Bangladesh.

This case study describes the project, referring to planning, implementation and outcome stages. Although contextual conditions affect delivery processes, the main lessons learned may be applicable to similar projects and situations elsewhere in the world.

The case study is guided by the following research questions:

**Question 1:** How was acceptance of the prepayment metering system achieved and resistance by meter readers, their trade unions, and electricity consumers managed?

**Question 2:** What role did the private sector play in implementing the project and achieving its goals?

**Question 3:** What risks and challenges did the project face, and how were they mitigated and addressed?
Contextual Conditions

Currently (2015) about 68 percent of Bangladesh’s people have access to electricity. Per capita power consumption of about 348 kWh per year, which is very low compared to other developing countries (Halder et al. 2015, 1640).

Insufficient power generation to cover demand and low plant efficiency resulted in erratic power supply and blackouts. Although Bangladesh’s energy policy aims at strengthening economic development through sufficient and reliable power supply this goal is still far from being achieved. At the root of the problem are high levels of corruption, which hinder efficiency.

The Bangladesh Power Development Board (BPDB) was created in 1972, just after independence. It is a public sector organization responsible for planning, developing, and operating the country’s power infrastructure, including power plants and transmission and distribution lines.

Disruptions of electricity supply were a daily occurrence, holding back economic development and costing the country an estimated 1 percent of GDP a year. Manufacturing companies were not able to meet delivery dates and had to pay their workers during power outages and for extra hours in order to catch up on production shortfalls. The significantly higher labor and production costs scared off national and international investors across business sectors. BPDB’s performance was so poor that major international donors stopped financing new power plants in Bangladesh in the early 1990s, exacerbating the situation.

The worst problem was the very high level of system losses, especially at the distribution level, which were crippling the finances of the utility. Total power losses in Bangladesh amounted to about 35 percent—considerably higher than in neighboring countries (estimated at 15 percent in Thailand, 17 percent in Sri Lanka, 24 percent in Pakistan, and 25 percent in Nepal), which themselves had much higher losses than developed countries like Germany (which had losses of less than 5 percent at the time). According to BPDB, 1 percent of system losses amounted to lost annual income of $5 million. These losses hampered expansion of power generation capacities, as money for proper maintenance of existing power plants was lacking and new investments could not be financed. Power prices were set artificially low for political reasons so were below the long-run marginal costs of electricity generation. This contributed to BPDB’s worsening financial situation and made new investments unprofitable.

In 1994, Bangladesh adopted a plan for reforming the electricity sector. Opposition from the meter reader unions (which opposed institutional changes) and the population (which opposed higher electricity prices) posed obstacles and slowed the reform process. Eventually, however, higher electricity tariffs and the unbundling of the power sector were implemented. An independent regulatory authority was founded; separate publicly owned entities for generation, transmission, and distribution were created; and a single-buyer market model was developed. These reforms led to the entry of a number of independent power producers (IPPs), which received a guarantee of power purchased through BPDB (the single buyer) as an investment incentive. Over time new investments by the IPPs helped reduce the gap in power supply and made electricity generation more reliable.

Reforms succeeded in bringing in the private sector, but they had no impact on the high level of power losses, especially at the distribution level. Of the 35 percent of electricity that was lost, 5 percentage points came from power plants’ own consumption, 4 percentage points from transmission losses, and 26 percentage points from distribution losses, of which about 60 percent were nontechnical losses (theft), making theft the most important single source of power losses. Distribution losses in Chittagong were even higher than the average.

This theft of electricity stemmed partly from the fact that many poor people could not afford a connection to the power grid or simply had not been connected by BPDB. Indeed, at the time the project began, only 16 percent of the population was officially connected to the power grid. Many households that were connected could not afford to pay for power. Thus, they illegally tapped power lines to steal electricity.

Electricity is stolen in three main ways:

• tapping low-voltage lines before the meters
• having corrupt technical employees of BPDB manipulate or bypass meters
• having corrupt meter readers record lower than actual meter values and sharing the difference with customers (the meter readers pass on a share of their profit to their trade union, which offers them protection; the project’s appraisal report describes mafia-like structures in this context).
The project aimed to demonstrate how electricity theft could be reduced and the financial drain on the utility reduced by introducing prepayment meters in Chittagong (see box 1 for an explanation of prepayment meters and how they work).

Tracing the Implementation Process

Various solutions for reducing nontechnical losses had been tested before the project. One approach—in which meter reading, invoicing, and collection of payments were outsourced to private companies in four cities—was carried out with support from the World Bank. It reduced nontechnical losses from 35 percent to 25 percent in the pilot cities and was expanded to other cities. A measure financed by the Organisation for Economic Co-operation and Development (OECD) supported intensified controls that reduced system losses by 7 percent in study areas. With support from the Asian Development Bank, a computer-based centralized invoicing system was introduced in Dhaka and Chittagong for a total of 20,000 customers. The system improved invoicing but did not address theft.

The solutions supported by the World Bank and OECD reduced electricity theft, but losses remained high. The government of Bangladesh and BPDB wanted to see whether introduction of prepayment meters would have a more significant impact, as it had in South Africa and Tanzania (Northeast Group 2014).

Agreeing to Pilot a Prepayment Metering System

In 1995 the chairman of BPDB, Mizanur Rahman, and his successor, Syed Abdul Mayeed, visited South Africa with a consultant financed by the German government through KfW. They concluded that prepayment might be a viable tool for Bangladesh and recommended to KfW that a feasibility study be conducted before implementing a pilot project.

The feasibility study, which was elaborated in 1996 and financed from KfW’s Special Fund for Project Preparation, analyzed six potential locations for the pilot. Because distribution losses in Chittagong were higher than the national average but the distribution lines were in a technically acceptable state, it proposed three supply areas there for implementing the pilot project. The objective of the pilot project was to replace the meters of all customers connected to one of three 11 kV-feeders with prepayment meters.

Based on the outcomes of the feasibility study, in 1999 KfW sent a project proposal to the German Ministry for Economic Cooperation and Development requesting the required funds, which were approved the same year. KfW’s intervention was designed as a pilot project for the introduction of prepayment electricity meters in three supply areas in Chittagong in order to reduce nontechnical losses (electricity theft). Additional expected outcomes were reduced customer payment defaults, improvements in monitoring and

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Box 1 Prepayment Meters: How Do They Work?

The prepayment metering system is easily explained: First, a new kind of meter is installed by the customer's house, which has an in-built disconnection device. The customer buys electricity in advance by paying in a vending office, also described as a Credit Dispensing Unit (CDU). As the paid amount reaches exhaustion, the meter provides an alarm indicating that it needs to be recharged. If it is not recharged, the meter automatically disconnects the supply once the paid amount is exhausted. If disconnected, the consumer can reconnect himself by buying electricity and recharging the meter.

Since the electricity is paid in advance, arrears or payment defaults are no longer possible and the clients’ awareness of the link between payment and electricity consumed is raised. Furthermore, clients are enabled to directly monitor their power consumption and to adapt it according to their available budget.

The electronic metering mechanism is located inside a robust plastic housing, which would need to be broken up in order to tamper with the meter, making manipulation more difficult and more easily detectable. Connection of the meters is carried out via isolated steel-armed air-cables with concentric conductors, which make it impossible to tap the lines before the meter or bypass the meter without causing visible damage.

Two main types of prepayment meters are available on the market. Some function by introducing a magnet card that was previously charged with a certain purchase amount. Others are activated by introducing a code generated upon purchase of power.
recovery of arrears, and increased consumer awareness about energy consumption and efficiency. The overall project goal was to contribute to an economically efficient power supply. If the pilot was successful, the plan was to replicate it on a larger scale in Chittagong or other cities.

The specific aims of the project included the following:
• Replace conventional meters by installing 8,500 one-phase and 450 three-phase prepayment meters.¹
• Rehabilitate the parts of the distribution grid which connects the prepayment metering system.
• Install control meters in order to register the amount of electricity fed into and passed through the distribution grid.
• Install up to 10 vending offices, in which magnet cards or number codes could be purchased in order to activate the prepayment meters.
• Select a private operator of the prepayment metering system.
• Provide support through an external implementation consultant.

Success of the project was to be based on the achievement of two indicators by 2003: reduction of distribution losses from about 34 percent to 20 percent² and reduction of arrears on power invoices from 35 percent to 5 percent.³

Partnering with BPDB
The project measures were to be implemented together with BPDB. The project appraisal report by KfW considered this partnership “very high risk,” because of BPDB’s poor economic performance and its lack of sufficiently qualified managerial and other staff. KfW’s fears proved well founded: a 2002 progress report stated that “things are further complicated by an inefficient and unreliable internal and external communication system and lengthy internal decision-making procedures. Additionally, the responsible project director has recently been replaced. This has impacted negatively on the project’s progress.”

¹ Single Phase power refers to a two wire alternating current (AC) power circuit. Typically there is one power wire and one neutral wire. Three-phase power refers to three wire alternating current (AC) power circuits. Typically there are three (Phase A, Phase B, Phase C) power wires (120 degrees out of phase with one another) and one neutral wire.
² The total loss figure includes technical losses, illegal connections, losses on conventional meters, and tampering and bypassing of prepayment meters.
³ The collection/billing rate for prepayment customers is by definition 100 percent, because all billed amounts are prepaid. The remaining 5 percent of arrears was chosen to allow for nonprepayment collections.

The government of Bangladesh insisted that BPDB be the project’s counterpart institution. KfW eventually agreed, for two reasons. First, it believed that with the support of a highly qualified implementation consultant, BPDB would be enabled to successfully implement the project. Second, outsourcing the operation of the prepayment metering system to a private company as an essential component of the project was seen as an effective way of mitigating risks.

Hiring the Consultant
Implementation of the project began with a tender (limited to German companies) for selection of the implementation consultant. The winning firm was to help define the scope of the prepayment metering system, select a supplier of the meters and a private operator, create a new tariff structure, carry out a one-year test phase, and deliver training and capacity building.

In May 2000, BPDB selected Fichtner, a Stuttgart-based consulting firm. Because of long and tedious contract negotiations (largely because of very slow and complicated decision-making procedures within BPDB), the contract was not signed until February of 2001. Fichtner began work in March 2001, nine months later than planned.

Defining the Scope of Work
Fichtner began by conducting a comprehensive study to define the scope of work required to implement the prepayment metering system. Its study included a customer survey to verify all customer details and register customers who had been connecting illegally. The study revealed that more extensive rehabilitation work was required to the distribution grid than had initially been assumed. This work involved replacing bare overhead conductors with aerial bundle conductors, replacing service connection cables with tamper-resistant split concentric cables, and installing new transformers.

Defining the Technical Specifications of the Prepayment Meters and Meeting the Preconditions for Selecting the Contractor
Fichtner was also responsible for defining the technical specifications of the prepayment meters and assisting
with the selection of a supplier. KfW defined several preconditions that needed to be fulfilled before such a supply contract could be signed.

The first was the creation of a new tariff structure for customers using the prepayment meters. Before the introduction of the prepayment meters, customers would automatically move into a higher tariff class if they surpassed a certain amount of electricity consumption. This system would not be applicable to prepayment meters, where the amount of consumption needed to be defined at the moment of power purchase. On the one hand, the new pricing scheme for prepayment meters had to consist of special tariffs (differentiated by customer groups) that would be sufficiently attractive for consumers, particularly given the opportunity cost of paying their bill in advance. On the other hand, the new tariffs needed to be high enough for the future operator of the prepayment system to be able to run the system profitably.

Fichtner crafted a proposal for the tariff structure, which both BPDB and KfW approved. It consisted of a 2 percent discount on the regular tariff for customers receiving prepayment meters—a measure intended to help foster customer acceptance. The approval procedures proved very slow and time consuming. Elections were taking place at the time, which led to shifting priorities and contributed to delays. In April 2002 the Ministry of Power, Energy, and Mineral Resources finally gave its approval.

KfW also supported BPDB’s desire that a private company should operate the entire prepayment metering system, including the vending offices. BPDB did not have clear ideas on how such an operator contract should be designed. It was therefore agreed that an operational model and contract would be developed before the prepayment meters could be purchased. This contract was to regulate the rights and obligations of the operator and of BPDB with respect to maintenance of the distribution grid and the meters.

Fichtner proposed an operating model and a contract design that was approved by BPDB and KfW. Under this model, the private operator of the prepayment system would buy electricity directly from BPDB, just like any other large customer, and sell it to customers via the prepayment meters. The private operator would install and operate several vending offices at which customers could purchase electricity in advance and receive a code to activate their meters. Where the voltage transformed from the distribution grid level voltage (11 kV) down to the consumption grid level voltage (400 V), control meters were to be installed to measure the amount of power made available at the consumption grid level. Although it would still be technically possible to illegally tap the lines between the control meters and the customers’ prepayment meters, any such theft of electricity could easily be identified by a gap in the readings between the control meters and the prepayment meters. The risk of any such losses would lie with the operator of the prepayment system, which therefore had the right to remove any illegal connections. The operator was also allowed to charge penalties based on average consumption as well as a reconnection fee for illegally connected customers. According to the operating contract, maintenance of the prepayment metering system was to be carried out by the operator, while maintenance of the distribution grid in the project area would remain the responsibility of BPDB.

Selecting the Supplier and Operator of the Prepayment Metering System

With both preconditions fulfilled, the project moved on to selecting a supplier and operator of the prepayment metering system. Initially, it was intended to separately tender (a) the supply and installation of the prepayment meters and their auxiliary equipment, as well as the required rehabilitation measures and (b) operation and maintenance of the prepayment system. However, BPDB proposed integrating the operation of the system into the tender for supplying the turn-key equipment, a proposal that KfW approved. The idea was to integrate the future operator of the prepayment system into the project’s implementation and acquaint the operator with the project’s history at an early stage.

Fichtner elaborated the tender documents for the supply and services of the prepayment metering system. Because of lengthy decision-making procedures within BPDB, discussion and approval of the final version of the tender documents extended from February to October of 2002. Finally, on October 30, 2002, an international open tender procedure was launched. At the request of interested firms, the deadline for bid submission was extended twice, to March 2003. Despite the extension, the tender was unsuccessful, as none of the three bids received was fully responsive, probably because the technical requirements were too restrictive.
The specifications were revised to make them more open, and the requirements were elaborated in a pre-bid conference held in Dhaka. As a result of these changes, a second round tender was successful, and a contract was awarded in July 2005. The contractor was a joint venture between the British firm Polymeter Response Int. as turnkey equipment supplier and the Bangladeshi firm KCJ & Associates Ltd. (KCJAL) as operator of the prepayment system.

An evaluation of the project was carried out by KfW on behalf of BMZ after the termination of the contract in 2009. This evaluation concluded that “From today’s perspective it would have been more reasonable to carry out separate tenders for the required rehabilitation measures in the distribution grid on one hand and the prepayment metering system on the other, since the scope of both components was too different and it was too difficult, laborious and risky for interested companies to create suitable joint ventures for such a project in Bangladesh.”

Implementing the Project

By the time the contract for supply and service of the prepayment metering system was signed, project implementation had been delayed by more than four years. The unsuccessful first round of the tender procedure was one of the causes; delays also resulted from extremely lengthy decision-making and approval procedures within BPDB and the Bangladeshi government institutions involved. The pilot nature of the project and the inexperience of the institutions with prepayment metering systems probably also played a role.

Delays dogged the first years of the project’s implementation. KfW had identified the risk of such delays in its project appraisal report and planned to mitigate them through support by the implementation consultant. In the event, Fichtner was not able to influence the tedious internal procedures, especially of BPDB.

Only once the contract for supply and service of the prepayment metering system had been signed could the rest of the project be implemented quickly. The first stage of the prepayment metering system was operational in the last quarter of 2007. In October of 2008 ownership was completely transferred to BPDB.

The contract for operation of the prepayment system had an initial duration of five years. After termination of the contract, an extension was tendered. KCJAL won the contract and is still in charge of operations today. It has done an excellent job. Customer acceptance and satisfaction are high, and BPDB has not made complaints. These outcomes confirm that the decision to outsource operation of the prepayment system was correct and contributed significantly to the efficiency and success of the project.

The prepayment meters came with a three-year manufacturer guarantee; defective meters were repaired or replaced free of charge during that period. The annual rate of defects was about 1 percent for single-phase meters and 1.7 percent for three-phase meters. This rate lies within what had been expected based on experience with prepayment metering systems in South Africa and Tanzania, where defect rates were 1–2 percent a year.

Training and Building the Capacity of BPDB

During the first year of operation, Fichtner helped resolve problems and promote efficiency and acceptance of the new metering system. It also trained BPDP staff and helped increase the utility’s capacity, to enable it to manage the interface with KJCAL. Measures included site visits in South Africa and Tanzania to talk with utility personnel and see the meters and vending systems in operation, a two-week metering and vending training in the United Kingdom, and a month of on-site on-the-job training with KCJAL.

The trainings also included some components that were within the scope of KCJAL’s contract, such as operating the vending offices. BPDB was made familiar with these tasks in order to be able to assess KCJAL’s performance. This training also probably helped BPDB in other supply areas of Chittagong where it is operating its own prepayment metering systems. Some BPDB staff were apparently trained without any return, as they later moved to other departments of the company, where their knowledge was not put to use.

Defusing Opposition from Meter Readers and Customers

The project faced opposition from meter readers, who feared for their jobs, and from customers, especially people who previously had not paid for the electricity they used. In early 2006 the trade union of the meter readers called
for a boycott of the project, which threatened to affect acceptance of the prepayment meters by the population. Only by assuring the union that no jobs would be lost and that the meter readers would be employed in other supply areas did BPDB manage to call off the boycott.

In order to raise acceptance of the prepayment meters by customers (who had no possibility of opting out of the program), KCJAL, with the support of Fichtner, conducted a four-month promotional campaign in which the affected households as well as the general public were informed about the new technology and its advantages as well as possibilities for saving electricity. The campaign used various channels, including newspapers, pamphlets distributed with bills, roadshows, and radio. At the customer center, a promotional video was displayed and a meter and vending demonstration area set up. KCJAL is continuing such information and promotion activities today.

Acceptance was also enhanced by the fact that the prepayment meters came at no cost to customers, that customers received a 2 percent discount on the official slab tariff for electricity, and that rehabilitation measures carried out by the project in the distribution grid increased the security and reliability of power supply. Pursuing a holistic approach that focused not only on installing and operating the prepayment metering system but also on allaying fears and defusing opposition contributed to the success and a high level of acceptance of the project.

**Measuring Success**

Thanks to the rapid increase in the number of customers in the supply areas of the project, the number of prepayment meters rose: Instead of the 8,500 one-phase and 450 three-phase prepayment meters planned, the project installed 12,300 one-phase and 1,045 three-phase meters. The operating system implemented comprises an electronic invoicing system and five vending offices. The project also installed 195 control meters, in order to monitor the feed-in and distribution of power in the distribution grid and identify any losses caused by theft.

The project surpassed both of its indicators by large margins. The first indicator was to reduce distribution losses from 34 percent to 20 percent. By the time the rehabilitation measures and installation of prepayment meters began, average distribution losses in the supply areas of the project had already been reduced to 16 percent. Some of the decline can be attributed to the comprehensive scoping study carried out by Fichtner, which included a customer survey to verify all existing customer details and register previously illegally connected customers. This measure alone led to a reduction in electricity theft, presumably because it raised concerns of being caught.

After the rehabilitation measures were implemented and the prepayment metering system had operated for one year, total distribution losses were reduced to 3 percent. All losses are now technical losses, as theft has been all but eliminated.

Simple measures like intensified customer support can apparently reduce theft of electricity considerably, but eliminating nontechnical losses would not have been possible without the installation and operation of prepayment meters. In hindsight the first indicator seems to have been too conservative; more ambitious reductions can be aimed for in future similar projects.

The second indicator was to reduce arrears on power invoices from 35 percent to 5 percent. In 2007/08 actual arrears represented just 3.1 percent of invoiced amounts. Arrears have since been effectively reduced to zero.

The overall results of the project can thus be described as extremely satisfactory. Perhaps the clearest proof of success is that following the pilot, BPDB introduced prepayment metering systems in other supply areas of Chittagong on its own.

Achieving results also came at a lower cost than projected. During implementation, the project underwent many changes in total costs and cost structure. The total costs of the project were initially estimated at €5.7 million. Of this amount, €4.1 million was to be foreign currency costs for the supply of the prepayment metering system and cost of the implementation consultant, which was to be covered through a grant from KfW on behalf of BMZ. The remaining €1.6 million were local currency costs for local construction work and consultancy services, as well as taxes and custom duties, which were to be covered by BPDB.

The contract with the implementation consultant rose from about €1 to €1.25 million, mainly because of the need for a more comprehensive analysis in order to define the exact scope of work required and because of the lengthy delays caused by BPDB and Bangladeshi government institutions. The increase in costs was limited by transferring several local construction supervision tasks from Fichtner to a less expensive local consultant. Another factor contributing to higher costs was the fact that many more prepayment meters were installed than originally intended.
Despite the increases, the foreign currency costs amounted to just €3.8 million (less than the €4.1 million planned). The lower cost reflected the fact that the required rehabilitation measures turned out to be less costly than planned: The time delays meant that BPDB did some rehabilitation work in the interim. In addition, some of the transformers identified for replacement were refurbished instead of replaced, reducing costs. Further savings resulted from a large reduction in the prices of prepayment metering systems over time.

The local currency costs also turned out to be much lower than estimated, at only €700,000 (instead of €1.6 million), largely as a result of the devaluation of the Bangladeshi taka. In the end, the total costs of the project were about 20 percent lower than planned (€4.5 million instead of €5.7 million).

Although local currency costs were considerably lower than initially estimated when calculated in euros, the burden to BPDB in local currency was still high. Furthermore, the share of local currency costs in total project costs rose from 72 percent (as initially planned) to 84 percent. In view of this burden, a share of the foreign currency costs saved by KfW was transferred to BPDB to cover the larger share of local currency costs.

Even after this adjustment, KfW had about €72,000 of the initial funds left at the end of the project. It transferred these monies to its Energy Efficiency Programme III, which aims to introduce prepayment metering systems in Bangladesh on a larger scale.

Lessons from the Case Study

This case study yields several lessons about implementing prepayment metering systems in developing countries. They are reflected in the responses to the three research questions:

**Question 1: How was acceptance of the prepayment metering system achieved and resistance by meter readers, their union, and electricity consumers overcome?**

To allay the fears of meter readers—and avoid a boycott by their union—BPDB guaranteed that no jobs would be lost. Meter readers who were no longer needed in the supply areas of the project were transferred to other supply areas and did not lose their jobs.

To gain customer acceptance of the project, BPDB provided the prepayment meters free of charge and granted a 2 percent discount on the official slab tariff for electricity. It also made the new tariff and its implications easy to understand. Installation of the prepayment meters went hand in hand with a number of rehabilitation measures in the distribution grid, which improved the security and reliability of power supply.

The company launched a four-month promotional campaign, in which households as well as the general public were informed about the new technology and its advantages as well as possibilities for saving electricity and reducing costs.

Through these measures, the operator achieved a high level of acceptance of the prepayment metering system. A holistic approach designed to respond to the concerns of people who might have been negatively affected proved critical.

**Question 2: What role did the private sector play in implementing the project and achieving its goals?**

At the beginning of the project, BPDB, KfW’s Bangladeshi counterpart for project implementation, was characterized by poor performance, insufficiently qualified management and other staff capacities, and complicated internal and external communication structures, which lead to lengthy decision-making procedures. BPDB was a weak and inefficient public entity and counterpart.

To compensate for BPDB’s shortcomings, the project involved private sector companies in two major functions. An implementation consultant was hired to assist BPDB in a number of activities, including defining the scope of the prepayment metering system and selecting a supplier and operator, elaborating a new tariff structure, carrying out a one-year test-phase, and delivering training and capacity building measures. The consultant played a significant role in supporting BPDB, closing capacity gaps and successfully implementing the project.

Operation of the prepayment metering system was outsourced to a private company. It was assumed that the expertise, experience, and profit orientation of a private company would lead to more professional and efficient implementation than could be achieved by BPDB.

Following an international tender, Bangladeshi company KCJAL was selected to operate the prepayment metering system. To further reduce risks, the implementation consultant assisted KCJAL in the first year of operations.

KCJAL did an excellent job, achieving high levels of satisfaction among both customers and BPDB.
Outsourcing operation of the prepayment system to a private company was a key element in the efficiency and success of the project.

**Question 3: What risks and challenges did the project face, and how were they mitigated and addressed?**

In its project appraisal report, KfW perceived the risk of delays in essential implementation steps. Although this risk was partially mitigated by the implementation consultant, who elaborated the essential proposals, it was not possible to reduce the time-consuming decision-making and approval procedures on the BPDB side. Without the assistance of the implementation consultant, project implementation would probably have been delayed even more or not been possible at all. Involving such expertise was thus a key success factor.

An unsuccessful first tender for the supply and operation of the prepayment metering system also contributed to delays in implementation. The technical specifications in the first tender were too restrictive, reducing interest and making it impossible for bidding firms to fully comply with the requirements. This problem was resolved by defining the specifications in a more open manner and holding a pre-bid conference at which the requirements were explained in detail. The scope of the assignment still remained large and complex. It may be that a larger number of qualified bids would have been received had separate tenders been issued for the required rehabilitation measures in the distribution grid on the one hand and the prepayment metering system on the other.

Fears that the expected delays could lead to significant increases in project costs prompted KfW to include sufficient contingencies in the project’s cost calculation. Delays did lead to increased consultancy costs. Despite this increase, however, total project costs were lower than planned. Planning for unforeseen cost increases should be common practice, since development projects that often involve multiple partners and intensive collaboration often do not proceed as initially intended.

**How the Case Study Informs the Science of Delivery**

The emerging framework of the science of delivery identifies five elements that are seen to be important in influencing project outcomes. This section examines the findings of the case study with respect to those five elements.

**Focus on Measurable Welfare Gains of Citizens**

The most significant side effect of the installation of the prepayment metering system is that households have become more aware of how to use electricity economically. Consumers with prepayment meters use about 10 percent less electricity than equivalent consumers with postpaid metering. Increased power saving also reduces CO₂ emissions. The elimination of electricity theft improves the profitability of electricity generators, which are then able to better maintain their power plants and make urgently needed investments. Improvements in the power sector improve living conditions and help reduce poverty.

These welfare gains are qualitative. It would be useful for similar future projects to attempt to quantify them more directly.

**Adopt Multisector, Interdisciplinary, Multistakeholder Approaches and Partnerships**

Involvement of private sector actors—namely, the implementation consultant (Fichtner) and the operator of the prepayment metering system (KCJAL)—helped compensate for capacity gaps within BPDB. These partnerships proved essential for successful implementation.

**Use Evidence to Inform Experimentation, Learn, Adapt, and Measure Results**

The project was designed as a pilot project for testing prepayment metering systems in selected supply areas of the city of Chittagong. As such, implementing the project was a constant iterative process where the best solutions were developed during the course of the project, and based on experience. The lessons learned from the project were incorporated and developed within a new project that will install prepayment meters on a larger scale in Bangladesh. However, it would have been desirable for this project to further document its learning processes, so that they could be made more readily available to other institutions and donors in other countries.
Change Management, Leadership, and Learning from Practitioners

Before the project, Bangladesh had sought to reduce nontechnical electricity losses in various ways, with the support of donors. Although some of these approaches achieved limited results, power losses remained high.

KfW’s approach was based on similar projects implemented in South Africa and Tanzania. Its overwhelming success in Bangladesh shows that successful concepts can be relevant to other countries, although local adaptation will be needed.

Be Adaptive, Flexible, and Iterative When Implementing Solutions

The project had to react with flexibility to new situations and a changing environment on several occasions. For example, the scope of rehabilitation measures in the distribution grid was adapted, the specifications of the prepayment metering system and its operation were revised following a first unsuccessful tender, a conflict with the trade union of the meter readers was resolved, and an increase in the costs of the implementation consultant was partially mitigated by transferring several local construction supervision tasks to a less expensive local consultant. Being able to adapt in a flexible way was an important factor for successful implementation of the project.

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